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Association

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DECEMBER 2014 VOLUME 88 NUMBER 6

- Attention Deficit/Hyperactivity Disorder Medication and Dental Caries in Children
- Numb Chin Syndrome: A Signal of Underlying Concern
- A Qualitative Analysis of Oral Health Care Needs in Arkansas Nursing Facilities: The Professional Role of the Dental Hygienist
- Perceptions of Kansas Extended Care Permit Dental Hygienists' Impact on Dental Care
- Educational Deficiencies Recognized by Independent Practice Dental Hygienists and their Suggestions for Change
- A Comparison of Dental Hygienists' Salaries to State Dental Supervision Levels
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- Exploration of Critical Thinking in Dental Hygiene Education

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STATEMENT OF PURPOSE

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

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Rebecca S. Wilder, RDH, BS, MS



The Promise and Potential of a New Year

As 2014 quickly comes to a close, I would like to take a moment to reflect on another exciting and productive year for the Journal of Dental Hygiene, as well as look forward to the promise and potential of 2015. The past year was busy, productive and full of plans for positive change with the Journal. In 2014, we continued to receive a high number of submissions from authors across the globe, leading to some high quality manuscripts that helped reinforce the need for transformation in our profession. Due to increasing demand, the Journal continues to publish bi-monthly, and is showing no signs of slowing down. All of this is possible in part to our partnership with HighWire Press. This past year was our first full calendar year publishing the Journal of Dental Hygiene online with the HighWire team, and they have ensured that our publication can be read anywhere at any time, and providing us the freedom to work on additional content.

The next year will continue to be a busy time for the Journal of Dental Hygiene, and it all starts in February with the a special supplement – the Proceedings from the 3rd North American/Global Dental Hygiene Research Conference. This supplement will include the many wonderful presentations and discussions that participants of this conference heard in October of this year. In addition to a special print version, there will be an expanded online version which will include a wealth of information that researchers will find invaluable.

Shortly after this issue, a co-branded supplement, published by the American Dental Hygienists' Association (ADHA) and the Journal of Dental Hygiene, will feature a White Paper authored by ADHA members. This White Paper will focus on the current state of dental hygiene education, and provides a wonderful opportunity to see how far our profession has come, and where it can go in the future.

Finally, we are pleased to announce the return of the special Journal of Dental Hygiene CLL Supplement. This print supplement will be available to attendees of the 92nd Center for Lifelong Learning in Nashville, and will highlight the most outstanding research published in the Journal of Dental Hygiene, including our expanding awards program. The 2014 Sigma Phi Alpha Journalism Award winners will be published in this issue. In addition, we will once again offer the Journal of Dental Hygiene second annual Best Paper Award, which highlights the best research paper published in the Journal of Dental Hygiene during the preceding year. Any research manuscript published in 2014 is eligible to be considered for the award.

An exciting change will be implemented for authors and journal reviewers in 2015 with the adoption of the BenchPress system for all manuscript submissions. This automated process will allow authors to easily submit manuscripts to the Journal, and will increase the speed at which manuscripts are reviewed and published. It is changes like these that will allow the Journal to stay on the cutting edge and offer the most timely and impactful research.

Believe it or not, this is just the tip of the iceberg. We have many more changes planned for 2015, and I cannot wait to share them with you. As the dental hygiene profession begins its process of transformation, so too does the Journal of Dental Hygiene. Here's to a Happy New Year, and to an exciting and wonderful road ahead for the Journal!

Sincerely,

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

Review of the Literature

Attention Deficit/Hyperactivity Disorder Medication and Dental Caries in Children

Sandra S. Rosenberg, RDH, MDH; Sajeesh Kumar, PhD; Nancy J. Williams, RDH, EdD

Introduction

Attention deficit/hyperactivity disorder (ADHD) is the most common behavioral disorder in school-aged children today. According to Friedlander, in 2007, ADHD affects 4 to 9% of children in the U.S.¹ Prevalence of this neurologic disorder has been reported to be as widespread as 2 to 18% of the population.² The characteristic features of ADHD can include excessive motor activity, developmentally inappropriate activity level, low frustration tolerance, impulsivity, poor organizational behavior, distractibility, and inability to sustain attention and concentration.¹⁻⁹ Since more children are being diagnosed with ADHD today than ever before, causes and treatment of dental caries in children with ADHD are of great interest to the dental community and to the public.

Studies have been conducted that support the anecdotal evidence that children with ADHD have a significantly higher prevalence of dental caries than children without ADHD.²⁻⁶ Since xerostomia (dry mouth) has been reported as a side-effect of methylphenidate, and dextroamphetamine medications and non-stimulant medications such as serotonin reuptake medicines and tricyclic antidepressants commonly used to manage the symptoms of ADHD, it is hypothesized that xerostomia may contribute to a higher prevalence of dental caries.^{2,7-9} Saliva production, the body's natural protection system against dental caries, may be reduced by these medications. A reduction in saliva flow is considered to be a factor in dental caries risk.¹⁰

Healthy saliva plays many important functions in the prevention of dental caries. Reduction of salivary flow or changes in the composition of the sa-

Abstract

Purpose: Few studies have been conducted to investigate the effects, if any, of specific medication used to manage the symptoms of attention deficit/hyperactivity disorder (ADHD) as a risk factor for dental caries. A reported side-effect of the medication is a reduction in saliva. Healthy saliva has been shown to play many important functions in the prevention of dental caries. The focus of this review is to determine if any evidence exists to confirm that stimulant medication used to treat the symptoms of ADHD in children increases the risk of dental caries by virtue of its effect on the reduction of salivary flow.

Methods: A MEDLINE search was conducted for relevant studies. Search terms used were dental caries, attention deficit/hyperactivity disorder, ADHD, pharmacologic treatment of ADHD, stimulant medication, xerostomia, dry-mouth and saliva flow. Publication dates ranged from 2002 to 2012.

Results: Although dental caries prevalence has been found to be higher in children with ADHD, decreased salivary flow as a side-effect of pharmacological treatment does not appear to be responsible.

Conclusion: Dental caries is a multi-factorial disease process. The most effective method of reducing dental caries in ADHD children is more frequent recare visits focusing on home plaque removal practices along with dietary counseling to reduce the consumption of cariogenic foods and drinks. This can only be accomplished with inclusion of the parent/guardian in the process.

Keywords: attention deficit/hyperactivity disorder, dental caries, medication, xerostomia

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Investigate how dental hygienists use emerging science to reduce risk in susceptible patients (risk reduction strategies).

liva caused by medications in children with ADHD may have an effect on the risk of dental caries.⁷⁻⁹ In search of contributing factors to higher caries rates in children with ADHD, researchers have also investigated factors such as poor oral hygiene, high consumption of sugar-containing foods and beverages demographics, low IQ, low socioeconomic status of parents, dental anxiety, and pathophysiologic changes.²⁻⁹

Stimulant medications are effective in treating ADHD because they enhance the release of dopa-

mine and norepinephrine, thereby allowing previously under-stimulated areas of the brain to regain their normal functionality.¹ In the case of ADHD, these normal functions are the suppression of hyperactivity, impulsiveness, aggression and unusual distractibility.¹

Although medical management brings about a 50 to 75% reduction in symptoms, a combination of pharmacological and behavioral therapy is generally more effective than either one alone.¹ In 2002, Wender reported that stimulant medication is the medication of choice in the treatment of children with ADHD.¹¹ Table I lists the names of some of the stimulant drugs used to treat ADHD. Medications used to treat ADHD that may also cause xerostomia are antidepressants, such as desipramine, imipramine and bupropion sold as Norpramin®, Tofranil® and Wellbutrin®.^{12,13}

The focus of this review is to determine if stimulant medication used to treat the symptoms of ADHD in children increases the risk of dental caries by virtue of its effect on the reduction of salivary flow.

Methods and Materials

A PubMed/Medline search was performed using the terms "ADHD medications" and "dental caries" to discover a connection between the two. Additional sources were located using the search terms "attention deficit/hyperactivity disorder," "dental caries," "xerostomia and dental caries" and "saliva and dental caries." Further information on pertinent articles was retrieved from the reference sections of these articles. Early studies were included that tested for a correlation between ADHD and dental caries.^{2-6,8}

Studies were reviewed for data relevant to a connection between xerogenic medications used to treat symptoms of ADHD and the risk of dental caries. Only studies that either identified or examined the prevalence of dental caries in children with ADHD and/or those who discussed and/or used xerogenic medication as a variable were included in this review.

Studies Conducted to Establish a Relationship Between ADHD and Dental Caries

Most of the early research concerning dental caries and children with ADHD has been performed with

Table I: Stimulant Medications Used to Treat ADHD in Children

Generic Name	Brand Name	Available as a Generic Prescription?
Amphetamine	Adderall®	Yes
	Adderall XR®	Yes
Dextroamphetamine	Dexedrine	Yes
Dexmethylphenidate	Focalin®	Yes
	Focalin XR®	No
Methylphenidate	Concerta®	Yes
	Daytrana patch®	No
	Metadate CD®	No
	Metadate ER®	Yes
	Methylin oral suspension®	Yes
	Methylin chewable tablet®	No
	Ritalin®	Yes
Ritalin LA®	Yes	
Ritalin SR®	Yes	

small case studies to confirm the anecdotal evidence that children with ADHD have a significantly higher caries rate than children without ADHD. Broadbent et al conducted a regression analysis to determine if dental caries remained higher in children with ADHD and to quantify the role of confounding factors in any observed relationship between dental caries and ADHD.² This study was one of the first to ask the question, "How might ADHD be associated with dental caries experience?"² Four possible explanations were offered. One idea was that characteristics of the disorder itself may lead to a lack of motivation to maintain good oral hygiene. Another possibility was that parents of a child with ADHD may be more likely to reward that child with cariogenic treats.² Thirdly, medications used to treat the symptoms of ADHD have been reported to have the side effect of xerostomia which is often associated with increased frequency of consumption of soft drinks and poorer oral hygiene.² A fourth suggestion was that parents/guardians of children with developmental disorders (including ADHD) may report the unmet need for oral health treatment than parents of children without developmental disorders.

Using questionnaires and dental records of 128 case-controlled pairs (aged 11 to 13), cases and controls were matched on age, sex, ethnicity and socio-economic status. After controlling for fluoride history, medical problems, diet and self-reported oral hygiene, analysis showed children with ADHD had nearly 10 times the odds of having a high decayed, missing or filled teeth (DMFT) score than children who did not have ADHD. None of the other co-variants were significantly associated with the outcome of higher caries in the ADHD group. On the basis of the association between medication for ADHD and high DMFT, it was suggested that there may be some validity to the idea that medication might be a risk factor for the high rate of dental car-

ies. But, given that medication was not studied as a possible risk factor in dental caries, there is no supporting evidence for this conclusion.¹³ In fact, the limitations of this study were that, in addition to its small sample size, treatment with medication was only used as a positive diagnosis of ADHD and 9 of 14 of the subjects with ADHD were medicated.

All other variables being constant, the outcome of a study of dental caries in children with ADHD could be influenced by the age of the children which correlates with the eruption sequence. Three clinical and retrospective, double-cohort studies (2006, 2007 and 2011) were conducted by Bloomqvist et al using subjects from the same population pool for all 3 studies.³⁻⁵ All 3 studies tested for dental caries experience in children with ADHD as compared to children without ADHD along with other factors. The 2006 study which tested for oral health, dental anxiety and behavioral management problems studied both children with ADHD (n=25) and children without ADHD (n=58). All of the children were 11 years of age.³ A significantly higher rate of dental caries was found in the ADHD subjects. The ADHD group was not found to have a higher degree of anxiety, but they did have more behavioral management problems than the control group. The 2007 study which tested for dental caries and oral health behavior did not find a significant difference in caries prevalence between a group of 13 year old children with ADHD (n=21) and control subjects (n=79).⁴ They did, however, find children with ADHD had poorer oral health behavior than the control group. The 2011 study considered caries experience and oral hygiene status in a group of 17 year olds.⁵ The ADHD group consisted of medicated (n=40) and non-medicated (n=40) subjects. Results found significantly higher decay rates in the ADHD group along with poor oral hygiene and an increased consumption of sugary foods.

It was postulated that the lack of caries among the 13 year old group may have been attributed to the shedding of deciduous teeth and the lack of time for caries development in the new dentition.⁴ Another study, by Chandra et al, found a similar difference.⁷ Children, aged 6 to 14 years of age with ADHD (n=80) were found to experience more caries (DMFT) in the primary dentition (p=0.002) than children not diagnosed with ADHD. However, in the same study, no such difference (p=0.144) was found in the permanent dentition (DMFT). This would appear to give credence to the theory that the newly erupted teeth had not been in the oral environment a sufficient length of time for caries to develop. These studies would seem to support the theory that children with ADHD have a tendency toward a higher rate of caries and generally poorer

oral hygiene than children without ADHD. However, more research using a larger sample size is needed to confirm this finding.

Studies Using Medication as a Variable in ADHD and Dental Caries

Although medication has been used to diagnose subjects having ADHD, few studies have controlled for medication as a risk factor in dental caries. Proper investigation of any relationship of xerogenic drugs and dental caries among ADHD children would require using medication and saliva production as variables.¹³

A cross-sectional study to examine whether children with ADHD had the same caries experience as children without ADHD was conducted in by Grooms in 2005.⁷ Saliva flow was considered in this study to test for xerostomia in children with ADHD. Participants ranged in age from 6 to 10 years old, and were divided into 2 groups consisting of 38 subjects each (31 boys and 7 girls). One group was diagnosed with ADHD and taking medication. The other group was composed of healthy children who were not taking any medications. All 76 children were screened by 1 examiner for decayed, missing, filled surfaces (DMFS). A visual exam was conducted and subjects' teeth were charted for their presence, caries, restorations and sealants. At the same screening, the examiner collected a timed, quantitative, unstimulated, whole saliva sample for each participant. The weight of the saliva was measured to the nearest one-hundredth of a gram. Both a medical questionnaire and a questionnaire concerning each child's oral health including diet, oral hygiene, dental care, fluoride exposure, and daily activities was completed by the parent/guardian.

With no data yet available on DMFS for children with ADHD, researchers proposed that a two-fold increase in DMFS among ADHD children would represent a clinically meaningful elevation in caries.⁷ Results revealed that children in the ADHD group had statistically more enamel carious lesions in the primary dentition (p=0.04) and significantly more enamel caries in the permanent dentition (p=0.01) than the control group.⁷ No differences were identified in key preventive practices such as tooth brushing, fluoride exposure and flossing and no differences in diet were reported between ADHD subjects and the control group. No significant differences (p=0.5) were found for the amount of saliva (0.5 g) produced in the ADHD group of subjects taking different types of medications and those in the control group. These findings lead researchers to conclude saliva flow is not significantly reduced in children prescribed medications for ADHD.⁷ A limitation of

this study is that it did not perform a plaque index (PI) and therefore could not determine if oral self-care contributed to the higher caries experience in the ADHD group.

Although the previous study found children with ADHD did not have a significant reduction in saliva to cause xerostomia, it did not separate children with ADHD who were treated with medication from those with the disorder who were not treated. Without comparing the 2 distinct groups of children with ADHD, it is not clear if dental caries prevalence is related to ADHD itself or the medications.

In 2011 and 2012, Hidas et al published results of 2 individual studies that further investigated how saliva affects dental caries by studying the effect of children medicated for symptoms of ADHD as opposed to those not medicated.^{8,9} In both studies, researchers separated subjects into 3 groups according to their medication status. One group had ADHD and no pharmacologic intervention, another group had ADHD and was treated with methylphenidate, and the control group consisted of healthy non-ADHD subjects taking no medications. The 3 groups in each study contained 31, 30 and 30 individuals, respectively. The aim of the 2011 study was to investigate the relationship between ADHD and the prevalence of caries in children, adolescents and young adults by focusing on salivary quality in terms of salivary flow rate, oral mucosal pH, PI, oral hygiene and dietary behavior.⁸ It was hypothesized that children medicated for ADHD would have lower unstimulated salivary flow rates (an outcome of the medicament) which would result in lower buffer capacity and higher bacterial count than those not treated.⁸

Data were collected including unstimulated salivary flow rate, oral mucosal pH, PI, DMFT index, oral hygiene and dietary behavior were compared between the 3 subject groups. It was found that the non-medicated ADHD group had the lowest mean unstimulated salivary flow (0.72 ml/min) and the control group had the greatest (1.13 ml/min). The medicated ADHD group had 0.85ml/min, which was not significantly higher than the non-medicated ADHD group. Both subject groups with ADHD (medicated and non-medicated) had significantly lower unstimulated salivary flow than the control ($p=0.016$). However, it was noted that none of the children in any group had very low levels (<0.1 ml/min).⁹ No significant correlation between DMFT and unstimulated saliva flow was found among the 3 groups. Although PI scores were significantly higher ($p<0.05$) in the 2 ADHD groups combined than the control, no significant correlation was found between DMFT/dmft and PI. No significant differences

were found among the groups for the other factors studied.⁹

Reduced salivary flow impairs buffering abilities and creates an oral environment that is more acidic.⁸ Mutans streptococci (MS) and lactobacillus (LB), the major caries pathogens, have been found to be higher in patients with more concentrated saliva.⁸ While the previous study investigated salivary flow and pH to establish a link between ADHD and dental caries,⁸ the 2012 study looked at the composition of the saliva, focusing on MS and LB levels, salivary buffer capacity and salivary flow rate along with oral hygiene and diet in 3 groups of children.⁹ It was hypothesized that lower salivary flow rates in medicated ADHD children (an outcome of the medicament) would result in lower buffer capacity and higher bacterial count.⁹

Three groups of children – ADHD1 (with no pharmacological intervention, $n=31$), ADHD2 (medicated with methylphenidate, Ritalin® or Concerta®, $n=30$) and a healthy group ($n=30$). Each group was composed of children between approximately 6 and 17 years of age (mean age 10.3 ± 2.8 years). The main finding of this study was that despite a higher PI in the ADHD groups, no significant differences existed in salivary buffer capacity ($p=1.00$), LB and MS counts ($p=0.579$), or the DMFT index between children with ADHD (with or without pharmacologic intervention) and the control group.⁹ As reported in questionnaires from parents/guardians of all subjects, there were no differences in diet and oral health behaviors between the 3 groups. Consumption of sugary sodas was associated with higher DMFT rates in all 3 groups ($p=0.043$).⁹ It was noted that significantly higher ($p=0.024$) levels of plaque were found in the 2 ADHD groups combined compared with the control group.

Discussion

Current thought on the caries risk of children medicated for ADHD is due to the reported xerogenic effect of these medications. Most early studies were conducted to simply evaluate this theory by comparing the caries experience of children with ADHD to that of healthy children. Few studies have been conducted to evaluate the effect of ADHD medications on dental caries in children.⁷⁻⁹

Results of the Grooms⁷ and Hidas^{8,9} studies suggest reduced saliva flow from ADHD medications is not a factor in the rate of caries in children with ADHD.⁷⁻⁹ However, only the 2 Hidas studies have compared medicated and non-medicated ADHD subjects.^{8,9} The 2012 study provided preliminary evidence that children medicated for symptoms of

ADHD were not at higher risk for caries than non-medicated ADHD children due to the side effect of the medication reducing the amount of saliva.⁹ However, due to the small sample size of both studies, more research is needed.

Although dental caries prevalence has been found to be higher in children with ADHD,^{2,3,5,7,9} decreased salivary flow as a side-effect of pharmacological treatment does not appear to be responsible.^{8,9} It has been suggested children with ADHD may be unable to perform regular routine activity like tooth brushing in an effective manner which may lead to improper oral hygiene practices due to their symptoms of inattention, hyperactivity and impulsivity.¹² According to the studies, pharmacologic intervention should not be discontinued based on a fear of it contributing to dental caries. Medication is an effective and essential part of the management of behavioral symptoms associated with ADHD. As long as the medication is well tolerated by the child and effective in controlling symptoms, pharmacotherapy should go hand-in-hand with behavioral therapy.

It has been postulated that the child's perception of xerostomia may increase the desire for sugar-filled candies, mints and sodas because sugar temporarily increases saliva flow.¹² The increase in sugar along with the general finding of higher levels of plaque and poorer oral hygiene practices may have an effect on the higher prevalence of dental caries in children with ADHD.² Quantitative, objective data regarding the capacity of medications to induce xerostomia are usually based on patient report in clinical drug trials.¹⁴

The flow rate of saliva varies greatly from person to person and xerostomia is a subjective sensation that may not be related to an actual reduction in salivary flow.¹⁵ The experience of dry mouth is usually considered to be minor when evaluating the side effects of a medication and is often listed in the information sheet along with other side-effects.¹⁵ Investigations to evaluate the actual flow rate of saliva are complex, expensive and rarely performed.¹⁵

Sodas containing sugar and several types of acid provide a compounded threat for dental caries by introducing refined carbohydrates into the oral environment and significantly reducing the oral pH.¹⁶ It is important to note that even artificially sweetened sodas contain the same amount of acid as sugar-sweetened sodas.¹⁶ The presence of sugar is not the only threat. Cariogenic oral bacteria thrive in an acidic environment.¹⁶ Saliva's normal pH is 6.5 to 7.5. The pH required for enamel demineralization is 4.5 to 5.5.¹⁶ A can of soda has a pH level of between 2.7 and 3.5.¹⁶ Perhaps the best method of preventing dental caries in children with ADHD is to encourage both children and parents to limit the consumption of cariogenic food and drinks. Parents/caregivers should be encouraged to not have them available and not use them for behavioral rewards.

Conclusion

Knowing that children diagnosed with ADHD may have a higher risk of dental caries^{2,3,5,7,9} and a tendency toward higher plaque formation,^{1,4,5,8,9} practicing dentists and dental hygienists need to be assertive in recommending shorter intervals between recare visits as well as nutritional counseling to include a non-cariogenic diet along with additional preventive measures such as topical fluoride and increased parental monitoring of the child's daily oral hygiene practices. Although decreased salivary flow as a side-effect of pharmacological treatment does not appear to be responsible for the increase in dental caries in children with ADHD,⁷⁻⁹ the role of saliva in the caries process still needs further study.

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Short Report

Numb Chin Syndrome: A Signal of Underlying Concern

Norma J. Chapa, RDH, BSDH

Introduction

The prickling sensation of an appendage that “fell asleep” and the numbness that is experienced with dental anesthesia are not life threatening. Numbness that occurs with no explanation and does not resolve quickly may indicate the presence of a serious underlying condition, especially if it occurs in the mandible. The medical literature reveals that chin numbness may be indicative of a more serious underlying condition, especially if cancer or the treatment of radiation or chemotherapy preceded numbness.

Case Study

In September of 2011, a 39 year old female, non-smoker and rare drinker presented to the University of Texas School of Dentistry for an adult prophylaxis. The patient complained of localized numbness to her lower left quadrant with slight discomfort, which she had experienced for approximately 2 weeks. She reported that she had been diagnosed with high-grade sarcoma in her left breast the previous year and had been treated with radiation therapy and chemotherapy, but she ultimately underwent a radical mastectomy in January 2011. A review of her chart revealed no report of any symptoms in the head and neck during her previous two dental visits since 2007. No remarkable findings were noted on either the medical history or intra/extra oral exams. The patient’s last visit to the dental school was in July 2010. Her treatment plan consisted of an adult prophylaxis for her maxillary arch with localized scaling and root planing (SRP) for her mandible. The localized SRP was preformed and the patient was scheduled to come back to complete treatment but never returned.

At the September 2011 appointment, significant findings in her intra/extra-oral exam consisted of palpable lymph nodes across the left side of the mandible with numbness affecting the lip and chin, tenderness in the region of tooth #20, and redness

Abstract

Purpose: The purpose of this article is to present a case study of a patient with chin numbness and to review its relationship, through research, to possible underlying diseases and conditions. Mental nerve neuropathy, better known as numb chin syndrome, is a rare condition. Research suggests that there are a high number of cases where numb chin syndrome runs parallel with progression or relapses of metastatic cancer. Clinical presentation of numb chin syndrome is characterized by patient complaints of localized numbness to the mandible. Since this syndrome has been associated with serious conditions such as diabetes, multiple sclerosis and metastatic disease, patients who present with signs and report unexplained symptoms of numbness should be examined thoroughly. Dental professionals who encounter patients with this symptom should refer them for further medical evaluation can potentially save lives.

Keywords: mental nerve neuropathy, numb chin syndrome, chin numbness, breast cancer, metastatic cancer

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Investigate how dental hygienists identify patients who are at-risk for oral/systemic disease.

with inflammation that was consistent with gingivitis. To diagnose the etiology of her numbness, a partial full mouth series of radiographs were taken. No distinguishable carious lesions or apical lesions were noted; however, tooth #19 had a stainless steel restoration consistent with a history of endodontic treatment (Figure 1). To rule out other pathologic conditions, an oral pathologist ordered a panoramic image, which was interpreted by a dental radiologist. The radiograph revealed no signs of trauma or other sources to explain the etiology of the numbness. Idiopathic osteosclerosis in the right side of the mandible was present (Figure 2). A prophylaxis was performed and on a 3 week follow-up visit, her gingival tissue health improved but her symptoms still persisted. Recommending she should consult with her oncologist, her treating physician found no evidence of any recurring malignancy.

When the patient returned to the clinic 5 months later, additional radiographs were taken and interpreted by an oral pathologist revealing a “moth-eaten” radiolucent lesion of apical resorption around tooth #18 (Figures 3, 4). The area was swollen and teeth #18 and #19 were tender to per-

cussion. Further testing included a pulp vitality test to tooth #18 with a biopsy to the surrounding bone. A Cone Beam Computed Tomography scan was also recommended to rule out metastatic disease and intraosseous malignancy. Original differential diagnoses included acute apical abscess and subacute osteomyelitis but after a biopsy the differential diagnoses expanded to myofibroma, lipoma, adenoma, adenocarcinoma, lymphoma and sarcoma. Ultimately, the lesion was described as a malignant spindle tumor compatible with myofibroblastic sarcoma. The patient was referred to a local hospital for treatment, which included surgery to remove the mass, affected tissues, and all portions of diseased bone within the left side of mandible. However, the patient lived for approximately 1 year after surgery, dying 19 months after the onset of chin numbness.

Mental Nerve Neuropathy/ Numb Chin Syndrome

Mental nerve neuropathy, better known as numb chin syndrome, is a rare condition with one of the first documented cases reported in the early 1800s by Charles Bell in a patient with breast cancer.^{1,2} Since then, studies have reported a positive correlation linking neuropathies of the mental nerve to metastatic cancers. The most notable are recurrent cancers in the breast, lung and prostate, as well as leukemia and lymphoma; however, the strongest relationship with numb chin syndrome has been with breast cancer and lymphoma.¹⁻⁴ Research indicates a high number of instances where chin numbness runs parallel with the progression of or relapses in the aforementioned cancers. A systematic review by Galán-Gil et al reported 136 documented numb chin syndrome cases showing that numb chin syndrome has the greatest correlation with breast cancer (40.4%) followed by lymphoma (20.5%).³ This relationship is of importance to dentistry because the oral cavity is often sensitive to internal changes and will display signs of an obscure systemic disease long before it is discovered. It is important for clinicians to be thorough when reviewing a patient's medical history and while doing an intra/extra oral exam. One study found that in 47% of cases where numb chin syndrome was detected, the syndrome preceded the diagnosis of malignancy and in 30% of the cases examined, neuropathies preceded re-

Figure 1: Periapicals From Partial Full Mouth Series on the Patient's Initial Complaints of Numbness



Top: Lower left premolar (left) and molar view (right)
Bottom: Enlarged view of lower left molar

lapses of malignancies.⁵ Unfortunately, in the instances where numb chin syndrome was detected and associated with cancer, the survival rate was poor. Statistics reveal that life-expectancy is less than 12 months from the date of diagnosis.^{2,5-7} It is critical for dental professionals to be cognizant and acknowledge possible symptoms of numb chin syndrome in patients, especially for those with a history of cancer.

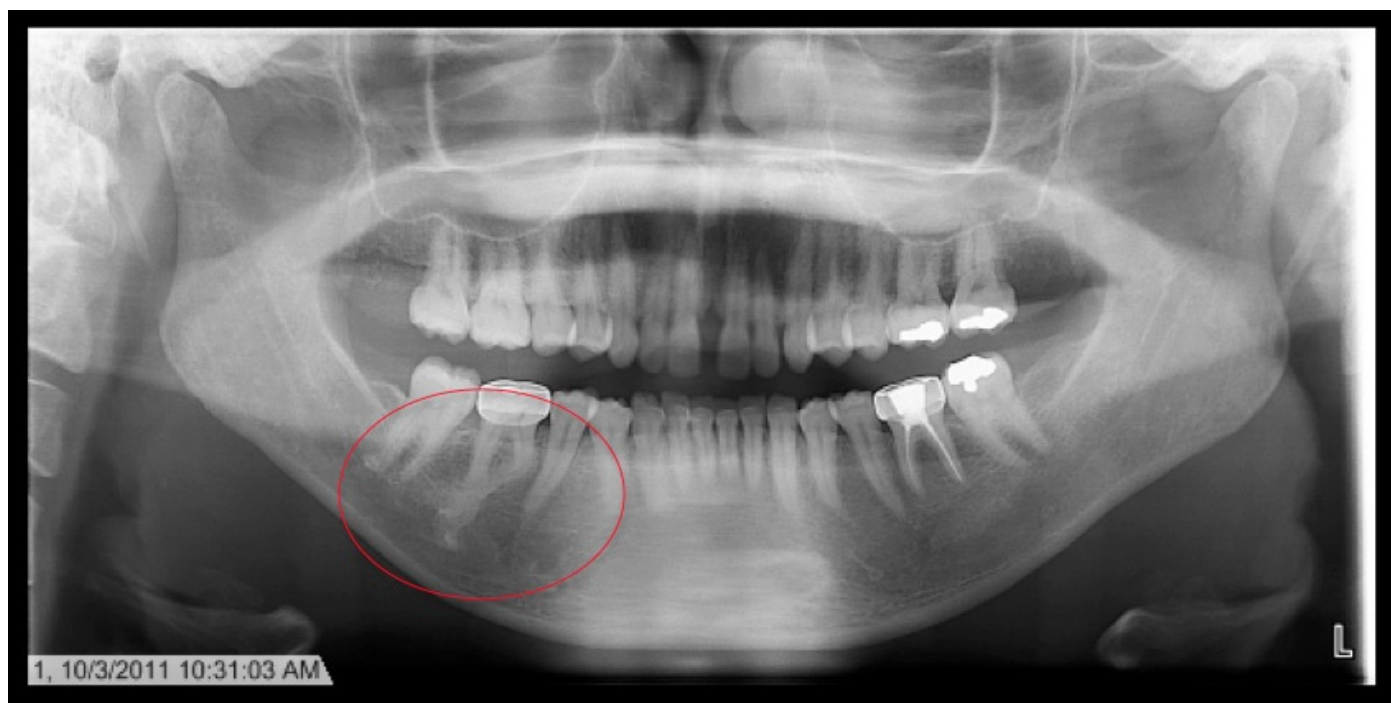
Clinical Presentation

Numb chin syndrome normally presents as unilateral numbness along the lip and chin with patients describing effects feeling similar to local anesthesia.^{2,7,8} The functions of the lip and tongue, such as movement and taste, may appear normal.^{9,10} Diagnostic dental radiographs may not indicate an etiologic source.^{6,10} In circumstances where a patient reports symptoms of numbness without an identifiable source, a referral to a specialist for further medical examination should be considered.

Patient Considerations and Diagnostic Tests

There are several factors to consider if numb chin

Figure 2: Panoramic Radiograph Taken on a Follow-Up Visit Exhibiting Idiopathic Osteosclerosis on the Opposing Side (Noted in Red)



Idiopathic osteosclerosis noted in red. No pathology for numbness noted for the left side.

syndrome is suspected. In numerous case studies, diagnostic dental radiographs found no correlation to the etiologic pathology of the symptoms to paraesthesia. In a case report by Ryba et al, a 58 year old edentulous male described an abrupt onset of localized numbness to the lower left side of his mandible.⁷ Although no significant abnormalities in dental radiographs or oral examination were found, neurological tests exposed disturbances in the inferior and mental nerve, and blood tests revealed signs of widespread metastatic disease.⁷ In another report, a 56 year old woman who presented with a 3 month cough, shortness of breath and bone pain, indicated a tingling sensation in the lower right region of her mouth. No tangible abnormalities within the lymph nodes or neurologic evidence were described. However, a Computed Tomography (CT) scan discovered a mass in the patient's lung along with multiple liver metastases and bone marrow involvement. Radiographs of the cervical area and the CT scan of the mandible revealed no defects within either region.⁵ In respect to other cases reviewed for this article, the patients' initial dental radiographs were the least useful in determining an early diagnosis, cases that presented radiolucent lesions were in later stages of an already manifesting disease.

Prescriptions are meant to treat common dental problems; however, when antibiotics and medications have limited or no effect in treating numb-

Figure 3: Periapical Taken 5 Months after Figure 1



Moth-eaten borders and apical root resorption affecting and surrounding tooth #18

ness, clinicians should view this lack of response as a sign of urgency.^{2,8,11} This was the case of a 37 year old male with no prior symptoms who experienced pain in the lower jaw after an adult prophylaxis. The patient was treated with erythromycin for 5 days, which failed to alleviate what was thought to be a dental infection. Findings from his magnetic resonance imaging (MRI) were within normal lim-

its; however, this condition persisted and later, after he developed a fever, blood tests and a bone marrow biopsy verified that the underlying condition was lymphoma.² In another case, a 48 year old female with diabetes was seen by her physician to treat her symptoms of numbness and tingling to the lower right side of her lip and chin. Prednisone was prescribed to relieve her symptoms, both of which returned about a month later. The woman's neurological exam and MRI appeared normal but blood tests and a bone marrow biopsy revealed lymphoma.² These cases illustrate why additional testing and evaluation are essential for proper diagnosis.

Other Diagnostic Tests

Blood and neurological tests are useful in detecting underlying conditions and diseases associated with numb chin syndrome.^{2,5-7,11,12} Useful diagnostic tools are MRI and CT scans, with CT scans most widely used.^{1,4,5,8,9,11-13} An additional test referenced in studies is the touch and pain test which is relatively simple to execute with an explorer or small brush on the soft tissues. The test helps to diagnose the extent of manifesting numbness by comparing the affected region to a non-affected area.¹⁰ Another notable test is the technetium Tc 99m methylene diphosphonate bone scan, which uses a radioactive intravenous imaging agent to locate the sites of possible lesions.¹⁰ Of note, in all of the cases reviewed in this paper, a combination of tests were used to determine a diagnosis. Because neuropathies have the tendency to imitate tooth pain, multiple tests may be recommended to form an accurate diagnosis.⁸ A misdiagnosis could cause a dangerous delay in suitable treatment.

Differential Diagnosis and Other Possible Causes to Numbness

Typical sources of paresthesia or numbness frequently have dental origins. These include, but are not limited to, iatrogenic causes such as trauma to the mandible, damage to the nerve from extractions, mandibular surgery, ill-fitting dentures and implants.^{8,9} In these cases, the aforementioned are likely to cause injuries to the nerves of the ramus and cause hypoesthesia. Other causes may arise from benign tumors, radiotherapy, bone infection (osteomyelitis) and dental abscesses partly due to infection imposing or compressing on the nerve (Table I).⁷⁻⁹

Chronic systemic disorders such as diabetes or demyelinating disorders such as multiple sclerosis can lead to neuropathies and nerve damage. Possible sources of nerve damage in diabetes include high blood glucose levels, abnormal blood fat levels

Figure 4: An Enlarged Section of the Pre-Surgical Panoramic Radiograph, Taken 5 Months after Initial Complaints of Numbness



Affected area noted in red circle

Table I: Names of Conditions and Diseases With Links to Numb Chin Syndrome

Numb Chin Syndrome Links		
Non-Dental Related	Metastatic or Recurrent Cancer	Breast Lung Prostate Lymphoma Leukemia
	Systemic Disease	Multiple Sclerosis Diabetes
	Other	Benign tumors Radiotherapy Osteomyelitis Abscess
Dental Related	Iatrogenic Trauma	Extractions Mandibular surgery Implants Ill fitting dentures

Please note that metastatic and recurrent cancer of the breast ranks the highest followed by lymphoma

and inflammation caused by the autoimmune response.¹⁴ Similar findings of chin numbness have also been associated with multiple sclerosis. These cranial nerve palsies involve several cranial nerves (CN), including CN III (Oculomotor), CN VI (Abducens) and CN V (Trigeminal), not limited to the mandibular nerve alone.¹³

Conclusion

Health care professionals who encounter patients reporting chin numbness should not underestimate the significance of this symptom. Because many dental professionals are unaware of numb chin syndrome and its links to serious underlying

systemic conditions, unnecessary dental treatment may be recommended with little or no improvement. A patient's medical history proves to be an essential part of every visit. Dental professionals should further investigate patients who present symptoms of chin numbness, especially when cancer or the treatment of cancer was ever a part of their history. Unexplained numbness is not a normal symptom, and consultation with other medical experts may provide needed answers. Having the ability to recognize numb chin syndrome, or mental nerve neuropathy, as a possible indicator to serious disease is important for the health and the potential survival of a patient.

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A Qualitative Analysis of Oral Health Care Needs in Arkansas Nursing Facilities: The Professional Role of the Dental Hygienist

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Introduction

Older adults are the fastest growing population segment in the U.S. according to the 2010 U.S. census.¹ Data from the Center for Disease Control (CDC) National Health and Nutrition Examination Survey (NHANES) indicate older adults in the U.S. are living longer and experiencing a significant decline in edentulism resulting in more teeth being exposed to dental disease.² National and Arkansas statistics related to declining tooth loss are illustrated in Figure 1.³

Retention of teeth throughout the lifespan is desirable; however, dental care and maintenance become more complex and present additional challenges in long-term care (LTC) and assisted living facilities.^{4,5} Nursing facilities are defined by the level of care they provide. The highest level of care is provided through skilled nursing facilities referred to as LTC. Assisted Living facilities encompass any facility that provides personal care services to three or more adult residents and include Levels I and II. Residents of Level I facilities do not have serious medical conditions while Level II facilities accept residents that meet the lowest level of care and must have a nurse on contract.⁶

The Surgeon General's Report identified frail elders and nursing home residents among the populations most vulnerable to poor dental care.⁷ Aging populations have fewer financial resources and often do not retain dental insurance upon retirement.⁸ Elderly individuals are faced with a variety of age related functional disabilities directly and indirectly affecting their oral health.⁹⁻¹⁶ A primary concern is the association between poor oral health and aspira-

tion pneumonia. Aspiration pneumonia accounts for the majority of admissions to hospitals from nursing homes and is the leading cause of death in nursing home populations.^{15,16} Inadequate oral health and disability status are further related to poor oral health related quality of life, thus increasing the need for access to oral health care.^{15,17-21} Research clearly documents the inadequacy of oral care provided in LTC facilities.^{12-14,22-29}

Improving oral health for older adults by reducing the incidence of untreated decay and periodontitis is among the health objectives outlined in Healthy

Abstract

Purpose: Frail elders and nursing home residents are vulnerable to poor oral health and frequently lack access to dental care. The purpose of this study was to determine why residents in Arkansas skilled nursing facilities have limited access to oral health care.

Methods: This study utilized qualitative research methodology. Data was collected from oral health care personnel through open-ended responses in a written survey (n=23) and through telephone interviews (n=21). The investigators applied the constant comparative method to analyze and unitize the data and ultimately reach consensus.

Results: Data analysis resulted in consensus on 2 emergent themes: policy and access.

Conclusion: This qualitative case study suggests access to oral health care for residents living in both long-term care (LTC) and assisted living I and II facilities in Arkansas is affected by public and facility policies and access to oral health care as a function of the patient's health status and availability of oral health care providers. Access for residents residing in assisted living I and II facilities is also limited by the residents' inability to assume responsibility for accessing oral health care. The outcomes from this study may serve to inform policymakers and advocates for access to oral health care as they develop new policies to address this growing need.

Keywords: access to care, assisted living, dental hygiene, elderly, long term care, nursing home, older adult, oral health

This study supports the NDHRA priority area, **Health Services Research:** Identify how public policies impact the delivery, utilization, and access to oral health care services.

People 2020.²⁹ Arkansans are typically behind in oral health care status as evidenced by earning a grade of "F" on the Oral Health America Report Card.²² Screenings of residents in LTC facilities in Arkansas revealed that virtually all residents (99.9%) had a history of dental caries or periodontal disease.³⁰

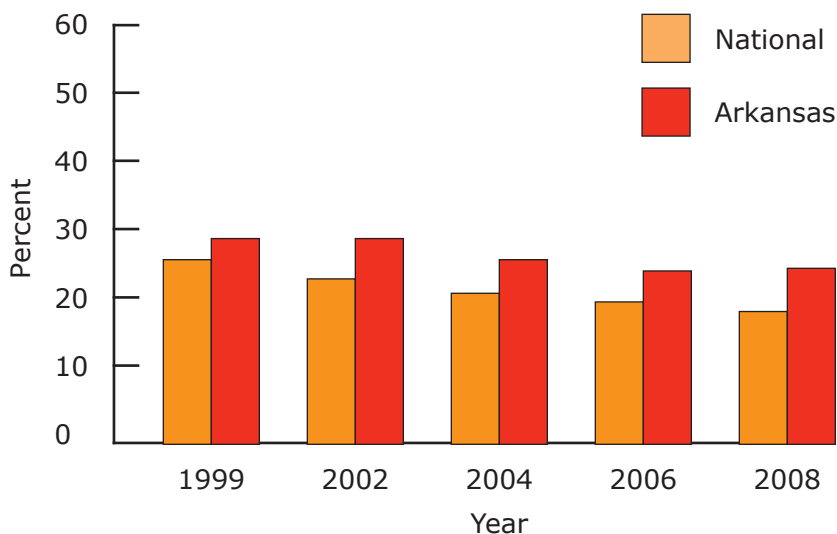
The state of Arkansas, through its 2011 Oral Health Plan, addressed this disparity by setting goals for increasing access to oral care and passing Senate Bill 42, creating a collaborative care permit program for dental hygienists.³¹ The main purpose of the legislative change was to alleviate oral health care disparities by expanding the scope of dental hygiene practice. Similar workforce models have been implemented in other states.³² The Arkansas collaborative care permit program can aid in helping to preserve the natural dentition of the elderly population and decrease dental morbidity of vulnerable elders living in LTC and assisted living facilities. Three key components of this population's oral health needs include: regular oral assessment, preventive oral hygiene care and provision of dental treatment.²³

It is important to assess dental needs of residents in nursing facilities in an effort to better provide oral health care. The purpose of this study was to determine why residents in Arkansas skilled nursing facilities have limited access to oral health care.

Methods and Materials

Institutional review board research protocol was approved by the University of Missouri-Kansas City. This study used a qualitative research design with descriptive statistics. The study was initially designed to capture quantitative and qualitative data using a validated survey instrument that identified current issues in meeting oral health needs of nursing facility residents.²⁸ A question delineating the type of facility (LTC or assisted living) and open ended questions about dental hygienists providing oral care were added to the survey. Paper copies of the survey and follow up postcards were mailed to oral health care personnel in Arkansas nursing facilities (n=311). The oral health care personnel were defined as the staff member most involved with oral health care in Arkansas nursing facilities and included Directors of Nursing, registered nurses, certified nursing assistants (CNA) and health and wellness coordinators. Administrators who received the initial survey and cover letter made this determination. The survey was also distributed electronically to all

Figure 1: National/Arkansas Complete Tooth Loss, Adults Age 65 or Older Who Have Lost All Their Natural Teeth



registered Arkansas Health Care Association members (n=306) in a weekly members' newsletter.

Collectively, 23 surveys representing 14 counties were returned. The response rate was low (7.4%), so a quantitative analysis, as originally planned, was not implemented. Four researchers separately analyzed the open ended responses using the constant comparative methods described by Lincoln et al.³³ Data was unitized by deconstructing the open responses and identifying key themes. Table I lists the descriptive and interpretive codes that were used. As themes emerged, the unitized data were reviewed and compared to reflect and describe specific themes.

In order to increase the response rate the primary investigator conducted telephone interviews with oral health care personnel working in facilities located in zip codes where the mailed surveys were not returned. A purposeful sampling strategy was used to target facilities (15 LTCs, 3 assisted living I and 3 assisted living II) for a combined total of 21 interviews. Facilities were located in 13 counties equally distributed across the state.

Unstructured, open-ended questions were asked to investigate why residents in Arkansas nursing facilities have limited access to oral health care. The primary investigator began each interview asking: "From your perspective, what are the greatest needs and barriers to providing oral care for residents of your facility?" Questions were asked until no new information emerged. The primary investigator took detailed notes to capture the essence of each conversation.³³ Four investigators separately analyzed interview notes and reached consensus identifying key themes. Descriptive numerical frequencies were

tracked and totaled within categories and calculated as an overall total percentage.

Several approaches were employed to establish validity and reliability of the findings as suggested and described by Creswell.³⁴ Triangulation was achieved by collecting and analyzing data from 2 separate sources and by comparing the present findings with published literature. Between the 2 sources of information, 23 of Arkansas' 75 counties were represented. Using descriptions to convey findings providing a sense of shared experiences was accomplished by including original quotes in the results. Peer debriefing was used within the qualitative study for describing results for other care providers, government officials or families reviewing results to enhance accuracy.

Results

Table II summarizes the key themes that emerged from the survey's open-ended questions and interview responses. Collectively, 133 units of data were analyzed. The emergent themes included policy (77%) and access (23%). Policy was defined as the rules and regulations in place that direct the provision of health care in LTC and assisted living facilities. Access was defined as making oral health care available for both LTC and assisted living facilities.

Within the theme of policy, 4 representative interpretive codes emerged. The areas of particular interest include regulations (12%), education (12%), infrastructure (44%) and personnel (8%). A majority of oral health care personnel's expressed not having appropriate infrastructure (44%) for the provision of oral health care within their facilities. Oral health care personnel's discussed a lack of dental equipment, providers, money and time, all of which impacted the delivery of care.

The majority of facility oral health care personnel's reported not having space dedicated to oral

Table I: Emergent Category and Representative Interpretive and Descriptive Codes for Interview Analysis

Theme	Interpretive Codes	Representative Descriptive Codes
Policy	Regulations	<ul style="list-style-type: none"> • [NREG] Not Regulated • [HREG] Highly Regulated • [PPW] Lots of paperwork/Red Tape • [NDA] No dental assessments • [QA] Quarterly assessments
	Education	<ul style="list-style-type: none"> • [LED] Lack/need oral health education • [EDMREQ] Education not required • [DVD] DVD provided for education • [LP] Low priority among residents and staff • [POHS] Poor oral hygiene among staff • [ED] More education needed for staff
	Infrastructure	<ul style="list-style-type: none"> • [NONS] No onsite dental equipment • [VOCP] Variety of oral care providers • [NDDS] No dental personnel • [HAVEDENT] Have Dentist on staff • [HTVR] High turnover rate • [FIN] Lack of money/finances/reimbursement • [TB] Too busy/demanding environment • [ONBFP] Director of Nursing Burn-out especially in for profit • [RSHIP] Need for staff to develop relationship with residents to benefit both caretaker and resident
	Personnel	<ul style="list-style-type: none"> • [PATT] Positive attitudes • [NRC] No return call • [NATT] Negative attitudes
Access	Patient Health Status	<ul style="list-style-type: none"> • [NATT] Natural teeth • [DENP] Difficulty with dementia patients • [UNCoop] Uncooperative • [CPAIN] Consequence of pain • [WL] Weight loss
	Provision of care	<ul style="list-style-type: none"> • [RDHOK] Treatment by a RDH is OK • [MTB] Mechanical toothbrushes needed
	Resident Responsibility	<ul style="list-style-type: none"> • [GSHIP] Guardianship • [RRFDC] Resident Responsible for Dental Care

health care. One oral health care personnel expressed: "Residents staying in a familiar environment might increase cooperation making it easier to provide care." Another oral health care personnel commented about the lack of dental personnel (8%): "We need dentists who are willing to come do

Table II: Summary of Emergent Themes with Representative Interpretive Codes for Long Term Care and Assisted Living Facilities for Survey Open End Responses and Interview Responses

		Long Term Care Frequencies (Percent)			Assisted Living Frequencies (Percent)			Combined Long Term Care and Assisted Living Responses (n=133)
Theme	Interpretive Codes	Survey Open End Responses (n=17)	Interview Responses (n=77)	Total Long Term Care Responses (n=94)	Survey Open End Responses (n=13)	Interview Responses (n=26)	Total Assisted Living Responses (n=39)	
Policy	Regulations	1 (6%)	3 (4%)	4 (4%)	4 (31%)	8 (31%)	12 (31%)	16 (12%)
	Education	-	14 (18%)	14 (15%)	-	2 (8%)	2 (5%)	16 (12%)
	Infrastructure	7 (41%)	40 (52%)	47 (50%)	4 (31%)	8 (31%)	12 (31%)	59 (44%)
	Personnel	-	7 (9%)	7 (7%)	-	4 (15%)	4 (10%)	11 (8%)
	Total	8 (47%)	64 (83%)	72 (77%)	8 (62%)	22 (85%)	30 (77%)	102 (77%)
Access	Patient Health Status	-	10 (13%)	10 (11%)	-	1 (4%)	1 (3%)	11 (8%)
	Provision of care	9 (53%)	3 (4%)	12 (13%)	-	3 (12%)	3 (8%)	15 (11%)
	Residential Responsibility	-	-	-	5 (38%)	-	5 (13%)	5 (4%)
	Total	9 (53%)	13 (17%)	22 (23%)	5 (38%)	4 (15%)	9 (23%)	31 (23%)

assessments on residents at the facility.” Additional comments included: “It would help if a familiar CNA or family member was involved during care.”

Residents within these facilities may be insured, uninsured or underinsured; thus all residents living in the same facility do not have the same financial resources. This variability requires the oral health care personnel to understand multiple plans and know how to navigate each system. Respondents stated: “Our mobile dental services cannot provide emergency care and only people on the ‘offset plan’ usually get services,” “Families cannot afford dental care” and “This is a rural area with lots of people with no money.” Thematically, these statements support issues associated with infrastructure (44%) and regulation (12%) practices.

An oral health care personnel with extensive experience described a demanding work environment: “There is a prevalence of OHCP (oral health care personnel) burnout especially in the for-profit setting. OHCP staff frequently work 14 hour days. Oral care is often sacrificed as it is not visible, providing OHCPs a shortcut to surviving the day.” The oral health care personnel further discusses current attempts by nursing homes to implement a culture change when she described: “This change is to focus not just on the elder, but on the elder caregiver; to promote relationships between elders and staff by promoting consistent assignments in which the CNA would work with the same person or group of

elders.” This finding described the theme of lack of personnel (8%) and the importance of staff providing quality care for residents being served.

Throughout the interviews oral health care personnel’s at assisted living facilities discussed the need for better oral health education among personnel: “Educating staff about oral care is not required as nursing staff is primarily responsible for taking medication to the resident and reminding them to take it,” and: “Oral care is not regulated but we do provide some in-service education related to oral care.” The amount of oral health education provided to staff ranged from none to occasional and was inconsistent between facilities. Thematically, issues associated with staff education (12%) and personnel (8%) have significant impacts on care provision.

Lack of finances was a commonly cited barrier for accessing care services. One oral health care personnel recalled a resident having to choose between accessing dental care and purchasing medication. The oral health care personnel reported: “He ‘chose his medicine.’” These statements supported the considerations thematically associated with infrastructure (44%).

Concerns regarding lack of regulations were significantly higher for assisted living facilities (31%) than for LTC facilities (4%). Survey responses and interviews with oral health care personnel in LTC facilities revealed concerns that facilities have too

many regulations and too much red tape hindering provision of oral health care. Conversely, survey responses and interviews with oral health care personnel in assisted living facilities expressed difficulties because of the lack of regulations. Assisted living facilities are not regulated and therefore are not required to provide oral care assessments or treatment. "We do not have dental assessments. The resident is responsible for making dental appointments." These statements support concerns thematically associated with regulations (31%).

Within the theme of access, 3 representative interpretive codes emerged: patient health status (8%), provision of care (11%) and residential responsibility (4%). The oral health care personnel at LTC facilities expressed access being impacted by patient health status (11%). This did not appear to be a concern for assisted living facilities (3%).

A number of oral health care personnel expressed challenges when working with patients who have dementia resulting in the following quotes: "They are uncooperative and don't understand what you are trying to do and may even think that the toothbrush feels funny." Additional concerns were related to residents being unable to articulate their own needs due to cognitive impairment: "They are often uncooperative, without it being their own fault—they don't understand what you are trying to do for them." Another described concern that an underlying dental problem could cause behavioral problems stating: "They cannot tell you where it hurts." These comments address concerns thematically associated with patient health status (8%) and provision of care (11%).

Repeated concerns were expressed about weight loss as a result of the lack of access to oral health care: "Many of the residents have ill-fitting dentures that discourage proper eating and cause weight loss," and: "It is important to improve oral care in order to avoid losing weight." Another stated: "They (residents) just don't care about taking care of their teeth." These comments support concerns thematically related to patient health status (8%) and provision of care (11%).

The oral health care personnel at assisted living facilities expressed access being impacted by residential responsibility (13%). This was not a concern for LTC facilities (0%). The following quote provides a rich description of this matter: "Either the family member or legal guardians make all decisions about their oral care and are responsible for making dental appointments."

Both types of facilities expressed that access is

influenced by the provision of care (LTC 13%, assisted living 8%). When asked whether or not the oral health care personnel would be receptive to having a dental hygienist serve as the primary oral care provider, oral health care personnel were generally supportive of this oral health care provider model. The following quote represents responses related to the provision of care and openness to dental hygienists having direct access to patients without direct supervision: "I see more residents than in the past with their natural teeth and could see the benefit of having a dental hygienist provide oral care."

Discussion

Limitations

Limitations are inherent in qualitative research. The investigator in qualitative research is considered to be the survey instrument.³⁵ Potential bias exists as the investigator's personal opinions and experiences are involved in the process. Researchers conferred that there could be overlapping codes within established categories. Limited sample size and possible geographic bias are acknowledged to be limitations of this study. Further, the variety of oral health care personnel could have provided inconsistencies. The opinion of a caretaker who has only worked in the environment for 2 weeks is not comparable to a registered nurse with 30 years of experience. The investigators of the present study attempted to control for these limitations by using well established qualitative research methods; nevertheless, findings cannot be generalized.³⁴

Reaching the target population of this study was problematic. Similar experiences have historically been reported in other studies involving nursing facilities.^{28,36,37} Interviews with industry experts acknowledged that the nursing home staff population is hard to reach, citing a demanding work environment, lack of email access and high turnover rate. A report from an Arkansas researcher showed difficulty acquiring informed consent and difficulty accessing the Arkansas nursing home population in a recent study.³⁸

Financial Needs and Barriers

Residents of LTC and assisted living facilities have a variety of public and private dental insurance plans. Oral health care personnel in the present study voiced difficulties leveraging the nuances of these plans. Often oral health care personnel do not have the knowledge and time to assist residents in using the resources that are available. It is unlikely that this will change in the near future. Dental care coverage prior to and following the im-

plementation of the Affordable Care Act (ACA) is provided primarily for children. Provisions of the ACA exclude mandatory dental coverage for adults deferring provisions to states.^{39,40} In Arkansas, older adults covered by both Medicare and Medicaid are selectively provided dental care under "life threatening conditions" only (Office of Oral Health, personal communication, 2014).

As in similar studies, financial concerns of the resident or family were considered to be an important barrier for both LTC and assisted living facilities. Those depending upon Medicaid and Medicare assistance are limited and encounter a significant amount of paperwork to attain needed assistance, adding to the demands of nursing staff and families. This burden results in treatment delays, prolonged pain and suffering and overall reduced quality of life.^{15,19,20}

Educational Needs and Barriers

The present study revealed oral health care personnel felt more oral health education would be beneficial. This finding mirrors conclusions made by the Institute of Medicine in the 2011 report "Improving Access to Oral Health Care for Vulnerable and Underserved Populations."⁴¹ The literature is replete with studies detailing the low priority of oral health by non-dental health care professionals.⁴¹⁻⁴⁵ In response to these shortcomings, the Committee on Oral Health Access to Services developed a core set of oral health competencies and curricula for non-dental health care professionals to improve their ability to promote oral health and disease prevention.⁴¹ A national initiative known as the Oral Health Nursing Education and Practice was established to address this concern.^{46,47} An important aim of this initiative is to use inter-professional teams across the health care system to improve oral care provisions. Nurses are on the front line with regard to providing oral health care. With adequate education and training in oral health care, the nursing workforce has the potential to improve access and quality of oral health care. Education and training about activities of daily living could incorporate oral health care practices along with bathing, toileting and dressing. Oral health outcomes could be improved using an interdisciplinary approach to care.

Earlier Intervention

Assisted Living facilities are the fastest growing segment of the nursing care continuum,⁴⁸ with the typical assisted living resident being much like the nursing facility patient of the past with a high burden of functional impairment and related illness.⁴⁹ Research concerning oral care provision centers on

highly regulated LTC facilities. Limited attention is given to unregulated assisted living facilities. A comprehensive report funded by the State of Florida Health Care Administration revealed a general lack of oral care during the period after retirement and before entering a nursing facility.⁵⁰ Results from the current study indicate assisted living residents are less likely to have a dental exam than LTC residents. Residents of assisted living did not receive assistance with oral hygiene and a dental plan was not required. Downstream medical costs could be reduced by increasing access to oral care at this critical juncture by preventing disease and its associated comorbidity.

Policy

The Institute of Medicine's longitudinal landmark study cited numerous recommendations for policy reform including the establishment of a unified set of items and definitions for assessing all residents in nursing facilities in the nation.⁵¹ Concerns about poor quality of care and the rights of residents within the nursing home led to a government mandate known as the 1987 Omnibus Budget Reconciliation Act (OBRA) which provides a set of standards for nursing homes known as the minimum data set.^{52,53} Regulations, such as minimum data set, are in place today in an attempt to improve and monitor the quality of care provided in LTC,⁵³ yet many LTC residents have inadequate access to oral care.^{11,18} The inadequacy of the minimum data set has been reported by a study of Iowa nursing homes in which it was determined that the use of the oral, nutritional and dental sections of the minimum data set are often not useful and not used as intended in the identification of dental needs.²⁵ These regulations need to be updated to reflect the changing needs of older adults, who are living longer and retaining their teeth, so they have improved oral care.

In addition to OBRA regulations, Arkansas, as in most states, require that facilities establish a written cooperative agreement with an advising dentist or dental service which includes a provision to participate annually in a staff oral hygiene policies and practices development program.⁵⁴ Conclusions from studies of both LTC and assisted living facilities indicate that oral health policies and practices vary, and that dental involvement in policy creation and in providing consultation and service is limited.^{28,36} The current study supports these findings as evidenced by LTCs reporting annual policy development programs with inconsistent amounts of in-service education. Oral health care personnel in assisted living seemed receptive but stated they were not required to provide any dental care other

than transporting the resident to a dentist if necessary. Lack of time and funding, as well as an overall low priority seems to prevail.

Lack of on-site dental equipment and unwillingness of specialty and general dentists to provide care at nursing facilities were two of the primary barriers that emerged during this study. Further, time constraints of nursing staff presented a significant barrier making oral preventive care a low priority in this study and previous studies.^{28,36,55} The oral health care personnel in the present study expressed a need to provide more dental services within the familiar environment of the nursing home and with the assistance of a consistent caregiver or family member. This change would address identified concerns such as inability to communicate, lack of cooperation, dementia and weight loss. Multiple studies report similar needs and barriers.^{15,56,57}

Interestingly, the Arkansas state penitentiary employs a dental hygienist in an on-site dental clinic raising questions about the parity of policies and infrastructure in place for providing oral care within the state. This inequality is further illustrated in the 2011 Arkansas report card published by the PEW Center on the States where children's oral health improved from a "F" in 2010 to a "C" in 2012.⁵⁸ Infrastructure in Arkansas has been modified to provide access to oral health care for many different populations; however, older adults are being overlooked. A recent survey of the burden of oral disease in Arkansas has found demographic inequities in older adults especially with regard to education, race and gender.⁵⁹ Updating regulations and policies to require individualized care plans developed by a dental professional should be in place and available for all individuals.

The Role of the Dental Hygienist

The use of non-dental professionals to conduct assessments is needed to improve access. An interdisciplinary team approach, that includes dental professionals is necessary to more accurately identify oral health care needs and therefore facilitate the development and implementation of effective oral health care plans and educational programs. Implementation using an interdisciplinary model will be challenging. The present study underscores this disconnect in response to reports of frequent turnover of facility employees and a variety of providers with an inconsistent degree of oral health knowledge. One oral health care personnel stated that many of the caregivers do not have good oral care themselves and often do not feel it is a priority for residents. Educating staff members to value

their own oral care as well as residents is important to increase the overall awareness of quality oral care. Dental hygienists could aid in increasing the confidence of the caregiver in providing oral care and reduce some of the stress associated with caring for uncooperative residents. Based on insight from oral health care personnel, dental hygienists could be used to increase retention by alleviating some of the demanding workload of the oral health care personnel. Results from a recent pilot study conducted in Arkansas demonstrates how hands on support from a dental health champion working in collaboration with oral health care personnel can have a positive impact on the oral health of residents in LTC settings.⁶⁰

The present study suggests that oral health care personnel are overall receptive to the use of dental hygienists in providing care in their facilities; however, no current involvement exists. This circumstance is a problem in Arkansas because of limitations preventing dental hygienists from providing oral care and the small number of dentists treating residents within the facilities despite the apparent need. In 2011 the dental practice act in Arkansas was modified to allow them an opportunity to attain a Collaborative Care Permit enabling dental hygienists to provide needed oral care to populations that lack access. The permit, which mirrors other states' workforce models, is just beginning to be implemented in Arkansas. The possibility of increasing access to care in Arkansas through direct access to dental hygiene preventive services as outlined by the Collaborative Practice Permit promises to alleviate some of the disparities in oral health care and is a response to the state's efforts to increase access to care based on needs found in oral health care reports.³⁰ This model of care has demonstrated success in Louisiana. Testimony from Folse describes his geriatric model of care which uses hygienists to complete facility minimum data set items and provide treatment.⁶¹ He states:

"Without general supervision which fully enables a hygienist's abilities, I would not have a viable prevention model or the ability to provide my patients access to comprehensive care. Working with hygienists has increased the entry points of my patients into the dental delivery system. This is a winning model for my patients."⁶¹

Future Research

Replication of this study in other states would be beneficial to improve generalizability. In order to achieve an acceptable survey response, future research with this target population should explore ways to connect with oral health care personnel "in

person" in settings such as professional meetings. In person contact was suggested by oral health care personnel due to lack of time, and lack of access to electronic or regular mail within their workplace. Investigators may want to offer incentives for survey participation. A mixed methods approach incorporating before and after focus interviews along with a survey could also strengthen and enrich this study type. Additional suggestions for future research are to assess the perceptions of oral health care personnel as to their own oral care practices and beliefs and to investigate dentists and dental hygienists in Arkansas to determine their interest in, or experiences with providing care through the use of a Collaborative Care Permit.

Conclusion

This qualitative case study suggests access to oral health care for residents living in both LTC and assisted living I and II facilities in Arkansas is affected by public and facility policies and access to oral health care as a function of the patient's health status and availability of oral health care providers. Access for residents residing in assisted living I and II facilities is also limited by the residents' ability

to assume responsibility for accessing oral health care. The outcomes from this study may serve to inform policymakers and advocates for access to oral health care as they develop new approaches to address this growing need.

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Perceptions of Kansas Extended Care Permit Dental Hygienists' Impact on Dental Care

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Introduction

Access to care continues to draw significant concern and discussion among the dental community and social welfare advocates. Since its initial release in the year 2000, Oral Health in America: A Report of the Surgeon General has stimulated interest in the oral health disparities present in the U.S.¹ The Centers for Disease Control and Prevention released a progress report for the Healthy People 2010 initiative, a renewable 10 year agenda for improving the nation's health. Results indicated that despite numerous program implementations, little or no progress has occurred towards the goals of reducing or treating tooth decay in ages 6 to 44, reducing complete tooth loss in the 65 to 74 year old population, and increasing early detection of oral and pharyngeal cancer.²

Nearly one-third of U.S. citizens lack access to basic preventive dental health care services, mainly resultant from dental care costs and uneven geographic distribution of dental providers.³ Kansas has a larger rural population, 37%, in comparison to the national average of 21%.⁴ Eighty-nine out of 105 counties are classified as rural, concentrated in the western part of the state, with fewer than 40 persons per square mile.⁵ Furthermore, 86% of the total Kansas counties lack adequate dental care services and are federally designated as dental health professional shortage areas (Figure 1).⁶

In 2009, the Kansas Bureau of Oral Health Workforce Assessment reported the average age of Kansas dentists (n=1,334) was 50 years old.⁷ A majority of dentists working in rural areas plan to retire in

Abstract

Purpose: In 2003, Kansas addressed their access to oral health care needs with amended state dental practice act for registered dental hygienists. The Extended Care Permits (ECP) I, II and III have expanded the dental hygiene scope of practice, allowing dental hygienists to provide oral care to Kansans in different settings beyond the dental office. The purpose of this study was to examine the perceptions of Kansas ECP dental hygienists on change to oral care in Kansas.

Methods: A questionnaire was mailed to all ECP dental hygienists (n=158) registered with the Kansas Dental Board. Questions were open-ended, close-ended and Likert scale. Information was sought regarding demographics, areas of employment, work related activities and impact to oral health care. Study exclusions included ECP providers no longer practicing in Kansas, practice more than 50% in another state or no longer practice dental hygiene at all.

Results: A total of 69 surveys were returned, with 9 surveys excluded for exclusion criteria. Most respondents (92%) agreed the ECP is a solution to oral health care access issues in Kansas. Barriers to utilizing their permits fully included: difficulty locating a sponsoring dentist (12%), locating start up finances (22%), limited work space (14%) and difficulty with facility administrators (39%). Many respondents (62%) agreed the proposed registered dental practitioner would improve access to oral health care to Kansans.

Conclusion: The Extended Care Permit providers in Kansas appear to be satisfied with their current employment situations and feel oral health care has improved for their patients served but they are unable to utilize their permits fully for various reasons.

Keywords: dental hygienist, access to care, extended care permit, dental workforce

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Identify, describe and explain mechanisms that promote access to oral health care, e.g., financial, physical, transportation.

the next 6 to 10 years, thus projecting a decreased supply of Kansas dentists by 2045.⁸

The University of Missouri-Kansas City (UMKC) Dental School is the nearest dental institution offering education of dentists, bordering the Kansas and Missouri state line, and would seemingly provide an abundance of dental graduates for the region.

However, many of the institution's dental graduates have chosen to begin their dental practices outside of Kansas adding the dilemma of a projected shortage of dentists in the state.⁹ There are 5 dental hygiene academic programs in Kansas, and 2 additional programs are located in Missouri on the state line border. Of these locations, only one is located in rural western Kansas. An overwhelming majority of Kansas dentists and registered Kansas dental hygienists are concentrated in larger metropolitan areas located in the eastern half of the state.^{5,10} It is logical to assume new graduates from these dental hygiene programs will continue to seek employment in large Kansas metropolitan areas and not less populated rural areas of Kansas.

Kansas Addresses Access to Care

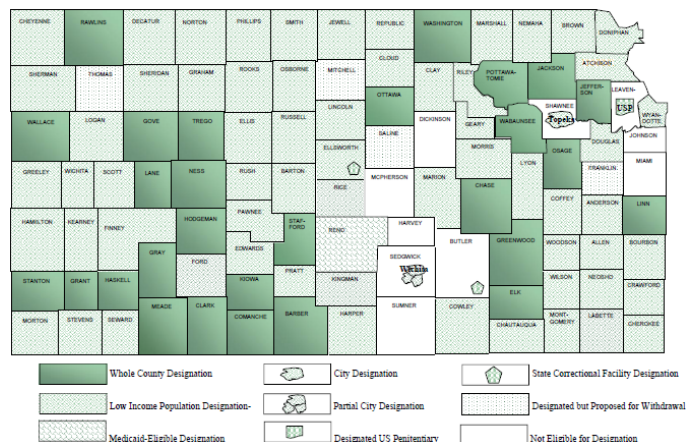
Kansas has struggled with their oral health disparity and has focused on how to provide preventive care to those in disadvantaged or underserved areas. Initially, Kansas addressed this in 1998 with a dental assistant model, termed scaling assistants. Tracking their impact to preventive oral care for the underserved population is difficult since scaling assistants are only required to register with the Kansas Dental Board after completion of approved courses. They are not required to maintain any licensure or registration, making the location of their practice and the populations served speculative.

Mitchell et al conducted a study examining the perceptions of Kansas dental hygienists and scaling assistants, then conducted a follow up study 5 years later.^{10,11} Findings were that the majority of scaling assistants were working in metropolitan areas and not practicing in the rural and underserved areas thus not addressing the workforce needs for the underserved Kansas population as was the original intent.¹¹

Kansas has since sought additional ways to increase the oral health care workforce to meet the needs of its citizens. In 2003, the Kansas Dental Board amended the dental practice act and expanded the dental hygiene scope of practice with the Extended Care Permit I (ECP I) thus creating an alternative practice model for dental hygienists. This workforce model works in collaboration with a sponsoring dentist, providing preventive services to targeted populations.¹²

In 2007, the dental practice act further expanded the scope of dental hygiene practice by creating the ECP II workforce model, allowing for a greater range of locations and populations for ECP providers to address preventive oral health care needs (Table I). All ECP providers are required to maintain regis-

Figure 1: Kansas Department of Health and Environment Bureau of Local and Rural Health Dental HPSAs



As of October 7,2011

tration with the Kansas Dental Board which serves to track the actual number of providers and their primary work locations.¹²

In 2011, Delinger et al conducted a study examining the experiences of ECP providers.¹³ Results supported the positive impact on preventive oral health care in Kansas to the targeted populations. Barriers were encountered, including locating start up funding, lack of support from facility administrators and even dentists. In spite of various challenges, these dental hygienists have a great entrepreneurial spirit, have developed a solid network of support and have found ways to sustain the ECP practice.

A dramatic increase in the number of patient contacts in safety net clinics, a main hub for many ECP providers, was noted, rising from approximately 5,000 patient contacts in 2007 to over 30,000 in 2010.¹³ Many of the patients served by ECP providers would not have access to preventive care from any other source. In the absence of safety net dental clinics, individuals in oral pain may seek care in their local hospital emergency room.¹⁴

The financial burden of dental related ER visits cannot be underestimated. Kansas reported more than 17,500 dental-related visits to emergency care facilities in 2010.⁷ From 2006 to 2009, there was a nationwide 16% overall increase in emergency room visits that resulted in a primary diagnosis of preventable dental conditions; some metropolitan areas reporting at least 20% where patients visited multiple times for the same condition.^{14,15} Most treatment involves a prescription for antibiotics and pain medications which fail to address the core of the dental need.¹⁶ It has been estimated

Table I: Kansas Extended Care Permit I and II Regulations

	ECP I	ECP II	ECPIII
Population Served	<ul style="list-style-type: none"> • Low income children • Adults in prison • Federally qualified health centers • Local health department 	<ul style="list-style-type: none"> • Same as ECP I • Persons over age 65 • Special health care needs population 	<ul style="list-style-type: none"> • Same as ECP I and ECP II
Requirements	<ul style="list-style-type: none"> • At least 1200 clinical hours, or Dental hygiene instruction of at least 2 years in the previous 3 years • Maintain CPR certification • Dentist sponsorship with signed agreement • Maintain professional liability insurance 	<ul style="list-style-type: none"> • At least 1800 clinical hours, or Dental hygiene instruction of at least 2 years in the previous 3 years • Six additional training hours, specific for care of special needs patients • Complete minimum of 6 hours continuing education in area of special needs care every 2 years • Dentist sponsorship with signed agreement • Maintain professional liability insurance 	<ul style="list-style-type: none"> • At least 2000 clinical hours, or Dental hygiene instruction of at least 3 years in the previous 4 years • Completion of 18 hour KS Dental Board approved course • Maintain CPR certification • Dentist sponsorship with signed agreement • Maintain professional liability insurance
Scope of Practice	<ul style="list-style-type: none"> • Prophylaxis, fluoride application, patient education and assessments 	<ul style="list-style-type: none"> • Same as ECP I • Removal of overhang restorations and periodontal dressings, administer local block and infiltration anesthesia and nitrous oxide (under general supervision) 	<ul style="list-style-type: none"> • Same as ECP I and ECP II • Identify decay, remove with hand instrument and place temporary filling, glass ionomer or other palliative material • Denture adjustments, soft relines • Smooth sharp teeth with slow speed handpiece • Simple extractions of deciduous teeth • Application of topical, local and block anesthetic
Location of Practice	<ul style="list-style-type: none"> • Schools, health departments, correctional facilities • Head Start programs 	<ul style="list-style-type: none"> • Same as ECP I • Adult care homes, hospital long-term units, state institutions, homebound patients 	<ul style="list-style-type: none"> • Same as ECP I and ECP II

Source: Kansas Dental Board

that hospital dental treatment is nearly 10% more expensive than the cost of preventive dental care in a private practice dental setting.¹⁴ For many states who already have strained budgets, the quest is on to identify cost-effective alternatives to provide access to dental care beyond the emergency room.

The Future of Kansas Oral Care Providers

Kansas is seeking to continue the positive impact of the ECP providers on oral health care to underserved populations. In 2012, Kansas legislation expanding the dental hygiene scope of practice further with the ECP III (Table I).¹⁷ Proposition

for a new model, the registered dental practitioner, was introduced but did not pass Kansas legislation in 2012 due to strong opposition from the Kansas Dental Association. This midlevel dental workforce model was proposed to be an advanced degree dental hygienist, similar to Minnesota's Advanced Dental Therapist.¹⁸

The approval for the ECP III in 2012 and the increasing drive for the RDP show a strong desire by Kansas to address what remains to be a dilemma: there are many individuals who are lacking adequate dental care. With geographic barriers in rural western Kansas and the projected shortage of den-

tists in the next decade, the quest is to incorporate a workforce model that is most effective to provide dental services to the populations in need or utilize a combination of models to best provide access to dental care.

Since 2008, there has been nearly 33% increase in the number of ECP providers registered with the Kansas Dental Board, with a total of 158 ECP providers as of 2011.¹⁹ Yet even with the steady increase of ECP providers since the legislation passed in 2003, there continues to be rural populations in Kansas who still lack access to oral health care.²⁰ Delinger's 2011 study provided encouraging evidence of the ECP's positive impact for school-aged children, elderly and special needs patients.¹³ The Kansas ECP model closely resembles the Limited Access Permit dental hygienists in Oregon, serving similar populations and locations of practice and are well received by the patients they serve and the collaborating dentists with whom they work with documented success.²¹

Because of the qualitative study design used in Delinger's research, only a limited number of ECP providers were studied.¹³ The purpose of this study, therefore, was to explore the entire population of ECP providers regarding perceptions of their positive impact to oral care in Kansas.

Methods and Materials

Subjects/Population

All Kansas dental hygienists who were registered with the Kansas Dental Board as having obtained either an ECP I and/or ECP II permit were invited to participate. At the time of this study, there were 158 dental hygienists with such permits, therefore a total of 158 surveys were mailed to eligible participants. In order to achieve the maximum response rate, the surveys were mailed in paper format with a 4 week response period.²² The following groups were excluded from the study: dental hygienists no longer practicing, dental hygienists no longer practicing in Kansas and dental hygienists who practiced more than 50% of their time in another state. All of the participants were asked to return the survey unanswered in a postage provided envelope.

Instrumentation and Measurement

A survey instrument developed by Mitchell et al examining workforce issues in Kansas was modified for use in this study.¹⁰ The questionnaire consisted of 3 sections with open-ended, close-ended and rank-scaled questions. Respondents were asked to write explanations and comments on the open-ended

questions and on close-ended dichotomous yes or no questions.

Demographic information was collected, including the education level of the dental hygienists and the county and practice setting of the groups. Perceptions from survey participants regarding the proposed ECP III and the registered dental practitioner were also requested.

A pilot test on a convenience sample of 10 dental hygienists and dental hygiene educators was conducted prior to the initial mailing to determine validity of the survey. The final questionnaire, cover letter and research design was approved by the Social Sciences Institutional Review Board at UMKC.

Data Collection

Surveys were mailed in the summer of 2012 to a total of 158 participants. Each dental hygienist was asked to complete the survey and return it in the self-addressed, stamped envelope provided in the initial mailing. To ensure anonymity and confidentiality, no coding remarks or labeling of any survey instrument was used. To encourage optimal response rates, a follow-up postcard was mailed 2 weeks after the initial mailing. The data collection period was a total of 4 weeks.

Results

Data were analyzed utilizing SPSS version 19. Of the 158 surveys mailed, 69 were returned, yielding a 44% response rate. Nine surveys were not included due to the exclusion criteria. The remaining 60 surveys (39%) were utilized for data analysis.

Demographics

The target population was Kansas ECP providers. Table II describes the demographic information, including total years of hygiene practice. The response overlap to the question of practice location prior to obtaining their ECP may be due to previous dental hygiene activity in multiple settings.

Areas of Employment

The ECP providers reported utilizing their permits in a variety of settings. Nearly half of ECP respondents (46%) indicated working in 4 or more different locations. Many of these included different schools and HeadStart centers. Other locations included safety net facilities, hospitals, WIC centers, special needs clinic, volunteer services, nursing homes, dental clinics without a full time dentist, homeless shelters and health departments. Several respon-

dents indicated the importance of their ability to go to the patients to provide care instead of having the patient come to them, allowing “children with limited resources to remain in school and be seen. The barriers such as transportation, time off work have been eliminated for preventive care.”

ECP-Related Work Activity

The respondents reported spending 1 to 60 hours per week performing ECP related activities, as reported in Table II. Some respondents reported having an ECP permit but were not using it for work related purposes (35%, n=19). Reasons for not actively using the ECP permits were varied. Some were unable to locate a sponsoring dentist or lacked support from local dentists in their community. Others expressed an interest in utilizing their permit on a part-time basis and were unable to find a location or opportunity in which to use it, stating “The clinic was closed because there was no more budget.” Finding time outside of a full time private practice schedule was a limiting factor for some ECP permit holders: “No part time opportunities. Federal grants not renewed.” The physical strain of transporting the equipment was also cited as an obstacle to full use of the ECP permit as was the frustration of limited funding and clinic closures due to budget cuts that eliminated an employment hub for ECP providers.

Perceptions of Impact to Care

Overall, most participants were satisfied with their current position as an ECP provider (70%, n=42). The ECP appears to be providing dental care to many underserved populations in Kansas. Nearly half on respondents (48%, n=28) agreed they were able to use their ECP to the fullest extent. Those who felt they were able to utilize their ECP fully also had the most perceived support from their sponsoring dentist ($r=0.438$, $p<0.05$).

Table II: Demographic and practice characteristics of the Kansas ECP dental hygiene respondents (n=60)

	Total Respondents	Number	Valid Percentage
Age	58		
25 to 34		14	24%
35 to 44		10	17.1%
45 to 54		21	36.2%
55 to 66		13	22.2%
Gender	58		
Female		57	98.3%
Male		1	1.7%
Dental Hygiene Education	58		
Associate Degree		32	55.2%
Bachelor’s Degree		23	39.7%
Master’s Degree		3	5.2%
Years of Active Dental Hygiene Practice	58		
1 to 5 years		8	13.8%
6 to 10 years		11	19%
11 to 15 years		8	13.8%
16 to 20 years		6	10.3%
21 to 25 years		6	10.3%
26+		19	32.8%
Prior Location of Dental Hygiene Practice	58		
Private Practice		54	93.1%
Public Health		11	19%
Dental Hygiene Educational Institution		3	5.2%
Number of Locations for ECP Dental Hygiene Practice	60		
1		14	34.1%
2		8	19.5%
3		0	0
4+		19	46.3%
Number of Hours for Weekly ECP Activity	55		
Less than 1		21	38.1%
1 to 10		14	25.4%
11 to 20		9	16.3%
21 to 30		3	5.4%
31 to 40		7	12.7%
41 to 50		0	0
51 to 60		1	1.0%
ECP Related Work Activity			
Preventive Scaling		38	55.1%
Fluoride Application		38	55.1%
Oral Hygiene Instruction		38	55.1%
Patient Assessment		36	52.2%
Other DDS Delegated Activities		33	47.8%

*Valid percentage does not include non-responses; percentages calculated from total responses for each question.

Conversely, many ECP respondents felt they were not utilizing the permit to its fullest extent (52%, n=30). Many cited barriers, as seen in Table III, including a “too restrictive scope of practice” for the ECP, “billing cannot be done directly to a hygienist,” “lack of equipment to travel to nursing homes” and “objections from the dentists in my area.” When asked if their sponsoring dentists felt the ECP was a solution to manpower issues in Kansas, nearly 22% (n=13) of the ECP providers surveyed for this research indicated their sponsoring dentists felt the ECP was not a solution to manpower issues in Kansas. One respondent stated they “work full time, need the steady flow in income, sponsoring dentist is not supportive and is only one I’ve found.”

Many respondents (62%, n=37) agreed the proposed registered dental practitioner would improve access to dental care in Kansas, yet only 45% (n=24) would be interested in pursuing this license if available. Reasons for this included a career nearing retirement and the perceived lack of support from “dentists willing to help out.” Over half (52%) indicated they plan to use their ECP for 10 years or less.

Respondents strongly agreed their permits are part of a solution to access to care issues in Kansas (92%, n=55) and felt their permits have a positive impact on dental care (93%, n=54). Likewise, they feel dental care has improved for the patients they serve (71%, n=42). One respondent commented: “I work in public health and we target southeast Kansas schools, HeadStart and WIC with our ECP license. This is a very low income area that does not go to the dentist. ECP allows us to go to them.” A majority (57%, n=33) of respondents agreed their sponsoring dentist viewed the ECP as one solution to access to dental care in Kansas.

Discussion

This study was designed to investigate the perceptions of Kansas ECP providers’ positive impact to dental care. A large majority of survey respondents (93%, n=54) felt the ECP has increased access to dental care in Kansas. This study echoes a previous study on the critical role and impact the ECP has had on reaching targeted underserved populations.¹³ Encouraging statements from ECP’s were: “provide services to many children who have never seen a dentist,” “provide preventive services so kids can stay in school,” “nursing home patients stay in their area” and “special needs do not have to travel.”

The dental benefit to Kansas children will presumably continue to increase since Kansas passed

Table III: Perceived Barriers Preventing Full Utilization of the ECP

	Response	n*	Percent
Difficulty locating start up finances	Yes	13	22
	No	46	78
Difficulty locating sponsoring dentist	Yes	7	12.1
	No	51	87.9
Limited space in work facility	Yes	8	13.6
	No	51	86.4
Obstacles with facility administrators	Yes	23	39
	No	36	61
Inadequate number of patients available for services	Yes	6	10.2
	No	53	89.8
Other barriers	Yes	23	39
	No	36	61

legislation for the ECP III in 2012. The ECP III will increase the dental hygiene scope of practice for specially trained hygienists and includes provisions to place temporary fillings, extract loose baby teeth and adjust dentures.¹² The ECP III has gone beyond a preventive scope of practice and allows for limited restorative dental treatment.

All 3 ECP permits are designed to allow dental hygienists to reach populations who are unable to receive traditional dental care in a private office, yet the fundamental focus for each permit is preventive care. The limited restorative capacity of the ECP III has been termed a “baby step” towards providing dental services to the underserved and many organizations are still advocating for a midlevel dental provider in Kansas.^{12,13} The registered dental practitioner would fill a gap that still exists. Legislation for a midlevel dental provider with more restorative capabilities, the, was introduced in 2012 and was strongly opposed by the Kansas Dental Association.

Although the ECP is providing preventive dental services, some of the ECP providers surveyed felt their scope of practice was limited with statements such as: “we see several kids in schools and they continue to have untreated decay that an registered dental practitioner could fix in the school setting, truly removing all barriers to access. ECP helps but no solution since a large percentage of our patients need more than just preventive care.”

When asked to explain if the ECP has increased access to dental care in Kansas, one respondent commented: “In a limited manner, yes. Cleanings and sealants in schools are beneficial but this is the tip of the iceberg.” The inability of the ECP to provide restorative services has been suggested pre-

viously as an obstacle to providing complete oral health care in school children and nursing home residents.¹³ Painful and unhealthy oral conditions are present in patients that an ECP provider cannot provide and a dentist referral may be several miles from the patient's location.¹³

In 2011, Simmer-Beck et al released a report describing the outcome of the Miles of Smiles program, a collaborative effort between UMKC School of Dentistry, the Olathe Kansas School district (in suburban Kansas City) and Kansas ECP providers.²³ Miles of Smiles utilizes portable dental equipment, ECP providers, UMKC dental hygiene students (as an academic service learning assignment) and volunteer dentists to provide dental screenings, preventive dental treatment and referrals for restorative dental needs at local schools in Olathe. Johnson County, one of the most densely populated in Kansas, has only 1 clinic for uninsured low income people. Of the 7 Medicaid dental providers listed, Simmer-Beck et al identified only 4 that were accepting new Medicaid patients. Upon end of school year evaluations, only 11% of the children who were referred for dental needs actually received dental care. Further research would warrant investigating obstacles in the transition process for these children.²³

The Miles of Smiles program is successfully providing hands-on experiences for dental hygiene students, introducing them to the disparities that exist even in wealthy suburban areas and providing them with the opportunity to experience firsthand the delivery of comprehensive preventive services in an elementary school setting. The Miles of Smiles program along with other academic service learning components in the dental hygiene curriculum has resulted in increasing numbers of students making career choices in the public health sector.²⁴

Advocating for more hygienists to obtain and utilize their ECP permits was suggested by more than one participant in the current survey. However, concern was noted about the ECP providers' geographic practice location to remain in "areas of need...afraid that distribution will follow same patterns" was cited by a respondent. Mitchell et al found that dental hygienists at the time were mainly located in metropolitan areas of Kansas and not in rural communities.¹¹

The current survey asked the ECP providers to indicate the counties of practice for their permits. Fifty-eight out of 105 Kansas counties were listed by the respondents and all are within a 1 or 2 county radius of a safety net clinic which provides oral care to underserved populations regardless of ability to pay (Figure 2). The 60 ECP providers in this study

Figure 2: ECP Respondents by County and Safety Net Locations (n=60; 60/158=40%)



have shown to have a wide geographic reach in the state and are in areas of most need including counties with designations of health professional shortage areas, low income populations and Medicaid eligible.⁶ This differs from Mitchell's ECP research which identified ECP location of practice mainly in metropolitan Kansas City and Wichita.^{10,11} Some counties, mainly in western Kansas, were not represented in this survey but the indication of ECP's geographic expansion is encouraging.

In theory, the ECP providers should be able to reach as many target populations as allowed. The results of this survey indicate many ECP providers perceived numerous barriers that obstructed their ability to provide care. Difficulty locating a sponsoring dentist was found in this study. Similarly, lack of support from sponsoring dentists has been noted in past research.¹³ One respondent stated, "most dentists in my rural area don't and won't employ a hygienist (I was told my assistants scale above the gums and I finish in 10 minutes!)." Other ECP providers indicated utilizing the ECP permit but are "limited by my sponsoring DDS" and "not doing very many cleanings due to objections from the dentists in my area." Kansas dentists also appear to be divided in their support or lack thereof for the ECP providers as one respondent described an encountered barrier: "other dentists in the area who do not help but do not support my sponsoring dentist." The dental community appears divided in the most efficient pathway and workforce model to deliver oral health care to the underserved Kansas populations.

Many in the Kansas dental community continue to seek innovative pathways for delivery of dental care to underserved populations. Although the legislation for the midlevel registered dental practitioner was not passed in early 2012, Fort Hays University is already committed to creating an educational program for midlevel practitioners.²⁵ The Kansas House Bill that created the new ECP III also includ-

ed provisions for increasing the number of dental student seats at UMKC School of Dentistry for Kansas students with the intention of these students returning to rural Kansas to practice upon graduation.¹² It is yet unknown if this strategy will indeed increase the number of dentists in rural Kansas.

The ECP permits allows opportunities for Kansas dental hygienists to expand their dental hygiene services outside of traditional dental settings. Similar to previous research, the ECP respondents to this survey were enthusiastic about their contribution to improve the dental care disparity in Kansas and their ability to take their career in a different direction.¹³ Over half of the respondents reported ages over 45 and intended to utilize their ECP permits for 10 years or less. Perhaps exposure to service learning projects, such as UMKC's Miles of Smiles, will encourage dental hygiene graduates to pursue careers in alternative settings.

Limitations to this study include the self-reporting nature of survey research. Respondents may have varying interpretations of the scale-ranked questions and potential for internal bias is present. The ECP III was initiated into legislation at the time of the data collection for this study. Future research to determine the ECP providers' impact to care with the ECP III would be warranted.

Conclusion

Kansas ECP providers reported making a positive impact on the dental care to underserved populations. They are generally satisfied with the

current utilization of their ECP permits and perceive the ECP to have increased access to dental care in Kansas. Barriers were noted, including lack of dentist support, limited scope of practice for preventive services only, and administrative obstacles. The ECP III, with very limited restorative capacity, was initiated immediately upon the launch of this survey therefore it is yet to be determined if this will impact the delivery of care to Kansas populations with limited or no access to dental care.

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Educational Deficiencies Recognized by Independent Practice Dental Hygienists and their Suggestions for Change

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Introduction

Access to dental care is a growing problem in many areas of the U.S. Specifically, 8 out of 16 counties in Maine are entirely designated as dental shortage areas. The remaining counties have at least some localized areas of dental shortage designation.¹ Dental shortages in Maine were documented as early as 1929 when it was noted that dentists served only 20% of communities.² In addition to the existing deficit of dental services in Maine, large numbers of dentists are expected to retire in the next 10 years with twice as many dentists retiring as graduating.^{3,4} Dental hygienists practicing in alternative settings, therefore, have a unique opportunity to increase access to care. The purpose of this study was to determine the perceived level of preparedness Maine Independent Practice Dental Hygienists (IPDHs) received from their standard undergraduate dental hygiene education, and recognize areas necessary for further education in order to explore careers beyond the private practice dental office model.

In 1982, Rovin et al predicted within 2 decades there would be new forms of dental care delivery which would lead to an increase in patient access.⁵ In response to the need for greater access to dental care, many states have moved to allow dental hygienists to provide care independently from a dentist. A study by Freed et al in 1996 found that IPDH practices appeared to offer advantages to underserved patients by increasing access to care.⁶

Colorado and Washington were the first states to allow unsupervised practice of dental hygienists during the 1980s.⁶ As of October 2012, 35 states

Abstract

Purpose: The purpose of this study was to determine the perceived level of preparedness Maine Independent Practice Dental Hygienists (IPDHs) received from their standard undergraduate dental hygiene education, and recognize areas necessary for further preparation in order to explore careers beyond the private practice dental model.

Methods: A convenience sample of 6 IPDHs participated in a survey exploring their educational experience in public health and alternative practice settings. The survey also asked for their recommendations to advance dental hygiene education to meet the needs of those wishing to pursue alternative practice careers.

Results: This study found that participants felt underprepared by their dental hygiene education with deficits in exposure to public health, business skills necessary for independent practice, communication training and understanding of situations which require referral for treatment beyond the IPDH scope of practice.

Conclusion: As the dental hygiene profession evolves, dental hygiene education must as well. The IPDH participants' recommendations for dental hygiene programs include increased exposure to alternative settings and underserved populations as well as elective courses for those students interested in alternative practice and business ownership.

Keywords: dental hygiene education, dental public health, independent practice, alternative practice

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

allow some form of direct access to dental hygiene care without specific authorization of a dentist.⁷ In 2008, Maine passed legislation to allow independent practice of the dental hygienist and more recently to allow IPDHs to be reimbursed directly by MaineCare (Maine's nomenclature for Medicaid) as a care provider. Specific information pertinent to Independent Practice Dental Hygiene in the State of Maine can be found in the State of Maine Dental Practice Act, Licensing Statue for Independent Practice Dental Hygienists-Title 32, Chapter 16, Subchapter 3-B.

Fees for services in dental hygiene practices were found to be lower than their counterparts in private practice dental offices.⁸ In Maine, the cost of an appointment at an IPDH practice was roughly <\$100 than its equivalent in a dental practice.¹ Paying the dental hygienist directly rather than accessing hygiene care through a dentist makes care more affordable. More affordable services not only increases access to MaineCare patients but also the under and uninsured population.

The IPDH model of care delivery, also called collaborative practice, alternative practice or unsupervised practice, was developed primarily to reach a greater number of patients including Medicaid patients.⁹ Years ago, few people thought of the business of dental hygiene as a career opportunity; however, it is now a rewarding career and thriving business for many.¹⁰ According to the American Dental Hygienists' Association (ADHA), dental hygiene education was, historically, tailored to dental hygienists who plan to provide care in private practice dental offices. ADHA suggests changes must be made to advance current dental hygiene curriculum in order to keep pace with the evolving health care delivery system.¹¹

The American Dental Education Association's (ADEA) Policy Statement: Recommendations and Guidelines for Academic Dental Institutions states that education institutions are encouraged to prepare students for evolving workforce models which will include interdisciplinary care and being part of a health team.¹² According to ADEA, dental hygiene programs specifically should:

"...prepare graduates for new and emerging responsibilities. Monitor and anticipate changes in supervision requirements within the state and modify the curriculum and extramural experiences of students so as to prepare them to provide more extended services in a variety of practice settings."¹²

The ADHA recommends programs redefine curricula to meet evolving oral health needs. Specifically, their recommendations are that dental hygiene programs:

"Evaluate the dental hygiene curriculum and create new models for entry level programs that address: oral health needs, training programs in community-based, underserved areas, community health and disease management, cultural competence, needs of special groups, health services research, public policy development, evidence-based research methodology and practice, and collaborative practice models."¹¹

Some states, such as California, require dental hygienists to take an educational course in addition to their education requirements for registered dental hygienist licensure prior to receiving their license to practice in alternative settings. California's course is 150 hours consisting of training in management, business, dental hygiene practice and medically complex patients.¹³ In Maine, there is no required course beyond the registered dental hygienist licensure education requirements necessary to obtain IPDH licensure. This leaves the responsibility for additional training necessary to succeed outside the private practice setting up to the dental hygienists to obtain on their own.

Previously, multiple surveys have been conducted asking alternative hygiene practitioners their thoughts about additional education requirements prior to licensing. A qualitative study of Limited Access Permit (LAP) dental hygienists in Oregon reported that LAP dental hygienists feel additional coursework should include organizational structure, billing, coding, prescription writing and public health delivery systems.¹⁴ Similarly, a study of Colorado IPDHs reported accounting, computer science, management and marketing coursework would be beneficial to those dental hygienists interested in practicing independently.¹⁵

Beach et al suggests successful independent dental hygienists will be practitioners with a strong urge for entrepreneurship.¹⁶ Research shows while only a few dental hygienists may want to own a practice, many more may be interested in working in this environment.⁸ Independent dental hygienists will have to assume the risks and responsibilities for items such as equipment malfunction and repair, running a business, managing employees, and the financial burdens of owning a business.¹⁶

Literature suggests dental hygienists practicing outside the private practice dental office will need skills beyond what the traditional dental hygiene education curriculum provides. Some states require additional training prior to licensure for alternative practice, but for those which do not, it is unclear where the responsibility lies to ensure dental hygienists have adequate training. Although it has not been determined that it is the responsibility of basic dental hygiene education programs to prepare students for alternative practice, it can be agreed upon that the profession is changing. The ADHA and ADEA recommend programs begin to evolve to meet the needs of the changing profession and this study will provide dental hygiene programs with suggestions to enable compliance with this recommendation.

Methods and Materials

A survey design approach using both closed and open-ended questions was utilized. The survey was developed by the researcher, and while not validated, was reviewed by experts in the field of dental hygiene education and curriculum development. The survey was administered via telephone.

A convenience sample of 6 practicing IPDHs was selected from Maine. In an effort to capture the most relevant information for today's dental hygiene curriculum, only the most recent graduates actively practicing as IPDHs were selected; more specifically, those who graduated since the new millennium. Contact information was obtained through the Maine State Board of Dental Examiners. Through review of the Maine State Board of Dental Examiners records, it was determined that 6 IPDHs had graduated since the year 2000. Participants were read a statement indicating the voluntary nature of the survey and verbal consent obtained. All 6 participants contacted agreed to participate and although participants were able to withdraw at any time, all chose to complete the survey.

Questions addressed included:

1. What are the perceptions of practicing IPDHs in Maine about their educational preparedness for alternative practice environments?
2. What recommendations do the IPDHs have for inclusions in dental hygiene education to better prepare dental hygienists for alternative practice settings?

This study was reviewed and approved by the University of Texas Health Science Center San Antonio Institutional Review Board (IRB). The IRB also reviewed and approved the statement read to the participants to obtain verbal consent and determined that recorded consents were not required. Likert Scale data were analyzed using descriptive statistics in Microsoft Excel 2007®. Themes evolved from transcription of the narrative portion of the survey.

Results

The average age of the participants was 36 with a range from 26 to 51. All participants graduated from dental hygiene programs located in Maine. Graduation year ranged from 2001 to 2008. Three received an Associate of Science degree and the other 3 received a Bachelor of Science degree in dental hygiene. The participants had been practicing independently for an average of 2 years with

a range of 1 to 4 years. The primary populations being served were reported as: MaineCare, low income, uninsured and, in one case, residents of long-term care facilities. All the IPDH practices represented in this study were located in a rural setting. Of the participants, 3 used traditional fixed dental equipment, the others used mobile. Although the equipment was reported as mobile, 2 of the 3 participants who reported using mobile equipment used it in a fixed location. All participants were owners of their practice, and only 1 reported having employees.

Participants responded to 10 questions based on a 4 point Likert Scale. The response choices were 1=Strongly Disagree, 2=Somewhat Disagree, 3=Somewhat Agree, 4=Strongly Agree. The most common response was "Somewhat Disagree" and the least common response was "Strongly Agree."

The 10 Likert Scale questions can be grouped by topic including exposure to public health (questions 3, 5, 6, 7), exposure to alternative practice environments (questions 2, 9) and overall perceptions of preparedness for the participant's chosen career path (questions 1, 4, 8, 10). When comparing responses to the topics, the IPDHs reported the lowest level of satisfaction with the exposure to alternative practice settings they received in their education. Of the 3 topics, none received overall positive responses (Table I).

The first open-ended question of the survey was: "Please describe your educational experiences with alternative practice setting career opportunities." Two responded that extramural internships were an integral part of their educational exposure to alternative practice settings. Two reported their only exposure was in the classroom through discussion in public/community health courses. One participant described visits to local schools to perform screenings as alternative practice exposure. Four stated they received inadequate exposure to alternative practice settings during their education.

The second open-ended question was: "Please elaborate on your level of interest in public health careers during your education and, if appropriate, how your education impacted that level of interest." Most survey participants felt their education impacted their interest in public health minimally or none at all. Various reasons were given such as they did not have enough public health exposure in their education to make an impact, they already had decided on a career in private practice dental offices prior to entering dental hygiene school, or private practice was portrayed as more appealing. Although their exposure to public health was mini-

Table I: Respondents' Frequency of Agreement or Disagreement toward Survey Statements Question and the Topics for Each Question

Survey Questions	Question Topic	Strongly Disagree=1	Somewhat Disagree=2	Somewhat Agree=3	Strongly Agree=4
Q1. I am satisfied with the preparedness I received during my dental hygiene education program for my chosen career path	Overall preparedness for chosen career path	1	3	2	0
Q2. I feel as though I was given ample opportunity to learn, explore, and pique my curiosity about alternative dental hygiene careers during my dental hygiene education	Exposure to alternative practice settings	2	3	1	0
Q3. I felt as though my level of interest in public health careers was impacted in some way by my dental hygiene education program	Exposure to Public Health	1	1	4	0
Q4. I feel as though ALL skills necessary to my current practice choice were included in my education	Overall preparedness for chosen career path	2	2	1	1
Q5. Upon graduation I felt very well informed about how to make an impact on the underserved population I was interested in helping	Exposure to Public Health	1	3	2	0
Q6. My dental hygiene education program helped me identify and underserved population I was interested in helping	Exposure to Public Health	1	3	0	2
Q7. During my dental hygiene education, I was well informed and made aware of the unmet dental needs existing in my own state	Exposure to Public Health	2	0	2	2
Q8. I feel as though I gained adequate clinical experience in alternative practice environments to prepare me for my chosen career in dental hygiene during my dental hygiene education	Overall preparedness for chosen career path	1	3	1	1
Q9. My dental hygiene education exposed me to a variety of practice environments available to me as a dental hygienist	Exposure to alternative practice settings	2	2	0	2
Q10. My dental hygiene education prepared me well for practice environments outside of the private practice dental office	Overall preparedness for chosen career path	0	4	2	0

mal, 2 participants were greatly impacted because they were able to witness the needs of underserved patients being met. They felt witnessing a change they could make first hand, was much more life changing than reading it in a text ever could be. They both credited this as a key moment in defining their career choices.

The final open-ended question was: "Please explain what you feel would have been helpful in your dental hygiene education that could have better prepared you for your current career practice choice." Of the 6 participants, 4 stressed that business training should be added to dental hygiene education to prepare students for independent practice. They stated financial, legal, business plan

creation and marketing were areas of owning a business they wished they'd been better trained in. Two participants said communication skills should be a greater part of dental hygiene education programs. Interpersonal, interprofessional and dental team communication skills were noted as important components of a successful independent practice business. One participant specified that empathy and compassion training is necessary because in alternative settings a clinician is more likely to encounter difficult situations and being able to handle these with finesse would facilitate better patient care.

One respondent felt strongly that a better understanding of treatment and referral procedures was necessary for those dental hygienists practicing independently. When working alone, relying on other dental professionals in the office to help treatment plan, refer, and guide would not be an option. Therefore, having a good understanding of when to refer to a dentist for more treatment beyond the scope of the IPDH practice is necessary to optimize patient care.

Discussion

Dental hygiene practice possibilities have changed in Maine with the advent of IPDH. Students in Maine have this career option available to them; however, the participants in this survey suggest a lack of preparation from their current dental hygiene curriculum. The participants described their overall dissatisfaction with alternative career experiences during their dental hygiene education. While they did feel prepared by their basic dental hygiene program for traditional private practice, they did not feel well prepared for their chosen career path as IPDHs and were not given ample opportunity to explore alternative practice settings.

Maine does not require additional education prior to IPDH licensure; however, all participants agreed further training is necessary. Some states require training prior to alternative practice licensure, but for those who do not, where does the responsibility lie? ADEA and ADHA suggest dental hygiene programs evolve to meet the changing needs of the profession and this includes preparing students for all opportunities available to them as dental hygienists.

Better preparation could be accomplished by adding elective courses and experiences designed to educate, inspire and motivate the student interested in alternative dental hygiene practice. Additional courses should include business, communication, and additional training identifying needs

which are beyond the dental hygiene scope of practice for referrals, as well as increased exposure to alternative practice settings through extramural internship opportunities.

When discussing exposure to alternative practice settings, participants felt extramural internships/experiences, and exposure through public/community health class discussions were the most impactful experiences they engaged in during their education; yet this exposure was minimal. This study demonstrates an appreciation and desire by students interested in public health dental hygiene to have programs with curriculum that nurtures and grows the extramural internship experience. One participant suggested that extramural experiences should include a variety of populations and not be limited to children so the student may gain a broader understanding of the multitude of underserved populations.

Further suggestions for educational programs emerged during the open-ended questions. Although extramural internships were identified by respondents to create the most exposure to public health practice settings, exposure to public health settings could also be accomplished in the classroom. Students could research various underserved populations and ways to meet their needs. Once students have identified a population of interest, they could create a business plan that would prepare them for future career prospects. Speakers could be invited into the classroom to discuss their own personal experiences in alternative dental hygiene positions. This would bring reality and create human connection to alternative practice settings. This would differ from the traditional community health course by emphasizing the career opportunity aspect of alternative settings as opposed to the public health component.

Participants felt elective courses should be offered to students planning to practice independently. Shadowing various dentists and office management for one semester to gain better knowledge of all aspects of dentistry was suggested. If a dental hygiene school has connections with a dental school, there should be ample opportunity for dental and dental hygiene students to collaborate, integrate and learn from each other in a mutually beneficial classroom/clinical/long-term care or hospital setting.

A communications elective including skills for communicating with both other professionals and patients was also suggested. One participant described their job duties "in the field" as more communicative than clinical. It was reported that more

time is spent educating patients, caregivers and working with other health care professionals than providing clinical services. Therefore, having advanced communication training would be ideal.

Participants also felt elective coursework in business would greatly benefit those wishing to engage in entrepreneurial business ownership. This would also be an opportunity for interprofessional training by allowing dental hygiene students to participate in a business course which is geared toward the health care professional.

A limitation of this study was that recent graduates with the most current information about student education experiences are not eligible for IPDH licensure until acquiring a minimum of 2 years of dental hygiene experience. Another limitation was that only 6 practicing IPDHs graduated since 2000. Although they all agreed to participate, the number of responses was limited along with the opportunity for random selection. It should also be noted that 3 of the participants graduated prior to IPDH legislation passing in the State of Maine in May 2008.

Continued research using this survey can be used to expand the number of participants in Maine and extend to other states with alternative practice licensure. Expansion of the research is important as more relevant information will surface as IPDHs who graduated following the enactment of IPDH legislation are licensed. Additional research should be done to determine how current dental hygiene programs are meeting the changing needs of Maine's Dental Hygiene scope of practice.

Conclusion

This study demonstrated that participants did not feel the current level of dental hygiene educational programs fully prepared them for their career choice. Meeting the needs of students now

includes those students who will one day practice independently outside the private dental practice, or in alternative settings. The responsibility to prepare students for business ownership and independent practice may not lie entirely within the basic dental hygiene curriculum, but as the field of dental hygiene changes so dramatically, there is a responsibility for programs to adjust their methods to align with these emerging priorities. This study shall serve as the beginning of the conversation, not the complete answer, nor the end. It does not provide all the answers, but it does identify a deficit and begin to discuss the changes necessary to meet the needs of graduates.

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A Comparison of Dental Hygienists' Salaries to State Dental Supervision Levels

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Introduction

Dental hygiene supervision is defined as direct, general or direct access and determined by state practice act laws. Although different states allow a variety of procedures and possible limitations on dental hygiene services, the Academy of General Dentistry and the American Dental Hygienists' Association define direct supervision as "the dentist needs to be present to provide services," general supervision as "the dentist needs to authorize prior to services, but need not be present" and direct access as "the dental hygienist can provide services as he or she determines appropriate without specific authorization."^{1,2} The dental hygiene profession does not have common national standards regarding practice restrictions and the level of dental supervision that is required to provide dental care to patients professionally. Some states require direct supervision by a dentist, which mandates that a dentist is on the premises while dental hygiene preventive care is being provided. Some states require general supervision, which requires that the dentist authorize dental hygiene procedures. General supervision, however, is different for each state and varies depending on state practice act language. For instance, dental hygienists may be limited to a set number of days annually without dentist supervision. Thirty five states allow dental hygienists to practice under less restrictive supervision laws. Unsupervised dental hygiene care given in certain settings outside the dental office is termed direct access.³ To date, there are no studies that have examined if there is a difference in registered dental hygiene compensation or average salaries. Therefore, this study examined the 3 different levels of dental supervision that are required within the U.S.

Abstract

Purpose: The purpose of this study is to evaluate the effect of dental supervision on registered dental hygienists' salaries in the 50 states and District of Columbia by comparing the average dental hygiene salaries from the largest metropolitan city within each state from May 2011, the most recent valid data, in relation to the required level of dental supervision.

Methods: A retrospective contrasted-group quasi-experimental design analysis was conducted using the most current mean dental hygiene salaries for the largest metropolitan city within each state and the District of Columbia which was matched to the appropriate dental supervision level. In addition, a dental assisting salary control group was utilized and correlated to the appropriate dental hygienist salary in the same metropolitan city and state. Samples were obtained from the U.S. Department of Labor. A multivariate analysis of variance (MANOVA) statistical analysis was utilized to assess the relationship of the 5 levels of dentist supervision, with the registered dental hygienist salaries. The MANOVA analysis was also utilized to assess the control group, dental assistant salaries.

Results: No statistically significant results were found among the dental supervision levels on the measures of dental hygiene salaries and dental assistant salaries. Wilks's $\Lambda=0.81$, $F(8, 90)=1.29$, $p=0.26$. Analyses of variances (ANOVA) on the dependent variables were also conducted as follow-up tests to the MANOVA.

Conclusion: Study results suggest dental hygienists who are required to have a dentist on the premises to complete any dental treatment obtain similar salaries to those dental hygienists who are allowed to work in some settings unsupervised by a dentist. Therefore, dental supervision does not seem to have an impact on dental hygienists' salaries.

Keywords: dental hygiene salaries, supervision level, access to dental care, autonomy

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Identify, describe and explain mechanisms that promote access to oral health care, e.g., financial, physical, transportation.

Methods and Materials

This research study utilized a quasi-experimental design which used a contrast-group as a method to control internal validity.⁴ This design allows registered dental hygienists to be assigned as members of separate categorical groups (directly supervised, generally supervised and dental hygienists allowed

direct access to patients).⁴ The mean dental hygiene salaries for each metropolitan city and the District of Columbia were matched to the appropriate dental supervision level that is legal for its state. The dental assisting salary control groups were correlated to the appropriate dental hygiene salary in the same metropolitan city and state. Since data could not be randomly assigned, a quasi-experimental design was used which allows for the selection of random samples from the population which is how the samples were obtained by the U.S. Department of Labor (USDL).^{4,5}

In order to address the differences in the state levels of dental supervision for dental hygienists, additional categories of the independent variable were added to the study. The results of this addition lead to 5 independent variables, which are:⁶

- Direct Supervision
- Direct Supervision with some General Supervision procedures allowed
- General Supervision
- Direct Access with some General Supervision procedures required
- Direct Access

The supervision levels for a dental prophylaxis were placed in an ordinal scale according to the level of required dental supervision for dental hygienists as determined in each state dental practice act. Mean salaries were selected from a metropolitan city within each state and the District of Columbia in order to standardize the statistics since states can have a substantial variation in size, population and number of rural areas. In addition, mean dental assistant salaries from the same metropolitan city and the District of Columbia were used as a control group since different areas of the U.S. have different cost of living levels.⁷

Using SPSS software, a multivariate analysis of variance (MANOVA) procedure was used to assess the relationship of the independent variables, which are the 5 levels of dental hygiene supervision, with a dependent variable, the dental hygienists' salaries and the control group of dental assistants' salaries, by conducting between-subject analyses.⁸ In order to reduce the possibility of variable errors, the research design included a parallel-forms technique that ensured that the data was entered correctly which was completed by performing the test twice on the same variables and correlating the results to ensure accuracy.⁴

The sample of May 2011 registered dental hygienists' and dental assistants' wages were obtained through the USDL State Occupational Employment

and Wage Estimates (OES) website.⁹ The state metropolitan cities used for each sample were located and obtained from the USDL website based on population size in order to obtain similar-sized cities for the study. The level of required dental hygiene supervision for each sample state was obtained from 2 charts developed by the American Dental Hygienists' Association and the Academy of General Dentistry.^{1,2} The USDL biannually mails the OES survey to sampled employers, which measures employment and wage rates every 6 months in May and November.⁹ The OES survey is funded by the Bureau of Labor Statistics (BLS), which also provides the procedures and technical support, while the State Workforce Agency collects most of the data.⁹ Each OES survey estimates are based on responses from the previous 6 semiannual surveys that are collected over a 3 year timeframe. The overall national response rate for the 6 semiannual surveys is 73.3% for employment and wages.⁹

The OES survey obtained its sampling from state unemployment insurance files for the USDL State OES.⁹ The OES survey sample is stratified by metropolitan and non-metropolitan areas, industries, and size.⁹ According to the USDL, larger employers and establishments are more likely to be selected for participation in the survey than smaller employers and establishments.⁹ However, in the field of dentistry, quota sampling is not a validity factor, since 176,670 (96%) of all dental hygienists and 296,810 (92%) of all dental assistants in the U.S. are employed by a self-employed dentist in a dental office.⁹

OES receives wage data in 12 intervals for each occupation. Sampled employers are asked to report the number of employees paid within a specific wage interval by both hourly rates and the corresponding annual rates.⁹ The annual rate is calculated by multiplying the hourly wage rate by 2,080 hours.⁹ The 6 survey sample that is obtained for each occupation allows for the production of estimates at detailed levels of occupation and location. Significant reductions in sampling errors are obtained by combining the 6 surveys of data for each occupation by updating the 5 previous surveys to the current survey's reference period according to the average movement of its broader occupational division.⁹

There is approximately a 20% non-response rate to the OES survey every 6 months.⁹ Non-responses can be attributed to people who are ill, those "not found" (which can include people who have moved or who are inaccessible) and "refusals" (which include people who refuse to cooperate or answer the survey).⁹ Therefore, a "nearest neighbor" imputation procedure is used to credit missing occupational employment totals and a variant of mean

Table I: Mean Dental Hygienist Salaries in May 2011 and State Dental Supervision Levels for a Dental Hygiene Prophylaxis (Part I)

Metropolitan City, State	Employment Size of Dental Hygienists	Dental Hygienists Mean Salary	Supervision Level for Prophylaxis
Birmingham, Alabama	840	44,410	D
Anchorage, Alaska	210	84,300	G/A
Phoenix, Arizona	2,200	80,470	G/A
Little Rock, Arkansas	360	59,650	G/A
Los Angeles, California	4,280	93,130	G/A
Denver, Colorado	1,940	77,660	A
Hartford, Connecticut	940	77,090	G/A
Dover, Delaware	100	70,170	G
District of Columbia	2,700	90,500	G
Miami, Florida	1,150	49,660	G/A
Atlanta, Georgia	2,830	70,020	D
Honolulu, Hawaii	770	66,500	D/G
Boise, Idaho	630	68,420	G
Chicago, Illinois	5,620	62,250	G
Indianapolis, Indiana	1,040	71,350	D/G
Des Moines, Iowa	450	67,300	G/A
Wichita, Kansas	370	64,350	G/A
Louisville, Kentucky	540	59,340	G/A
Baton Rouge, Louisiana	320	52,150	D/G
Portland, Maine	440	74,260	G/A
Baltimore, Maryland	1,200	73,940	G
Boston, Massachusetts	4,310	78,510	G/A
Detroit, Michigan	1,120	65,810	G/A
Minneapolis, Minnesota	2,820	72,480	G/A
Jackson, Mississippi	230	47,910	D
Saint Louis, Missouri	1,630	70,870	G/A

Note: Table I adapted from USDL⁵ and American Dental Hygienists' Association.²

imputation is completed to credit missing wage distributions.⁹ The sampled employers are weighted to represent all employers of an occupation for each survey period. Weights are additionally adjusted by the ratio of employment totals from the BLS Quarterly Census of Employment and Wages to OES survey employment totals by the USDL.⁹

This study examined the dental hygiene and dental assistant salaries from a metropolitan city within all 50 states and the District of Columbia from this collected USDL data. Each sample of dental hygienists and dental assistants consisted of a sample larger than 30 participants to ensure validity. The smallest sample size of dental hygienists and dental assistants were both in Cheyenne, Wyoming with a sample size of 80 dental hygienists and a sample

size of 110 dental assistants (Table I).⁷ The number of states with Direct Supervision had 3 samples, the Direct/General Supervision had 5 samples and the Direct Access Supervision sample size contained 1 sample. These small sample sizes could have affected the statistical test results. A MANOVA was conducted to determine the effect of dental supervision on the 2 dependent variables, the dental hygienists' and dental assistants' salaries for 50 metropolitan cities within each state and the District of Columbia.

Results

With a 97.5% confidence level, non-significant differences were found among the dental supervision levels on the 2 dependent measures, dental hygienists' and dental assistants' salaries, Wilks's

Table I: Mean Dental Hygienist Salaries in May 2011 and State Dental Supervision Levels for a Dental Hygiene Prophylaxis (Part II)

Metropolitan City, State	Employment Size of Dental Hygienists	Dental Hygienists Mean Salary	Supervision Level for Prophylaxis
Billings, Montana	200	68,930	G/A
Omaha, Nebraska	380	68,280	G/A
Las Vegas, Nevada	850	87,110	G/A
Manchester, New Hampshire	110	76,850	G/A
Newark, New Jersey	1,180	82,410	D/G
Albuquerque, New Mexico	510	73,560	G/A
Buffalo, New York	1,120	51,450	G
Charlotte, North Carolina	1,340	68,320	D/G
Fargo, North Dakota	240	50,330	G
Cincinnati, Ohio	1,380	64,900	G/A
Oklahoma City, Oklahoma	650	58,400	G
Portland, Oregon	1,970	80,760	G/A
Pittsburgh, Pennsylvania	1,840	52,660	G/A
Providence, Rhode Island	1,100	72,470	G/A
Columbia, South Carolina	460	57,170	G
Sioux Falls, South Dakota	140	58,730	G
Memphis, Tennessee	620	63,260	G
Dallas, Texas	2,910	74,530	G/A
Salt Lake City, Utah	950	67,800	G
Burlington, Vermont	150	71,540	G/A
Virginia Beach, Virginia	930	73,310	G/A
Seattle, Washington	2,660	94,000	G/A
Charleston, West Virginia	230	52,720	G/A
Milwaukee, Wisconsin	1,300	60,550	G/A
Cheyenne, Wyoming	80	67,160	G

Note: Table I adapted from USDL⁵ and American Dental Hygienists' Association.²

$\Lambda=0.81$, $F(8,90)=1.29$, $p=0.26$. Analyses of variances (ANOVA) on the dependent variables were conducted as follow-up tests to the MANOVA. Using the Dunnett-Bonferroni methods, each ANOVA was tested at the 0.025 level. Post hoc tests did not show a significant difference between the dental hygienists' salaries or the dental assistants' salaries with $p>0.05$. Table II shows that the mean dental hygienists' salary increased and decreased correspondingly to the control group of dental assistant salary means.

Discussion

These study results show that as dental hygienists' mean salary increased and decreased, the control group (dental assistants' mean salary)

also increased and decreased. Although the mean salaries for dental hygienists increased as the level of dental supervision decreased, it appears to be associated with the cost of living since the control group's mean salaries for dental assistants raised and lowered at a similar percentage rate (Table II).

Employment is defined by the USDL as the number of workers who can be classified as full-time or part-time employees, including workers on paid vacation or any other type of paid leave.⁹ In 2010, approximately 38% of dental hygienists worked full time.⁵ According to the USDL, there were approximately 184,110 dental hygienists employed in the U.S. in May 2012, with the majority of them working in metropolitan areas.⁵ A distinctive fea-

Table II: SPSS Mean Comparisons

Supervision Level	Number of States with Supervision Level	Average Dental Hygiene Salaries (Difference from Previous Level)	Average Dental Assistant Salaries (Control Group) (Difference from Previous Level)
Direct	3	\$54,113 (N/A)	\$32,493 (N/A)
Direct/General	5	\$68,146 (+1.28%)	\$35,124 (+1.08%)
General	13	\$64,583 (-0.95%)	\$33,349 (-0.95%)
General/Access	28	\$71,360 (+1.10%)	\$35,468 (+1.06%)
Direct Access	1	\$77,660 (+1.09%)	\$40,580 (+1.14%)

ture of dental hygiene employment is a flexible schedule. More than one-half of all dental hygienists work part time for only a few days a week and many dental hygienists work for more than one dentist weekly.⁵

When trying to determine a cause-and-effect relationship between dental hygienists' salaries and supervision levels, many other factors need to be taken into consideration. For example, recent legislation expanding the role of dental hygienists in several states may be increasing dental hygiene salaries in these areas. In addition, there has been a pronounced geographic shift in the American population with southern and western states increasing in population and the number of oral health personnel which may be increasing the health care salaries in these areas.¹⁰ There has also been a recent increase in the number of mobile and teledentistry services brought to areas where there is a need for dental services in underserved areas in recent years which may also be affecting dental hygiene salaries.¹¹ These factors may be causing a higher demand for registered dental hygienists which can be increasing salaries.¹¹ Similarly, a study in 1991 involving registered nurses showed that increasing wages increased the supply of individuals who were available in the labor market.¹¹ However, many dental hygienists are now choosing to work part-time.⁵ And with dental hygiene being predominantly a female profession similar to nursing, the presence of children may be decreasing the probability of working full-time as a registered dental hygienist.¹¹ All of these factors need to be taken into consideration when looking at the relationship between dental hygiene salaries, the level of dental supervision, and the mean differences that were

assessed for analysis rather than a correlation analysis.

The relationship between salaries and supervision levels cannot be expressed by a universal law because not every case of a change in dental supervision level will bring about a change in dental hygiene salary level.⁴ These study results can only suggest that there is a high probability that a large percentage of cases investigated led to these results because they are derived from probabilistic generalizations.⁴ The major limitation of probabilistic generalizations is that conclusions about specific cases cannot be drawn with complete certainty.⁴ Therefore, these results will only provide probabilistic generalizations and there are other aspects of dental supervision levels for dental hygienists that are more important such as access to preventive dental care for the poor and underserved populations within the U.S. that are not addressed in this study.⁴

Conclusion

This study suggests that there is no significant difference between compensation salaries between dental hygienists who work under direct supervision, general supervision or direct access state practice acts. Practical contributions for this study include a tentative empirical generalization that will need to be further investigated by future studies. This study may be of interest to dental personnel and lawmakers in the U.S. who are concerned in how dental supervision levels may affect dental hygienist compensation salaries.

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Comparison of Corded and Cordless Handpieces on Forearm Muscle Activity, Procedure Time and Ease of Use during Simulated Tooth Polishing

Gayle McCombs RDH, MS; Daniel M. Russell, PhD

Introduction

Musculoskeletal disorders (MSD) are a significant problem for the dental profession.^{1,2} A high prevalence (64 to 96%) of dental professionals report having musculoskeletal pain or discomfort in a 12 month period, indicating that much of these MSD are work related.³⁻⁷ General practice dentists commonly experience pain in the back (35 to 60%), wrists and hands (34 to 54%), neck (20 to 57%) and shoulders (21 to 53%).⁸⁻¹¹ Dental hygienists often demonstrate higher prevalence for these same regions: wrists and hands (64 to 70%), shoulder (60 to 68%), neck (54 to 69%) and back (24 to 67%).^{4,6,8} Variation in these reported rates between studies may result from different data collection techniques or different occupational responsibilities around the world.^{1,2} Of particular focus is the finding of a high prevalence of pain in the wrists and hands of dental hygienists. Previous research has revealed that dental hygienists have one of the greatest risks of developing the MSD carpal tunnel syndrome (CTS) compared with other professions,¹² with 7 to 8.4% receiving the clinical diagnosis of CTS and 44.2% displaying at least one symptom of CTS.^{4,13,14} Evidence shows that CTS and other MSD cause significant impact on dental hygienists and may lead to reduced productivity or performance, or even to decreased working hours and change of profession.^{5,13}

The incidence and location of pain match findings of a recent study which recorded significant physical workload in the neck, shoulders and wrists/hands of dental hygienists performing their regular duties.¹⁵

Abstract

Purpose: Dental professionals suffer from a high prevalence of work-related musculoskeletal disorders (MSD). Dental hygienists in particular have a high prevalence of pain in the forearms and hands. The objective of this study was to compare 1 cordless handpiece to 2 corded handpieces during simulated tooth polishing in terms of the muscle loads (recorded as electromyography (EMG) activity), duration of polishing procedure, and dental hygienist opinion about ease of use.

Methods: EMG was used to quantify muscle electrical activity of 4 forearm muscles during simulated dental polishing with 2 corded handpieces (HP-A and HP-B) and 1 cordless handpiece (HP-C). A convenience sample of 30 dental hygienists (23 to 57 years of age) with 1 to 20+ years of clinical practice experience completed the study. Each participant spent approximately 5 minutes polishing 3 predetermined teeth in each of the 4 quadrants. The sequence of the handpieces was randomly assigned. At the end of the study, participants completed a subjective end user evaluation of handpiece preference.

Results: Muscle activity levels of 10th, 50th and 90th percentiles did not differ significantly between the 3 handpieces tested ($p > 0.05$). However, total muscle workload (integrated EMG) was lowest for the cordless handpiece (HP-C), but this was only significantly less than HP-A ($p < 0.05$). Polishing using the cordless handpiece (HP-C) (M=257 seconds, SD=112 seconds) took significantly less time than either the HP-A corded (M=290 seconds, SD=137 seconds) or HP-B corded handpiece (M=290 seconds, SD=126 seconds) ($p < 0.05$). Overall, 50% of the study participants preferred the cordless handpiece, 37% preferred HP-A and 13% preferred HP-B ($p < 0.05$).

Conclusion: Use of the cordless handpiece reduced the duration of polishing, which in turn led to less total muscle activity, but not muscle intensity. Overall, dental hygienists preferred the cordless handpiece.

Keywords: ergonomics, cordless handpiece, musculoskeletal disorders, MSD, EMG

This study supports the NDHRA priority area, **Occupational Health and Safety:** Investigate the impact of exposure to environmental stressors on the health of the dental hygienist (aerosols, chemicals, latex, nitrous oxide, handpiece/instrument noise).

Holding instruments at a patient's mouth and far from the dental hygienist's own body places large force moments at the shoulders, while leaning the head or torso away from a neutral position increas-

es force moments at the neck and back, respectively. These force moments can be minimized by appropriate body postures. However, the repetitive procedures of hand scaling and tooth polishing for approximately 21 minutes of an average 50 minute appointment places a large load on the muscles and tendons of the wrists and hands.¹⁶ Precise movements require dental hygienists to hold body positions and accurately control the location and force application of different instruments. Ergonomic design improvements to instruments hold the promise of reducing the workload on wrist and hands, but research is needed to determine whether dental instruments achieve these goals.

Currently, the most accurate technique to quantify muscle workload of operating a dental instrument is to record the electrical activity of muscles through electromyography (EMG).^{15,17} Electrodes placed on the surface of the skin over the belly of a muscle detect a summation of the action potentials (small voltages produced when muscles are activated). The greater the voltage the more the underlying muscle is being activated to generate force. Intensity, duration and frequency of activity are all important considerations for the potential development of MSD.¹⁷ Recording EMG during a procedure allows the intensity of muscle workload to be determined and the duration can also be readily measured. The total muscle activity is determined by intensity x duration. By quantifying and comparing the intensity and duration of electrical activity between dental tools with different design characteristics, researchers can determine which instruments cause the greatest or lowest muscle load. Frequency of a procedure would be expected to remain constant. Researchers have begun to determine the relevant ergonomic factors in dental instruments by using EMG to measure activity of muscles in the forearm which control movements at the wrist, fingers and thumb.¹⁸ Research has revealed that mirrors, which are lightweight and have soft and wider diameter handles, reduce muscle loads.¹⁹ Scaling instruments with a handle diameter of at least 10 mm, a mass of 15 g or possibly less, and a round and tapered shape lead to the lowest activity of muscles of the forearm.^{20,21} However, there is still much research and development of equipment needed to provide optimum instruments to minimize work related MSD in the dental profession.

One ergonomic concern is with the use of handpieces that require hoses or cords. Hoses or cords add weight to an instrument. They also create cord drag where additional resistance to motion is likely to increase muscle workloads. While development of the swivel hose mechanism has greatly improved handpiece ergonomics, the ideal handpiece would

have the ability to easily rotate and move effortlessly while performing the intended function. Recent technological advances have allowed for the development of cordless handpieces. Therefore, the objective of this study was to compare 1 cordless handpiece to 2 corded handpieces during simulated tooth polishing in terms of the muscle loads (recorded as EMG activity), time involved to complete standard procedures and dental hygienist opinion about ease of use. Studies such as this provide a scientific approach to determining which ergonomic factors reduce muscle loads and have the potential for reducing the incidence of work related MSD in the dental profession.

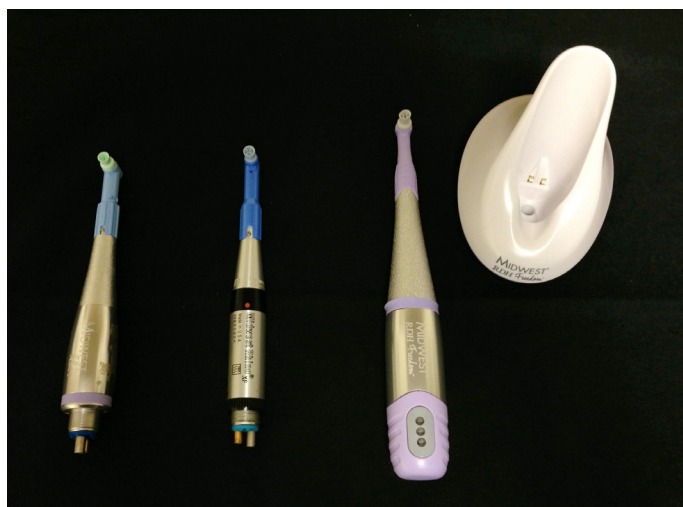
Methods and Materials

Practicing dental hygienists (n=30) of varying ages and length of employment participated in an institutional review board approved controlled clinical trial. Participants were recruited by distribution of an invitation letter sent to licensed dental hygienists in the Hampton Roads region. An initial phone screening of interested individuals was conducted to determine eligibility. In order to control for certain limitations, individuals with a dominant left hand were excluded, as well as individuals with history of surgery, injury or disability of the working hand, wrist, forearm or shoulder, or diagnosis of CTS. Strenuous arm muscle activity such as tennis and chopping wood were prohibited for 2 days prior to data collection to control for muscle strains. No attempt was made to control for variations in forearm muscle size among participants. Each participant served as their own control. Data was collected in one visit (lasting approximately 45 minutes) at the Dental Hygiene Research Center on the campus of Old Dominion University.

In a simulated oral polishing setting, 3 low speed handpieces were evaluated on forearm muscle activity that reflected load or force on the lower portion of the arm and hand. The handpieces tested were as follows: HP-A (corded), HP-B (corded) and HP-C (cordless) (Figure 1). The model names, handpiece masses and grip diameters are presented in Table I.

After informed consent was obtained and EMG equipment was connected, each individual polished selected teeth using all 3 handpieces, in the order determined through simple randomization. Dental chair-mounted typodonts (Kilgore International, Inc) equipped with an artificial face were used to simulate the oral cavity (Figure 2). For each handpiece a typodont, dpa and prophylaxis paste was provided. Each typodont had artificial brown stain placed on the facial and lingual surfaces of 3 predetermined teeth in each quadrant (3, 4, 7, 11, 12, 15, 19, 20,

Figure 1: Experimental Handpieces



From left to right: Corded HP-A; Corded HP-B; Cordless HP-C (Dentsply, International, York, Penn.)

Figure 2: Simulated Polishing Set Up



Pictured: Mannequin, typodont and participant with EMG electrodes attached to skin over 4 muscle sites for recording electrical activity of muscles.

Table I: Handpiece Specifications

Handpiece Code	Model Name	Corded/Cordless	Mass (g)	Diameter (mm)
HP-A	Midwest Rhino	Corded	81 (90° attachment)	22.7
HP-B	Midwest RDH	Corded	77 (motor only)	23.3
HP-C	Cordless RDH	Cordless	114	27.8

Data supplied by Dentsply, International, York, Penn.

24, 25, 29, 30). This experimental set-up provided a simulated polishing experience in all areas of the mouth and maintained consistency across the handpieces tested.

Prior to study initiation, participants were familiarized with both the EMG and polishing equipment. To standardize polishing procedures, participants were provided with written and oral instructions for neutral body positioning and were instructed to polish all surfaces of assigned teeth utilizing their normal polishing procedures, thus applying typical pressure and techniques. Each individual spent approximately 5 minutes polishing with each handpiece, although no time limits were placed on participants. To minimize the effects of fatigue, participants were allowed to rest for 1 to 2 minutes in between polishing sequences.

At the completion of the polishing sessions, participants completed an evaluation of handpiece diameter grip, balance, maneuverability, weight and noise level, utilizing a 5-point Likert scale (not comfortable to very comfortable), as well as responded to 5 opened ended questions related to handpiece preference.

EMG Procedure

EMG was used to record the electrical activity of 4 muscles (Figure 2) involved in high pinch forces and studied in previous dental research: flexor digitorum superficialis, flexor pollicis longus, extensor digitorum communis and extensor carpi radialis brevis.^{20,21} Participants washed their right forearm with regular soap and warm water to remove skin oils and lotions. The location for placement of the electrodes was determined using standard procedures and then these areas were wiped with alcohol and allowed to dry.²² Noraxon dual Ag/AgCl snap electrodes (Scottsdale, AZ), with 1 cm active areas and 2 cm inter-electrode distance, were placed over the belly of each muscle in parallel with the direction of the muscle fibers. A ground electrode was placed on the lateral epicondyle of the right arm. The action potentials produced by the muscles create voltages across the surface electrodes which flow along cables to a telemetry unit which then transmits the signal at 1,500 Hz to a Noraxon TeleMyo 2400T G2 wireless data acquisition system (Scottsdale, AZ). The location of the electrodes was checked with muscle function tests and changes were made if necessary. The electrodes and cables between the electrodes

Table II: Group Mean and Standard Deviations for 10th, 50th and 90th Percentile Levels of Activity for the Flexor Digitorum Superficialis, Flexor Pollicis Longus, Extensor Digitorum Communis and Extensor Carpi Radialis Brevis Muscles During Polishing With 3 Types of Handpiece

Muscle	10th percentile			50th percentile			90th percentile		
	HP-A	HP-B	HP-C	HP-A	HP-B	HP-C	HP-A	HP-B	HP-C
Flexor digitorum superficialis	7±5	7±5	7±5	13±8	13±8	13±8	25±17	24±17	24±15
Flexor pollicis longus	12±6	11±6	11±6	20±10	19±9	20±9	32±17	32±19	32±16
Extensor digitorum communis	10±4	10±3	10±4	17±5	17±5	17±6	27±8	26±8	27±8
Extensor carpi radialis brevis	9±5	9±4	9±5	15±7	15±7	15±8	24±13	23±12	24±12

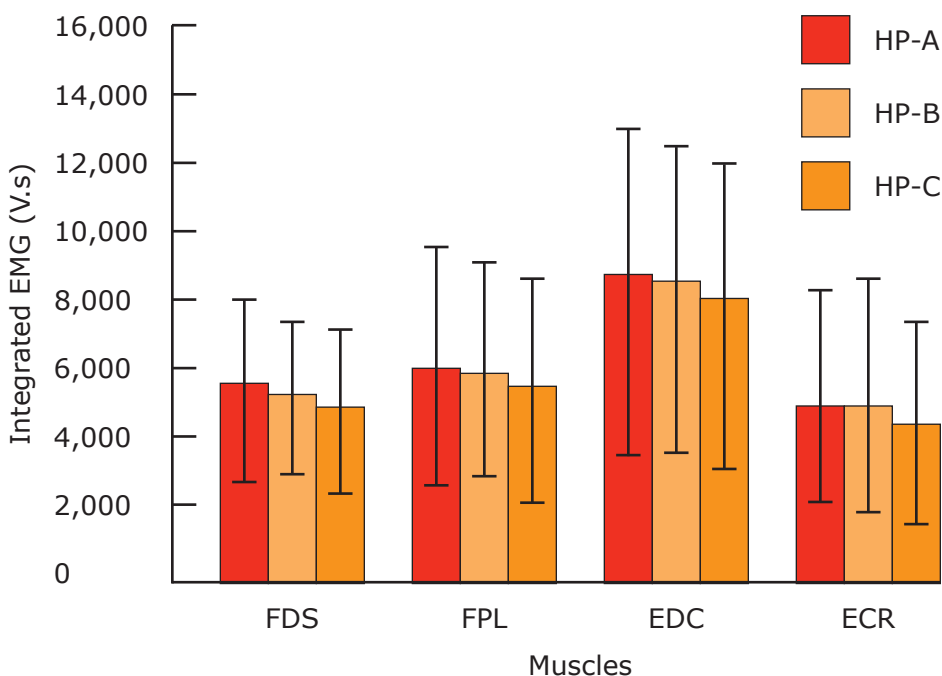
Values represent percentage of maximum voluntary isometric contraction. No significant differences were found in muscle activation between the 3 handpieces ($p>0.05$).

and telemetry unit were fastened down with non-allergenic tape to avoid movement artifact. Once the EMG equipment was set up correctly, participants performed maximum voluntary isometric contractions for each muscle separately, which were recorded for 3 seconds each. For each handpiece, EMG was recorded from the beginning to the end of polishing. The time of the EMG record was the trial duration. The raw EMG signals were rectified and filtered using a second order Butterworth filter with 10 Hz high pass cutoff frequency. The EMG was integrated (area under the voltage-time curve) to obtain a measure of total muscle activity across a polishing trial. Data from the polishing trials was also normalized by determining its percentage of maximum voluntary isometric contractions before determining the 10th, 50th and 90th percentile of the EMG signal for each of the 3 handpiece trials.

Data Analysis

EMG measures, trial duration and quantitative survey responses were entered into SPSS 19. EMG measures and trial duration were analyzed using repeated measures multivariate analysis of variance (RMANOVA) with 3 levels of handpiece. Planned simple contrasts compared the cordless handpiece with 2 corded handpieces. A chi-square test was employed to detect significant differences in preference between the handpieces. Survey ratings for handpiece properties of diameter, balance, maneuverability and weight were compared between the cordless and the corded handpieces using Wilcoxon

Figure 3: Integrated EMG (Means and Standard Deviation Error Bars) of the 4 Muscle Sites for Polishing With the 3 Different Handpieces (Corded HP-A, HP-B and Cordless HP-C)



Integrated EMG is the area under the rectified voltage-time (V.s) curve, which quantifies total muscle activity. The 4 muscles are: flexor digitorum superficialis, flexor pollicis longus, extensor digitorum communis and extensor carpi radialis brevis. The cordless handpiece (HP-C) resulted in significantly lower integrated EMG for the flexor digitorum superficialis, extensor digitorum communis and extensor carpi radialis brevis muscles ($p<0.05$).

signed-rank tests. The level of significance was set at $p<0.05$. Open ended questions in the survey were tabulated by recording the frequency of occurrence across the participants.

Results

Thirty female subjects between the ages of 23 to 57 years, with a mean age of 37.7 years, completed the study. All participants were employed at least 3 full days per week and had clinical practice experience between 1 to 20+ years: 1 to 5 years (30%),

Table III: Mean and Standard Deviation of Survey Handpiece Comfort Ratings for Grip Diameter, Balance, Maneuverability and Weight

Handpiece Characteristic	HP-A (corded)	HP-B (corded)	HP-C (cordless)
Grip diameter	3.7±1.0	4.2±0.7	3.8±0.9
Balance	3.1±1.1	4.0±0.7	3.6±1.1
Maneuverability	3.4±1.1	4.1±0.8	4.0±0.9
Weight	2.9±1.1	3.7±0.9	3.9±1.3

Ratings are on a scale of 1=not comfortable to 5=very comfortable. No significant differences between handpieces were observed for grip diameter, balance and maneuverability ($p>0.05$). Weight of the HP-C was rated as significantly more comfortable than HP-A ($p<0.05$).

Table IV: Results from Question 3 of the Survey - What Would You Change about Preferred Handpiece?

Handpiece Feature	HP-A (corded)	HP-B (corded)	HP-C (cordless)
Weight/balance	4	1	2
Maneuverability (lack of swivel head)	-	-	3
Speed	-	-	2
Noise	5	1	-
Diameter/grip	2	-	4
Cord	2	1	-

Values indicate the number of responses from participants.

Table V: Results from Question 2 of the Survey - What Did You like Most about Your Preferred Handpiece

Handpiece Feature	HP-A (corded)	HP-B (corded)	HP-C (cordless)
Weight/balance	5	2	6
Maneuverability	4	2	3
Speed	1	2	1
Quiet	-	-	5
Diameter/grip	5	2	1
Swivel head	2	-	-
Cordless HP	-	-	11
Cordless rheostat	-	-	1

Values indicate the number of responses from participants.

6 to 10 years (33%), 11 to 15 years (17%) and 16+ years (20%). Twenty-nine participants reported that they routinely conducted full-mouth polishing, while 1 respondent reported that selective polishing was provided.

Muscle activity levels (10th, 50th and 90th percentiles) did not vary significantly between the 3 handpieces for any of the muscles tested ($p>0.05$) (Table II). Mean total activity (integrated EMG) of the flexor digitorum superficialis, flexor pollicis longus, exten-

sor digitorum communis and extensor carpi radialis brevis muscles were lower for the cordless than the corded handpieces (Figure 3). RMANOVA indicated significant effects for the flexor digitorum superficialis and extensor digitorum communis muscles ($p<0.05$), but not the flexor pollicis longus ($p=0.18$) and extensor carpi radialis brevis ($p=0.08$) muscles. Simple planned contrasts revealed that the cordless handpiece led to significantly less total activity than the corded HP-A for the flexor digitorum superficialis, extensor digitorum communis and extensor carpi

radialis brevis muscles ($p < 0.05$), but not the flexor pollicis longus ($p = 0.06$). The effect of order was assessed using RMANOVA and Bonferroni post hoc tests. Only the extensor digitorum communis muscle revealed a significant order effect, with the third procedure employing greater 50th percentile activation than the second trial ($p < 0.05$).

On average, polishing using the cordless (HP-C) handpiece ($M = 257$ seconds, $SD = 112$ seconds) took over 30 seconds less time than with either the HP-A corded ($M = 290$ seconds, $SD = 137$ seconds) or HP-B corded ($M = 290$ seconds, $SD = 126$ seconds) handpieces. The RMANOVA revealed a significant effect of handpiece on polishing duration ($p < 0.05$) and simple planned contrasts revealed that using the cordless handpiece led to statistically significantly shorter polishing times than the 2 corded handpieces ($p < 0.05$). There were no significant differences in duration based on the order the handpieces were used ($p > 0.05$).

Handpiece Design and Preference

A chi-square analysis revealed significant differences ($p < 0.05$) in overall handpiece preferences with 50% ($n = 15$) of the study participants preferring the cordless handpiece (HP-C), 37% ($n = 11$) preferring the corded HP-A and 13% ($n = 5$) preferring the corded HP-B. The survey ratings for diameter, balance and maneuverability were not significantly different between the cordless and corded handpieces ($p > 0.05$) (Table III). However, the weight of the cordless HP-C was rated as significantly more comfortable than the HP-A ($p < 0.05$) (Table III). When participants were asked what they would change about their preferred handpiece, weight/balance, noise level, diameter/grip and cord were cited as common factors (Table IV). Table V reveals that respondents liked the cordless handpiece because it lacked a cord and also because it was light weight, balanced and quiet. Fifty-seven percent felt the cordless handpiece produced sufficient power throughout the procedures. Subjective comments by the dental hygienists emphasized the freedom of movement, lack of cord resistance, lightweight and low noise level of the cordless handpiece as important factors in determining their preferred experimental handpiece.

Discussion

Dental professionals have a high rate of MSD.¹⁻⁷ Dental hygienists are especially susceptible to pain in the wrists and hands.^{4,6,8} While ergonomically appropriate postures can minimize force moments on the body, the nature of performing repetitive movements, such as hand scaling and polishing, places high workloads on the muscles and tendons of the

forearms and hands. Ergonomically designed instruments offer the possibility of reducing the workload and minimizing the risk of developing work related MSD. Workload on the muscles can be quantified through recording the electrical activity of muscles (EMG).^{15,17} EMG research studies have only just begun to determine the characteristics of dental instruments that minimize muscle workload.^{20,21} For the first time, this study examined whether a cordless handpiece, which in principal could reduce the effects of cord pull, reduces intensity and duration of muscle activity of the forearm and hand during dental polishing compared with two standard, corded handpieces.

Polishing teeth with the cordless handpiece reduced the duration, but not the intensity of the muscular workload compared with the 2 corded handpieces. The EMG intensity distribution remained the same across handpieces as revealed by no significant changes to the 10th, 50th or 90th percentile levels of muscle activity. However, using the cordless handpiece reduced the integrated EMG of 3 out of 4 muscles, that is the total work (intensity x duration). These findings can be explained by the, on average, 30 second reduction in polishing time when using the cordless handpiece (HP-C) compared with the 2 corded handpieces (HP-A and HP-B). This difference in time cannot be readily explained by worse polishing performance. It is important to realize that 30 seconds is 20% of the average polishing time for only 12 teeth, hence a larger reduction in duration would be expected for polishing all the teeth, which most dental hygienists tested reported they do. Intensity, duration and frequency of activity are all important factors in the development of MSD.¹⁷ This research reveals that the cordless handpiece impacts the workload dose by decreasing duration, but not intensity of muscle activity, and would not change frequency. Unfortunately, the development of MSD is multi-factorial and varies greatly across individuals, therefore we cannot definitively state the workload dose that avoids MSD.^{15,17} Clearly, there is a need for future research to establish safe workloads and clinically meaningful changes in workload dose. Until these factors are determined it remains important to find ways to reduce workload during activities that have a high incidence of MSD.

The cordless handpiece was preferred most (50%) by the dental hygienists in spite of the fact that the participants were more familiar with the other handpieces and none had any prior experience with the new cordless handpiece. The lack of a cord, weight and balance, and low noise were listed as the main reasons for preferring the HP-C handpiece. While the other handpieces are lighter than the cordless, the hose adds to the weight and can impact the balance of the device. The larger diameter of the cordless

handpiece to the corded handpieces is unlikely to be the cause of reduced total muscle activity, although some dental hygienists did prefer the larger diameter. All handpieces tested here had diameters greater than the criterion of 10 mm, found to minimize muscle activity during a previous EMG study of scaling instruments,^{20,21} and handpiece diameter would be expected to influence muscle activity levels not necessarily the polishing time. Dental hygienists like using a polishing device without a cord, which appears to translate to shorter polishing duration, but not lower muscle intensity.

This study was the first to examine whether a cordless handpiece influenced muscle activity, polishing duration and dental hygienist opinion compared with corded handpieces. There are several limitations that impact the applicability of this research. The 3 handpieces were provided by one company and varied on several characteristics in addition to how they were powered. Future research could examine a broader range of handpieces to separately analyze different device properties. Dental hygienists were recruited using a convenience sample, rather than being randomly sampled from the population. There is also a need to develop a valid questionnaire for assessing dental professionals' opinions of dental equipment. Further research is needed to identify the workload dose and individual characteristics that lead to MSD in dental hygienists.

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Conclusion

Within the limitations of the current study, the cordless handpiece did not influence muscle intensity ($p>0.05$), but decreased the overall muscle workload ($p<0.05$) by reducing polishing duration ($p<0.05$). The cordless handpiece was preferred over the corded handpieces by the dental hygienists who participated in the study ($p<0.05$). Future research is needed to determine whether these changes impact the development of MSD.

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Exploration of Critical Thinking in Dental Hygiene Education

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Introduction

Twenty-first century health care is dynamic and challenging. On a daily basis, health care professionals make decisions which require calculated and structured thought, incorporating the use of critical thinking skills.¹⁻³ As health care evolves to include even more complex patient treatment options, increased pharmaceuticals and a diverse population, so should the manner in which professionals are taught in educational programs. Indeed, the Institute of Medicine has concluded that all health care professionals should be educated to deliver patient-centered care as members of an interdisciplinary team, emphasizing evidence based practice utilizing critical thinking skills, quality improvement approaches, and information.²

Historically, educational programs for health professionals, including the dental profession, have taught students by lecture and rote memorization with the goal to pass the national and state licensure exams.⁴⁻⁶ As indicated by numerous researchers in dental education, dental programs often have overcrowded curricula which are locked into a specific time frame, contain redundant or marginally useful information, and do not allow for unique educational experiences to develop critical thinking skills.⁴⁻¹¹ Dental education reform and curricular change has been needed to educate students using the best teaching methods currently available. This has led to the rethinking of practices in post-secondary preparation programs for dental hygiene, along with a number of other professional preparation programs in health and dental care.^{5,12}

Abundant literature also substantiates the need for inclusion of critical thinking skills in educa-

Abstract

Purpose: This qualitative study explores the perceptions of dental hygiene faculty regarding issues surrounding critical thinking skills integration within their associate degree dental hygiene programs.

Methods: Twenty faculty participated in the study, as drawn from 11 accredited associate degree dental hygiene programs in one Mid-west state. Multiple sources of data were collected, including email questionnaires, individual follow-up phone interviews and artifacts. Interpretive analysis was conducted.

Results: Data analysis revealed that faculty generally understood critical thinking, but interpretations varied. Most do not use varied teaching strategies to promote critical thinking skills, and focus on one particular strategy – that of case studies. The participants identified the need for allied health-focused faculty development opportunities, and noted that calibration of instruction was needed. Despite challenges, faculty felt responsible for teaching critical thinking skills, and identified the need for time to build critical thinking skills into the curriculum.

Conclusion: This study was conducted in response to the American Dental Education Association Commission on Change and Innovation's challenge for dental hygiene educators to comprehend their own knowledge on the concept of critical thinking related to research-based pedagogical approaches to teaching and learning. Findings revealed a strong desire among the dental hygiene faculty in this study to incorporate critical thinking into their work. They want to do what they believe is the right thing, but their actual knowledge of the definitional and application theories about critical thinking is still in the early stages of development. Regular and targeted faculty development opportunities are needed.

Keywords: critical thinking, curriculum, teaching strategies, dental hygiene

This study supports the NDHRA priority area, **Professional Education and Development:** Investigate the extent to which new research findings are incorporated into the dental hygiene curriculum.

tion.¹³⁻²¹ In addition, allied health programs, such as dental hygiene education, must provide evidence of meeting accreditation standards which indicate graduates are competent in the use of critical thinking and problem-solving skills related to comprehensive care of patients.²²⁻²⁴

Specifically, if the preservation of dentistry as a learned profession with sustainable vitality in education and research is to continue, there is a call

for serious curricular change and innovation in both the classroom and clinical setting for dental education.^{6,10,12} Dental education commissions, such as the Commission on Dental Accreditation, the American Dental Association Council on Dental Education and Licensure and the Joint Commission on National Dental Examiners, have unanimously recognized the need to change dental curricula as a part of improving the nation's oral health.²² The American Dental Education Association Commission on Change and Innovation suggests that changing science, technology, and disease patterns will transform oral health care delivery greatly impacting all disciplines of oral health education.²³ This, in turn, creates both a set of implications and a sense of urgency for rethinking dental education.

While it is generally agreed that instruction in dental hygiene programs must incorporate critical thinking and decision making skills, there is an absence of research on the cognitive components of clinical decision making, which includes concepts of critical thinking.^{7,8,10,24} As a result, it is difficult to chart a course for such change in dental hygiene programs without examining the current status of faculty regarding their understanding and practice of teaching critical thinking skills in their discipline.

Therefore, the goal of this research was to examine dental hygiene faculty perceptions and thinking surrounding critical thinking issues within their accredited associate degree dental hygiene programs. The focus was on faculty who teach or have taught first and/or second year clinical theory courses within their dental hygiene program. For the purposes of this study, critical thinking is defined as an art of analyzing and evaluating thinking by self-discipline, self-correction and self-monitoring within a framework to improve one's thinking.^{25,26}

The work of Paul and Elder was chosen as a lens for the study.²⁶⁻³⁰ In alignment with other theorists and researchers,^{13,14,18} Paul and Elder believe that within the critical thinking process there are 3 levels of critical thinking, and methodical practice is needed for a person to move from the lowest level to the highest level. These authors have also identified effective teaching activities and practices that offer opportunities for deeper learning which are based upon the use of their critical thinking model. Their model has been used by various higher education institutions and their ideas promoted through various faculty development centers, including those within the state where this study was conducted.³¹⁻³³ In addition, Cosgrove et al developed an "international critical thinking basic concepts and understanding test" which has been demonstrated to have a high degree of consequential va-

lidity.³⁴ Their white paper titled "Consequential Validity: Using Assessment to Drive Instruction" goes into further detail supporting this critical thinking skills test.³⁵ It was therefore appropriate to use their work for the study of dental hygiene faculty in this state, while the work of other critical thinking experts may serve as the lens for similar studies in other states.

Specifically, this study pursued the following research questions:

1. How do dental hygiene faculty define the concept of "critical thinking" (as viewed through the lens of Paul and Elder's work), and the process of becoming a critical thinker within the field of dental hygiene (including when and how they learned about the concept of critical thinking)?
2. How do these faculty describe their personal and departmental rationale and decision regarding the integration of critical thinking skills into their curriculum?
3. How do they describe their strategies and processes for teaching critical thinking skills in their discipline?
4. What challenges do they experience as they address new curriculum standards for integrating critical thinking in the classroom or clinic?

Methods and Materials

A qualitative study approach is often used to examine the social and cultural aspects of a particular program, group or organization, and thus was used in this study to assess the perceptions of dental hygiene faculty regarding various critical thinking issues.³⁶

The selection criteria was all faculty members who have taught and/or teach first and second year clinical theory courses within each of the 11 accredited associate degree dental hygiene programs in one Midwestern state. The theory courses are those that focus on clinical theory as applied to clinical procedures, and were chosen because they focus on helping students learn to think critically and with substance when treating a patient, including assessment, diagnosis, planning, implementation and evaluation. These courses also cover similar content across the 11 programs in this state as part of preparation for the North East Regional Board Exam, the clinical exam for this state and the National Board Dental Hygiene Exam.

This population of faculty was purposefully chosen, both because of their particular knowledge of the phenomenon being studied, and because the researchers had a connection with this state's den-

tal hygiene educator's association, making it more likely that faculty would be willing to participate in this study.³⁷ Initially, 26 faculty members were identified who met the selection criterion, and received an email invitation to participate. Three had left their institution or no longer taught those courses. Of the 23 remaining faculty members in the target population, 20 (87%), with at least 1 from each of the 11 programs in the state, offered their assent to participate (following the protocol approved by a Human Subjects Institutional Review Board).

To support triangulation of the data, 3 types of data were collected for this study.³⁸ First, open-ended questions were created and piloted tested with 2 dental hygiene colleagues to enhance face validity. These 2 colleagues were out of state and have embraced the concepts of Paul and Elder through various faculty development workshops. After appropriate revisions, the questions were sent by email to participants to elicit their understanding of what critical thinking is, and the strategies or methods used to teach students to think critically. The researchers choose this approach because it allowed time for participants to reflect upon the questions and craft their response by email.

A second data set was obtained via follow-up phone interviews, with specific interview questions developed for participants to probe beyond their initial email responses. These interview questions were also pilot tested and revised prior to usage. Each phone interview was approximately 20 to 40 minutes in length, and was recorded for later transcription.

A third data set involved a review of artifacts collected from participants which demonstrated their integration of critical thinking, such as class activities, syllabi, scoring rubrics and program web pages. These items were reviewed to see if they provided concrete evidence to back up (or not) what participants had indicated they were doing in relation to the topic of critical thinking.

The phone interview responses were transcribed, and the process of interpretative qualitative analysis began. The researchers first analyzed the verbatim transcripts and responses to narrative questionnaires, identifying themes related to understanding the concept of critical thinking. An initial list of commonalities was created, and then refined by sorting each commonality into similar categories and subcategories. This was followed by the identification of common themes until an emergence of repeating premises or regularities

resulted.³⁶⁻³⁸ Through this process, the researchers were able to eliminate redundancies and create a list of themes that emerged from analysis of the data related to the research questions.

The integrity of the research methods was enhanced by utilizing several approaches suggested by Creswell.³⁸ The email questions, as well as the follow-up interview questions, were piloted with 2 dental hygiene colleagues prior to their usage, and revisions were made to enhance the face validity of these tools.³⁷ Member-checking was used whereby each participant was allowed to review the narrative constructed from their interview and offered clarifications as needed.

Limitations

It is important to note that this research study had a specific targeted population and therefore cannot be generalized to populations beyond the faculty within these 11 accredited associate degree dental hygiene programs in one Midwest state.³⁶⁻³⁸ However, while the findings cannot be generalized, they may be of informational interest to other dental hygiene programs that are working to include critical thinking skills within their programs.

In addition, the primary researcher chose to use the work of Paul and Elder as a framework for this study, while the work of other critical thinking experts may serve as the lens for similar studies in other states.²⁶⁻³⁰

Results

Participants included 19 females and 1 male, ranging in age from 30 to 60 years old. Years of teaching experience ranged from one to 25 years. Two participants held doctoral degrees, 12 held masters and 6 had baccalaureate degrees. It should be noted that participant demographics were collected as a means to describe the population in the study, not to look for differences within this qualitative study.

Analysis of data revealed themes which were subsequently grouped under the core research question areas.

Research Question 1: Knowledge of the Concept of Critical Thinking

Research question 1 examined how dental hygiene faculty define the concept of "critical thinking" (based upon the framework of the concepts of critical thinking from Paul and Elder's work), and the process of someone becoming a critical thinker

within the field of dental hygiene (including when and how they learned about the concept of critical thinking).

Three themes emerged to address this research. First, most faculty members offer at best only a partial definition of the concept of critical thinking (theme 1.1). Only 5 of the 20 participants were able to give a complete and specific definition of critical thinking as defined by Paul and Elder.²⁶ Such responses included all essential elements such as clearly formulating vital questions and problems, assessing relevant information, determining well-reasoned conclusions and solutions, thinking open-mindedly with alternative systems of thought, and effectively communicating with others. For example, participant #8 (via the open-ended questionnaire) provided this complete definition of critical thinking, "Students critically think when they can assess information, define the problem, draw a conclusion, devise possible solutions, come up with a plan of action, and can evaluate whether their idea or plan worked." The other 15 participants offered only segmented critical thinking concepts.

The second theme which addressed this research questions was that most participants initially learned about the concept of critical thinking in a formal manner (theme 1.2). Eighteen of the 20 participants indicated they learned about the concept of critical thinking through different forms of educational opportunities, with 12 of these 18 first learning about the concept of critical thinking skills through some sort of faculty development opportunity. Several noted that they had initially learned about the concept as part of their own formal training as a student dental hygienist or dental student in the classroom.

The third theme for this research questions was that all participants indicated they learned how to teach critical thinking skills through various faculty development opportunities (theme 1.3). All 20 participants learned how to teach what they believe to be critical thinking skills during faculty development workshops and seminars. Thirteen reported such workshops were offered by their own educational institutions, while the other 7 attended training at other institutions.

Research Question 2: Decisions to Teach Critical Thinking Skills

Research question 2 examined how dental hygiene faculty describe their personal and departmental rationale, and their decisions regarding the integration of critical thinking skills into their curriculum. Two themes emerged to address this ques-

tion. The first theme was that the majority agreed as a faculty group to include the teaching of critical thinking skills into their programs (theme 2.1). Thirteen of the 20 participants indicated they agreed as a faculty group to implement the teaching of critical thinking skills into their curriculum. For example, participant #3 (via the open-ended questionnaire) shared this response, "program faculty (full time) decided together how to implement critical thinking skills into the curriculum. This is something that has evolved over time for us." The other 7 participants indicated they decided on their own to teach critical thinking skills in the curriculum.

The second theme for research question 2 was that a majority of faculty expressed limited resistance to changing their curriculum to include the teaching of critical thinking skills (theme 2.2). Fourteen of the 20 participants expressed no major resistance to the changes needed as they incorporated the teaching of critical thinking skills into their coursework. Most participants embraced the teaching of critical thinking skills, indicating that teaching critical thinking skills is a must for health care providers. For example, participant #2 (via the follow-up phone interview) shared this statement, "I love teaching this way. It allows and encourages students to share their personal experiences, what has worked and what has not. It incorporates all of their personal experiences to be applied and utilized as health care providers."

The other 6 participants expressed frustration and or felt resistance from their students to engage in classroom teaching strategies that included using critical thinking skills. For example, participant #18 (via the open-ended questionnaire) shared her frustration: "With increasing demands on instructors for quality assurance, the necessary steps to provide a quality accredited program, there seems to be less and less time to perfect the pedagogical skills involved in the goal of actually teaching critical thinking skills!"

Research Question 3: Teaching Strategies Using Critical Thinking Skills

The third research question examined how faculty described their strategies and processes for teaching critical thinking skills in their discipline. Three themes emerged. The first theme was that many faculty described using research-based teaching approaches to help students learn critical thinking skills (theme 3.1). Fifteen of the 20 participants indicated they are using several specific strategies to teach critical thinking skills, including: self-assessment, concept mapping, case studies, Socratic questioning and substantive writing. Some

participants indicated that case studies were used most often.

The other 5 participants provided responses of other teaching strategies not identified by Paul and Elder as the most effective ways to teach students critical thinking skills (e.g., lecture, group work; question and answer).²⁶ For example, participant #8 (via the open-ended questionnaire) shares this content, "In my Theory course, I lecture to students, and ask them their opinions or ideas, rather than just asking for "the right answer."

The second theme which addressed research question 3 was that all participants expressed they felt responsible to teach critical thinking skills in order to prepare students for the work world (theme 3.2). All 20 participants believed they have a duty to teach students critical thinking skills, helping them to engage in real world experiences. For example, participant #20 (via the follow-up phone interview) noted, "The primary responsibility lies with the individual instructors to integrate critical thinking into the various courses that they teach. As a faculty we are always working on ways to bring critical thinking skills into the clinical environment modeling the real work world." In congruence, participant #9 (via the open-ended questionnaire) noted: "Critical thinking is purposefully installed within courses by individual faculty. Critical thinking skills are something that must be implemented within our curriculum as often as is possible."

The third theme for this research question was that the majority of participants reported that second year students are given more autonomy, and as a result teaching strategies used to teach critical thinking skills become more complex (theme 3.3). Twelve of the 20 participants identified students having more autonomy as they progress through the last semester of the curriculum, and teaching strategies used to teach critical thinking skills become more complex. For example, participant #6 (via the open-ended questionnaire) noted: "Methods taught to first year students are self-corrective, and self-disciplined. Methods taught to second year are how to increase knowledge, skill assessment, and evaluate continuing care to patient case types." The other 8 participants were not consistent with their responses when questioned about the complexity of teaching strategies as students progressed through the curriculum.

Research Question 4: Challenges with Today's Students Teaching Critical Thinking Skills

The fourth research question focused on the challenges faculty experienced as they addressed

new curriculum standards for integrating critical thinking in the classroom or clinic. Two themes appeared: the first theme is that many reported their students simply have a "tell me what I need to know" approach rather than a desire to learn how to learn to think critically (theme 4.1). Thirteen of the 20 participants believe most students want to be taught what they need to know to pass the boards and not how to learn to think critically. For example, participant #10 (via the open-ended questionnaire) wrote: "The challenge is that students want faculty to spoon-feed them everything and tell them the answers because that may have been how they learned and were taught in the pre-dental hygiene courses."

The second theme which addresses this research question is that many participants' indicated there should be more calibration of instruction when teaching critical thinking skills in didactic and clinical settings (theme 4.2). As one major challenge, 11 of the 20 participants agreed that more work is needed to truly integrate critical thinking skills both in the classroom and the clinic. As the participants responded, it was almost as if this was a self-realization as to what steps the participant and/or the program was taking in regards to the cohesive teaching of critical thinking skills.

Other participants shared broad categories of challenges they face when teaching critical thinking skills within dental hygiene programs. Some shared the fact that time, reduction of credit hours per program, and awareness of students' different styles of learning creates the need for congruency among faculty teaching in the program.

Overall, on varying levels, all participants mentioned the difficulty of preparing students to critically think as required for such a demanding health care profession. As noted earlier, participants voiced the need for more time to teach the required dental hygiene course content utilizing teaching strategies incorporating critical thinking skill, especially as they strive to ensure that students actually learn the content by critically thinking.

Discussion

The overall goal was to understand dental hygiene faculty perceptions and understanding of critical thinking issues. After reviewing the themes found in this study, 8 major findings were identified. These findings are only applicable to the population involved in this study and while the framework for this research was based upon a single theory, it should be noted that there are more theoretical models researchers could explore.

First, the dental hygiene faculty in our study generally understood the concept of critical thinking, but interpretations varied, and not all could offer a complete definition. This finding is similar to work by who found most general education faculty believe they knew what critical thinking is, but could not give a concrete understanding of the concept.²⁵ Indeed, over 75% of the faculty were unable to adequately define the constructs underlying critical thinking.

Second, dissimilar to aspects of previous research by Paul and Elder,²⁶ Williams et al,³⁹ Giddens and Gloeckner,⁴⁰ and Hessheimer et al⁴¹ which reveals multiple researched-based teaching strategies to promote critical thinking skills, most of our participants primarily focused on one particular teaching strategy throughout the curriculum - that of case studies. Faculty did note the importance of other research-based teaching strategies, but cited case studies as the most important. This reveals a serious disconnect between the theories of how critical thinking should be taught (i.e., with case studies being just one of many strategies), and what was actually happening in the field with the faculty in this study (and perhaps what is happening elsewhere as well).

Third, adding to the previous research of Asadorian et al,⁵ Hessheimer et al,⁴¹ and Kassebaum et al,⁴² which found that faculty development opportunities on the instruction of critical thinking are essential, our participants identified the need for specific allied health-focused faculty development opportunities. The shift to teaching critical thinking skills requires a commitment from organizations to help faculty understand what critical thinking is, and identify what educational strategies can be used to effectively teach critical thinking and assess changes in students' critical thinking skills. Organizations must offer continuous allied health-focused faculty development opportunities, and venues to discuss, implement and examine the scholarship of teaching.

Fourth, while participants believed all faculty were teaching the concept of critical thinking, they expressed concerns of not knowing specifically what others were doing, or how well things were working. The need for faculty time, to share their experiences and assess what methods are really helping the students to learn critical thinking skills, was very apparent. Participant recommendations were that calibration of instruction was needed so that all faculty can make the necessary changes in an effective way, and allow them to focus on effective teaching strategies. No similar finding could be found in previous research.

Fifth, adding to the previous work of Doyle, Tagg and Weimer, who identified a paradigm shift in teaching, the participants in this study identified challenges with teaching today's students.^{14,19,21,43} Faculty found resistance from students who did not want to engage in the teaching strategies to promote critical thinking, and some students just wanted "to be spoon fed in order to know what was going to be on the boards."

Sixth, supporting the previous findings of Barlett, Ellerman, and Paul and Elder, which revealed that intellectual traits must be taught in health curricula moving from the novice to the expert thinker, the participants agreed that coursework intensifies throughout the curriculum and so should the students' ability to think critically.^{25-29,44,45} Faculty identify that first year students are learning large amounts of foundational content, and that students become more autonomous as they move through the second year of the curriculum.

Seventh, participants in this study felt responsible for teaching critical thinking skills to students as part of workforce preparation. Many acknowledge that a health professional must be able to think critically during patient clinical treatment. Clinical dental hygiene practice demands critical thinking and as such faculty are attempting to include critical thinking activities daily in their teaching practices. In addition, faculty recognized that critical thinking skills had been taught to them during their own experiences as students in dental hygiene school, and felt responsible to now teach critical thinking skills to others. Faculty reminisced that they remembered hearing and learning about critical thinking while being a student in their undergraduate dental hygiene program, and have been fortunate to receive institutional support to now learn how to teach critical thinking skills themselves. Boud et al⁴⁶ and Mezirow⁴⁷ would have indicated that these faculty are engaging in the reflective process from their own student experiences in the clinical setting, connecting it to prior theoretical knowledge in order to improve future clinical practice, and ultimately, learning from one's own experience.

Lastly, participants identified a lack of time to adequately teach critical thinking skills in the curriculum. Research indicates it takes time to develop increased levels of critical thinking and students must progress through the various levels.²⁵ Paul and Elder also indicate faculty must be willing to move students through the various levels of thinking utilizing research-based teaching strategies employing critical thinking skills.²⁶⁻³⁰ While our participants expressed willingness to engage in such

activities, and had an understanding of how such skills become more complex over time, they identified time as a constraint when trying to incorporate critical thinking skills into their coursework.

Conclusion

The findings of this study serve as one response to the American Dental Education Association Commission on Change and Innovation's challenge for dental hygiene educators to expand their research-based pedagogical approaches to teaching and learning with a particular emphasis on the concept of critical thinking.¹¹ This research provides an interpretation of how dental hygiene faculty in one Midwest state define and understand the concept of critical thinking within their dental hygiene program.

While a qualitative study focusing on the dental hygiene programs within a single state cannot be generalized to all dental hygiene programs,

this study revealed a very strong desire among these faculty to incorporate critical thinking into their work. They want to do what they believe is the right thing, but their actual knowledge of the definitional and application theories about critical thinking is still in the early stages of development. It is important for the profession to ascertain if other faculty across the country are also in a similar position, and if so, energy should be expended via targeted faculty development to help move the profession toward their ultimate goal – having well trained health professionals using critical thinking skills in their daily practices.

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