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# Journal of Dental Hygiene

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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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## Talented Dental Hygienists!

Rebecca S. Wilder, RDH, BS, MS

This issue of the Journal of Dental Hygiene is celebrating some of the most talented dental hygienists we have who are contributing to our science! It is with great pleasure that I have the opportunity to highlight their accomplishments in this special print issue. As we look to the future it will be important to have our profession led by committed dental hygienists who recognize the importance of research and publishing.

The ADHA/Sigma Phi Alpha Journalism Award competition has been in existence for several years. The competition is made possible through a grant from Johnson and Johnson Healthcare Products, Division of McNEIL PPC, Inc. We now have two categories for the award at the Master of Science/Doctoral level and at the Baccalaureate level. It is a very competitive process and can be quite challenging if the paper is the first one the student has ever submitted for publication. We are pleased to be publishing the two winning manuscripts from the 2014 competition. The schools that produced the winning manuscripts are The University of Texas Health Science Center at Houston School of Dentistry (undergraduate winner) and Idaho State University Department of Dental Hygiene (graduate winner).

Now in our second year, the Journal of Dental Hygiene has a Best Paper Award. This year, an independent panel of judges reviewed all original research project papers that were published

in the Journal of Dental Hygiene from January to December 2014. They had specific criteria to utilize to judge the manuscripts and were tasked with selecting the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> place winners. Although the papers have already been published in our digital journal, we are pleased to present the 1<sup>st</sup> and 2<sup>nd</sup> place manuscripts in full and the abstract of the 3<sup>rd</sup> place winners in this print supplement. The schools represented are the University of Michigan School Of Dentistry, Division of Dental Hygiene, and the University of North Carolina at Chapel Hill School of Dentistry Graduate Dental Hygiene Education Program. Congratulations to the authors of these important papers!

Finally, none of these papers would have been possible without outstanding mentoring from dental hygiene and dental faculty members who assisted, encouraged, edited and helped guide these students and authors through the writing process. We know it is not easy to mentor a novice writer but it is so worth it in the end! These students are our future leaders, scholars, educators and innovators. Mentors... thank you! And thank you J&J for helping us showcase our winning manuscripts!

Enjoy the CLL and Nashville!

Sincerely,

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

# ADHA/Sigma Phi Alpha Journalism Award: Baccalaureate

## Is Your Drinking Water Acidic? A Comparison of the Varied pH of Popular Bottled Waters

Kellie F. Wright, RDH, BS, CCLS

This project won 1<sup>st</sup> place in the ADHA/Sigma Phi Alpha Journalism Award Competition, June 2014, under the baccalaureate or degree completion candidate category. Award provided by a generous grant from Johnson & Johnson Healthcare Products, Division of McNEIL PPC, Inc.

### Introduction

Research substantiates that consumption of acidic beverages such as soft drinks and sports drinks is positively correlated with the incidence and prevalence of dental caries and dental erosion.<sup>1-3</sup> Dental erosion has been defined as the chemical removal of mineral from tooth structure.<sup>4</sup> Erosion of enamel and root surfaces of teeth is a potentially serious oral health concern in the U.S., and the consumption of acidic beverages is a contributing factor.<sup>1</sup> The overall consumption of carbonated soft drinks in the U.S. is continually increasing, with between 56 and 85% of school-age children consuming at least 1 per day.<sup>5</sup> The pH of most soft drinks is within the range of 2 to 4, indicating that it is very acidic. When the teeth are bathed in the acid from these drinks, they become susceptible to demineralization. Demineralization occurs when acidogenic bacteria, specifically *Streptococcus mutans*, colonize in the oral cavity, forming dental biofilm.<sup>6</sup> The biofilm metabolizes carbohydrates (such as sugars commonly found in soft drinks), which acidifies the saliva. The normal pH of the oral cavity is about 6.3, and when the pH falls below 5.5, tooth structure begins to demineralize.<sup>5</sup> The literature suggests that the lower the pH of the beverage, the high-

### Abstract

**Purpose:** Dental professionals continually educate patients on the dangers of consuming acidic foods and beverages due to their potential to contribute to dental erosion and tooth decay. Excess acid in the diet can also lead to acidosis, which causes negative systemic side effects. However, water is not typically categorized as acidic. The purpose of this in-vitro study was to investigate the pH levels of several popular brands of bottled water and compare them to various other acidic beverages. Two different brands of marketed alkaline water (with a pH of 8.8 or higher) were also studied, tested for acidity and described.

**Methods:** A pilot in-vitro study was conducted to determine the pH levels of a convenience sample of popular brands of bottled water, tap water and other known acidic beverages in comparison with the pH values reported on the respective manufacturers' website. Each beverage was tested in a laboratory using a calibrated Corning pH meter model 240, and waters were compared to the corresponding company's testified pH value. Waters were also compared and contrasted based on their process of purification. The data was then compiled and analyzed descriptively.

**Results:** The pH values for the tested beverages and bottled waters were found to be predominantly acidic. Ten out of the 14 beverages tested were acidic (pH<7), 2 municipal (or "tap") waters were neutral (pH=7) and 2 bottled waters were alkaline (pH>7). The majority of waters tested had a more acidic pH when tested in the lab than the value listed in their water quality reports.

**Conclusion:** It is beneficial for the health care provider to be aware of the potential acidity of popular bottled drinking waters and educate patients accordingly.

**Keywords:** dental erosion; acidosis; streptococcus mutans; drinking water; alkaline (mineral) water; alkaline ionized water; electrolysis; water purification

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Assess how dental hygienists are using emerging science throughout the dental hygiene process of care.

er the rate of demineralization of enamel.<sup>1</sup> Soft drinks are not the only acidic beverages that pose an oral health challenge in the U.S.; many Americans consume coffee and sports beverages as well, which are also acidic. Cochrane et al studied the pH of various sports drinks, finding that while not as low as Coca-Cola®, many Gatorade® and Powerade® drinks also had an acidic pH leading to dental erosion when tested.<sup>7</sup> While dental erosion can affect any individual, some are at increased risk for demineralization and, subsequently, dental caries. People with xerostomia (due to decreased saliva to buffer the acid content in the mouth), mouth breathers and those with orthodontic brackets are at increased risk for erosion.<sup>5</sup>

Acidosis is a pathologic condition of increased hydrogen ion concentration in blood and body tissues, and occurs when arterial pH falls below 7.35.<sup>8</sup> Harmful effects of acidosis may include increased bone resorption and decreased osteoblastic function, as evidenced in a study conducted by Brandao-Burch et al who found that as arterial pH drops, mineralization of bone reduces.<sup>9</sup> Alkaline mineral water (by definition, water with naturally occurring minerals such as calcium and magnesium and a pH above 7) has been shown to be therapeutic in decreasing bone resorption, increasing bone density and improving hydration.<sup>10-12</sup> Naturally alkaline artesian well water is beneficial due to its acid-buffering capacity and has been shown to be effective in adjunctively treating gastric reflux disease.<sup>12,13</sup> Additionally, there is some evidence that an alkaline diet may slow the progression of some chronic diseases, such as hypertension, muscle wasting and strokes.<sup>14</sup>

It is important for the oral health care provider to be aware of the relative acidity of the beverages consumed daily and how they affect oral health. Some waters, primarily bottled waters which people generally believe are safer than tap water, are actually acidic and potentially harmful to the teeth. For the reasons listed above, consumption could pose a threat to the oral and overall health of those who consume acidic water. Water's mineral content determines its pH and is dependent upon the source, in addition to the purification process.

Prior to discussing specific brands, it is necessary to distinguish between different types of bottled water. Natural spring water is derived from specific natural springs, where the earth filters it naturally. Some springs are naturally

alkaline, while others are more acidic. Natural spring water is typically filtered and disinfected using processes including, but not limited to activated carbon filtration to remove added chlorine, microfiltration to remove particles and ultraviolet light sanitation to destroy bacteria.<sup>15</sup> The original mineral content of the natural spring water is retained during the filtration process, thus making the pH correspond exactly to the alkaline (or acidic) mineral content of the water. Another term for the total mineral content of water is total dissolved solids (TDS), which refers to the inorganic and organic substances present in solution in water and able to survive filtration through a small filter.<sup>15</sup> TDS constituents include, but are not limited to, calcium, sodium, potassium, magnesium, chloride, sulfate and nitrate.<sup>15</sup> Artesian well water comes from a confined aquifer containing groundwater under positive pressure.<sup>16</sup> Like natural spring water, it also retains its mineral content during filtration. The pH of artesian water will depend on the acidity or alkalinity of the artesian well. Purified drinking water is derived from a public water supply of a given area and then filtered by reverse osmosis, distillation or another process.<sup>17</sup> The mineral content in the water is removed during the filtration process, and some brands subsequently add minerals and/or electrolytes for taste. Because the alkaline minerals are removed during filtration, it is possible that purified drinking water will have a lower pH than naturally occurring spring or well water (depending on the nature of the source).

Alkaline water, or mineral water, is becoming increasingly popular worldwide, but it is important to distinguish between naturally occurring alkaline (mineral) water and alkaline ionized water. It is not possible to differentiate between the two based on pH alone. The U.S. Food and Drug Administration requires naturally occurring alkaline water to contain at least 250 parts per million TDS from a geologically and physically protected underground water source, and the water is not to contain added minerals.<sup>18</sup> Naturally occurring alkaline water contains a high concentration of minerals directly from the source, and its pH corresponds exactly to its mineral content. Alkaline ionized water is source-independent (and frequently starts as tap water); the water pH is altered through electrolysis, or the splitting of the water molecule into hydrogen and hydroxide ions with an electric current.<sup>19</sup> Therefore, the alkaline pH is created artificially, and does not match the mineral content of the water. Ionized water can be

Table I: pH Values Compared

	Ozarka Natural Spring Water	Aquafina	Dasani	Nestlé Pure Life	Evian	Fiji
pH when tested in lab	5.16	5.63	5.72	6.24	6.89	6.9
pH reported in water quality report or website	5.7 to 7.3	NR*	NR*	6.6 to 8.0	7.3	7.7
	Smartwater	Houston Tap	Pasadena Tap	Evamor	Essentia	
pH when tested in lab	6.91	7.29	7.58	8.78	10.38	
pH reported in water quality report or website	NR*	8.0	7.8	8.8	9.5	

\*Not Reported

produced with a home appliance called a water ionizer, or can be purchased commercially. Proponents of alkaline ionized water claim that it is an antioxidant, increases hydration and energy, and can even slow the aging process.<sup>19</sup> However, there is a lack of scientific research available to support these claims. In fact, one clinical trial involving rats detected damage to the myocardial muscle following the consumption of alkaline ionized water.<sup>20-22</sup>

A clinical trial by Koufman and Johnston found naturally occurring alkaline water (pH 8.8) to be therapeutic in the treatment of acid reflux disease.<sup>13</sup> Alkaline water was found to denature human pepsin 3b, which is the enzyme that breaks down protein in the digestion process.<sup>13</sup> Sufferers of acid reflux experience painful, burning sensations due to acidic foods and beverages activating the pepsin that has been pushed into the airway from the stomach. It is imperative to recognize that this study highlighted the therapeutic benefits of naturally occurring alkaline water, as opposed to alkaline ionized water.

Equipped with a knowledge base on the important differences between types of bottled waters, the dental hygienist will be better prepared to educate and inform patients about water consumption. However, awareness of the water's pH and TDS value (which is often not found even online) will also play an important role in the provider's patient recommendations. The aim of this study was to research, test and compare specific brands and types of bottled water for potential acidity.

## Methods and Materials

A pilot in-vitro study was conducted to determine the pH levels of a convenience sample of popular beverages, including 9 brands of bottled water, 2 municipal (or "tap") water supplies and 3 additional beverages. Among the beverages tested were Coca-Cola® (Coca-Cola Co., Atlanta, Ga), VitaminWater® (Coca-Cola Co., Whitestone, NY), Gatorade® (PepsiCo Inc., U.S.), Ozarka Natural Spring Water® (Nestlé Waters, North America), Aquafina® (PepsiCo Inc., Purchase, NY), Dasani® (Coca-Cola Co., U.S.), Nestlé PureLife® (Nestlé Waters, North America), Evian Natural Spring Water® (Danone Group, France), Fiji Water® (Los Angeles, Calif), Smartwater® (Coca-Cola Co., Whitestone, NY), Evamor Natural Artesian Water® (Covington, La), Essentia® (Essentia Co. LLC, Bothell Wash), and tap water from Houston, Texas and Pasadena, Texas. All beverages (excluding the municipal waters) were obtained in unopened bottles from Houston, Texas. The pH values for each beverage were tested in the laboratory using a calibrated Corning pH meter model 240. The pH meter was calibrated by the researchers prior to testing the beverages. The tested pH values of each beverage were then compared with the pH values reported in the corresponding manufacturers' water quality reports found on their respective websites. The results were descriptively analyzed and compiled into tables and figures.

## Results

Table I and Figure 1 show that most of the waters tested had an acidic pH. Compared with

Figure 1: Tested pH Values on a Spectrum



Note: Water displayed under the red portion of the arrow indicates water that falls within an acidic pH range; water displayed under the blue portion indicates water that falls within a basic pH range.

Table II: Purification Process and Total Dissolved Solids

	Ozarka Natural Spring Water	Aquafina	Dasani	Nestlé Pure Life	Evian	Fiji
Type of Water	Natural Spring	Purified	Purified	Purified	Natural Spring	Natural Artesian
TDS	34 to 97 mg/l	ND*	ND**	61 to 100	340	220
	Smartwater	Houston Tap	Pasadena Tap	Evamor	Essentia	
Type of Water	Purified	Tap	Tap	Natural Artesian	Purified	
TDS	36	359	250	181	62	

\*Not detected; at or above minimum reporting level

\*\*Not detected; magnesium sulfate, potassium chloride and salt added

the most acidic non-water beverage (Coke®), which tested at a pH of 2.24, Ozarka Natural Spring Water® was the most acidic water, with a pH of 5.16. The following waters had a pH just below neutral (or pH=7): Nestlé PureLife® (6.24), Evian Natural Spring Water® (6.89), Fiji Water® (6.90) and Smartwater® (6.91). Both municipal (or public) water supplies (Houston and Pasadena) had a neutral pH, with Houston's being 7.29 and Pasadena's 7.58. The 2 commercially available alkaline bottled waters evaluated were Evamor® and Essentia®, either of which can be purchased online or in specialty grocery stores and guarantee an alkaline pH. Each of these, as evidenced in Table I, was found to have a pH above 7, with Evamor® testing at 8.78 and Essentia® at 10.38. Table II illustrates the type of filtration process by which

each brand of bottled water is purified, along with the reported TDS.

## Discussion

Most patients in the dental office will not be aware of the potential acidity of bottled water. It is the dental professional's responsibility to educate patients on the importance of limiting intake of acidic foods and beverages in order to prevent acid erosion and to maintain good oral and dental health. The dental hygienist has a professional duty to educate patients and to provide recommendations about the most current evidence regarding healthy drinking water. A knowledge of the differences between various water purification processes will aid the health care provider in determining which bottled wa-

ters to advocate. Furthermore, appropriate expertise on the difference between naturally occurring alkaline water and alkaline ionized water will ensure that patients reap optimal benefits of alkaline drinking water. The results of this pilot study indicate that some brands of popular bottled water have a low pH, which could potentially contribute to dental erosion and tooth decay.

Being the most acidic water evaluated in this study, it can be assumed that the natural source of the Ozarka® water had a lower pH (or fewer alkaline minerals), as the pH of natural spring water will correspond directly to its mineral content. The public water supplies from Houston and Pasadena had a neutral pH, likely because the minerals are retained in tap water during the filtration process. Interestingly, the total dissolved solids were higher in the natural artesian waters and tap waters, likely because the natural minerals are retained when the water is filtered. The 2 natural spring waters had TDS values that corresponded to their pH, one being acidic and the other closer to neutral. All the purified drinking waters evaluated, including Essentia® alkaline water, had either a low or undetected TDS value. This can likely be explained due to the removal of the water's natural minerals during filtration.

The two alkaline bottled waters evaluated were found to have an important difference. While both Evamor® and Essentia® waters guarantee an alkaline pH, the alkalinity is not achieved the same way. Evamor® water is sourced from a naturally alkaline artesian aquifer in Covington, La, and all of its minerals are kept during filtration. As a result, the mineral content in Evamor® water will match its pH exactly.<sup>16</sup> Essentia® however, is sourced from the public water supply; minerals are filtered, and then the water is artificially made alkaline by electrolysis.<sup>23</sup> Therefore, the high pH does not match the mineral content in the water (Table II), and is rather a result of the abundance of hydrogen ions created with the electric current. As mentioned previously in this paper, the health benefits of these two waters may be significantly different. If possible, the health care provider should be aware of not only the pH of a given bottled water, but also the total dissolved solids, in order to provide the best recommendation to patients.

Possible limitations of this study include small sample size of waters and beverages tested and unknown length of time spent in the bottle prior to opening. Variability of water source and loca-

tion is also a limiting factor. Further research is necessary to evaluate whether bottled water is acidic and to determine relationships between acidic water and dental erosion and caries formation. Additional study is also indicated to conclude whether or not there are additional oral or systemic benefits to drinking alkaline water (naturally occurring or ionized).

## Conclusion

It is beneficial for the practitioner to obtain baseline knowledge of various types of bottled water and their pH, and subsequently make patient recommendations. It is also prudent for the health care provider to be aware of the potential systemic risks and benefits of acidic and alkaline water. One can assume that both naturally alkaline water and alkaline ionized water will be safe for the protection of teeth from decay, as the critical pH for caries formation is 5.5 (or 6.7 for cementum).<sup>5</sup> However, familiarity with the therapeutic uses of naturally alkaline water and risks of alkaline ionized water will equip the dental hygienist in making recommendations to patients with specific health conditions.

The results of this study suggest that there may be several brands of widely accepted bottled water that have a pH between 5.16 to 10.38. The values found were lower than those reported in the manufacturers' online water quality reports for all but one water, excluding those that did not have a reported pH value online. While continued research on the pH of bottled water is essential, this pilot study provides a baseline for practitioners to study and adapt in practice as necessary.

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# ADHA/Sigma Phi Alpha Journalism Award: Masters/Doctoral

## New York State Dental Hygienists' Perceptions of a Baccalaureate Degree as the Entry-Level Degree Required for Practice

Christine Rogers, RDH, MS; Tara B. Johnson, RDH, PhD; JoAnn R. Gurenlian, RDH, PhD

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### Introduction

A century ago, Dr. Alfred C. Fones recognized the critical role preventive oral health care played in disease prevention. His vision for disease prevention led to the inception of the dental hygiene profession and, in 1906, Irene Newman became the first dental hygienist in the world. Fones and Newman had a mission to provide dental hygiene services, not only to patients in private practice, but also to individuals suffering from dental disparities who did not have access to care.<sup>1</sup> Since that time, the dental hygiene profession has made great gains. While the focus of the profession is still on disease prevention, the role of the dental hygienist has evolved and now encompasses a variety of workplace settings. Clinical dental hygienists may practice in private dental offices, school-based settings, community health centers, correctional institutions or nursing homes.<sup>2</sup> Outside of clinical practice, opportunities for dental hygienists exist in the fields of research, education, marketing, government, administration, health policy, advocacy and consulting.<sup>2</sup>

Existing dental hygiene education in the U.S. is characterized by wide diversity. Programs range

### Abstract

**Purpose:** Dual educational pathways exist for entry into the dental hygiene profession, namely associate and baccalaureate degrees. The purpose of this study was to examine practicing dental hygienists' perceptions, regarding the requirement of a baccalaureate degree as entry-to-practice for the profession.

**Methods:** A purposive sample of 800 dental hygienists licensed within New York State, both members and non-members of the Dental Hygienists' Association of the state of New York, were contacted via email and asked to participate in this Web-based survey. Survey items included both open-ended demographic and 12 Likert-type questions about perceptions of the Bachelor of Science in Dental Hygiene (BSDH) being required as entry-level into the profession. Data were analyzed using descriptive statistics, Spearman's rank correlations and the Kruskal-Wallis test.

**Results:** One hundred and seventeen surveys were returned and 107 (14%) were valid for analysis. Fifty-two percent of participants held an associate degree and 98% were members of the ADHA. Nearly a third of participants were employed in solo practice, and 43% agreed/strongly agreed the associate degree is sufficient preparation for dental hygiene practice. Still, more participants agreed/strongly agreed (50%) the BSDH should be considered entry-level for the discipline. Participants identified professional recognition by other health care practitioners and increased individual self-esteem as benefits of a BSDH.

**Conclusion:** Results indicate the BSDH as entry-to-practice may be essential in elevating the status of the dental hygiene profession to that of other mid-level health care providers. Improving professional competence and credibility with colleagues and patients may be an important personal benefit of earning a baccalaureate degree.

**Keywords:** associate degree, baccalaureate degree, entry-level degree, entry-to-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.

from 2 to 4 years at the college or university level or, more recently, in proprietary school settings. With the exception of Alabama, in which the Alabama Board of Dental Examiners provides a dental hygiene training program for employed dental assistants,<sup>3</sup> the minimum entry-to-practice credential in all states is currently at the associate degree level. Within the field of dental hygiene, two types of associate degree can be awarded - an associate of science degree or an associate of applied science degree. The associate of science degree is an undergraduate degree that is considered transferable and designed to prepare recipients to attend a 4-year degree program. The associate of applied science degree is designed to prepare individuals for employment in a career or technical occupation upon graduation.<sup>4</sup>

An associate degree dental hygiene program requires an average number of 2,650 clock hours of instruction compared to a baccalaureate degree, which requires approximately 3,100 clock hours of instruction.<sup>4</sup> While associate degree programs require, on average, the same number of clinical and laboratory clock hours, baccalaureate degree programs devote more didactic clock hours to patient care and provide more instruction in written communication, chemistry, oral health education and patient management.<sup>4</sup> When prerequisites are factored into total curriculum credit hours, academic associate degree programs take approximately 3 years (90 credit hours) to complete. This is approximately 20 to 30 credit hours beyond the traditional associate degree and only 30 credit hours less than a baccalaureate degree.<sup>5</sup> Licensure and scope of professional practice do not change whether one has a 2-year associate degree, 3-year associate degree or baccalaureate degree. Despite the plethora of program options for associate and baccalaureate education, the entry-to-practice requirement for dental hygiene in the U.S. continues to be the associate degree.<sup>4</sup> However, compared to mid-level providers across all health care disciplines, dental hygiene education does not require advanced professional preparation.

Additionally, graduates of a baccalaureate dental hygiene program have alternative career choices outside of clinical practice in areas such as administration, public health, research and education.<sup>4</sup> One might infer that a higher degree could equate to a higher salary, but the difference in salaries between 2-year gradu-

ates and 4-year graduates in clinical practice is relatively small. A 2007 survey administered by the American Dental Hygienists' Association (ADHA) found the mean salary for dental hygienists holding a 2-year degree to be \$54,315 per year while the mean salary for dental hygienists holding a baccalaureate degree to be \$58,105 per year.<sup>6</sup> This small difference in salary may not be a significant fiscal incentive for associate degree candidates to continue in a degree completion program or to choose a 4-year program as entry-to-practice.

### **Educational Changes within Health Care**

Over the years, health care professions in general have undergone increases in their entry-to-practice credential requirements. For example, occupational therapy now requires a master's degree and physical therapy has moved from a master's level graduate degree to a doctoral degree as the entry-level to practice.<sup>7</sup> The degree previously required to practice pharmacy in the U.S. was the Bachelor of Science in Pharmacy, but in 1997 the American Council for Pharmacy Education (ACPE) officially adopted the Doctor of Pharmacy (PharmD) as the entry-level degree for practicing pharmacists.<sup>8</sup> The changes made were based on health care provider competencies identified by the Institute of Medicine (IOM). As the profession (and medical care in general) evolved, so did pharmacy education in order to fit into the new health care model of inter-professional care and expanding roles of pharmacists.<sup>8</sup>

The nursing profession has struggled with its academic requirements for over a century,<sup>9</sup> and like the dental hygiene profession, nursing offers dual entry into the profession. Debates have surfaced within the nursing community as to whether or not 2-year graduates are adequately prepared to meet the demands of patient care. The registered nurse (RN) parallels a registered dental hygienist (RDH) in that both professions award licensure at either an associate degree or baccalaureate degree and the scope of practice for each are determined by the state. A survey conducted by the National Council of State Boards of Nursing found 4-year nursing graduates to incorporate critical thinking skills into daily practice and have less difficulty with the management of complex patients as compared to non-baccalaureate prepared nurses.<sup>9</sup>

## Increased Demand for Health Care

Oral Health in America: A Report of the Surgeon General was the first report that outlined the state of oral health care in America.<sup>10</sup> The purpose of the report was to “alert Americans to the full meaning of oral health and its importance to general health and well-being.”<sup>10</sup> The report also brought to the public’s attention the alarming number of individuals who are without dental care and the barriers to care that prevent many Americans from obtaining appropriate care. With the increasing need for oral health care and the declining dentist-to-population ratio, a question arises as to whether or not the dental workforce will be able to effectively meet the population’s demand.<sup>10</sup> The Surgeon General’s report further emphasized how critical education and training of dentists and allied dental personnel are to the provision of oral health care for the public.<sup>10</sup> More recently, Healthy People 2020, the government’s prevention agenda, emphasized the need to improve access to preventive services and dental care.<sup>11</sup> As preventive oral health care specialists, dental hygienists are at the forefront of the oral health crisis that is plaguing America. Within the 2020 report, 17 oral health objectives have been established.<sup>11</sup> Capitalizing on the skills of a qualified dental hygienist can achieve many of these objectives. According to The U.S. Department of Labor, Bureau of Labor and Statistics, dental hygiene is ranked among one of the fastest growing professions and it is estimated that it will grow 33% through 2022.<sup>12</sup> When this increase in the number of dental hygienists is compared to the declining number of dentists, and the increasing demand for oral health care is factored in, there will be a greater need to call upon dental hygienists to sufficiently meet the public’s demand.<sup>13</sup>

## Barriers to a Baccalaureate Degree

The cost of associate degree dental hygiene education versus the cost of a baccalaureate degree could influence which type of degree the student chooses. Program directors participating in a 2008 American Dental Education Association (ADEA) meeting were surveyed and perceived the increased cost of a baccalaureate degree as a possible disadvantage in raising the entry-level degree requirement. However, Owuje et al also reported three-quarters of those survey participants supported advancing dental hygiene entry-level educational requirements to a baccalaureate degree.<sup>5</sup> In a

2011 report compiled by ADEA, the pathway to a baccalaureate degree was examined. While ADEA supports raising the educational credentials of dental hygienists, it was noted that the additional cost of a baccalaureate degree may dissuade associate degree recipients from furthering their education.<sup>14</sup> According to the National Center for Education Statistics, 45% of students attending a 4-year college on a full-time basis will need an additional year or more to complete their education.<sup>15</sup> Additional time spent in college equates to additional expenses.

## Preferences Among Dental Professionals

Since most dental hygienists are employed in private practice, preferences of dentists could be a determining factor for which educational path the dental hygienist chooses. A survey completed by 225 dentists practicing in Ohio revealed that 56% had no hiring preference for a 2-year versus a 4-year dental hygiene graduate. Furthermore, 68% were not willing to pay a higher salary to a 4-year graduate. Extent of clinical experience was a determining factor in salary and 70% of the dentists surveyed agreed there would be no difference between 2-year graduates and 4-year graduates after 2 years of work experience.<sup>16</sup>

In the 2005 ADHA report Dental Hygiene: Focus on Advancing the Profession, a recommendation was made to implement the baccalaureate degree as the entry-level degree for the profession of dental hygiene.<sup>2</sup> To date, empirical data for implementing the baccalaureate degree as the entry point for the dental hygiene profession has both pros (elevated credentials and alternate career options) and cons (increased educational costs, limited articulation agreements and minimal wage increases). According to the ADHA, there are 335 entry-level dental hygiene programs with 288 of them offering an associate degree.<sup>4</sup> Nationwide, 44 dental hygiene programs offer a BSDH and 11 programs offer a degree completion.<sup>4</sup> Mandating a baccalaureate degree as the entry-level degree for the profession could impact dental hygiene education since there are more associate degree programs compared to baccalaureate degree and degree completion programs. Opinions favoring the change to entry-level professional credentials come primarily from faculty at baccalaureate programs and the professional association, which serves both the needs of the public and members of the profession.

Reporting of perceptions of practicing dental hygienists regarding entry-level degrees is limited in scope to either regional or program specific surveys. Specifically, this survey aimed to identify to what extent dental hygienists within the state of New York support the baccalaureate degree as the entry-level degree for the dental hygiene profession. Therefore, the purpose of this study was to survey practicing dental hygienists in the state of New York to determine their perceptions regarding changing the entry-to-practice degree from the associate degree to the baccalaureate degree. In addition, this study explored the relationship between participants' level of education with their support of the baccalaureate degree as the entry-level credential.

## Methods and Materials

This descriptive study utilized a survey instrument adapted from a previous study conducted by Anderson and Smith to assess the opinions and attitudes of dental hygienists.<sup>17</sup> The types of questions included in the electronic survey were demographic, Likert scale (12 items) and ranking (1 item) questions. Approval for the survey was secured from the Idaho State University Institutional Review Board (#3996). Validity of the survey was established through expert review. The content experts who reviewed the survey were comprised of three individuals experienced in dental hygiene education, research and statistics. A nonprobability, purposive sample of 800 licensed dental hygienists within the state of New York comprised the population for this study. A list of all email accessible registered dental hygienists, both members and non-members, was obtained from the Dental Hygienists' Association of the State of New York. This list was by no means inclusive of all dental hygienists registered in the state. The Dental Hygienists' Association of the State of New York initiated all correspondence with potential participants that included a cover letter, informed consent and a link to the survey. A follow-up e-mail was sent to participants at 2 and 3 weeks after the initial email.

Data were collected with Qualtrics® and downloaded into an Excel file, then imported into SPSS 20.0 for analysis. Descriptive statistics were computed to show frequency distributions, percentages and measures of central tendency. Bivariate relationships (ordinal level participant demographics and entry-level bac-

Table I: Demographic Profile of Participants

Age	n=113	Percent
18 to 28 years	13	12
29 to 38 years	17	15
39 to 48 years	16	14
49 to 58 years	38	34
>59 years	29	26
Years Since Graduation	n=99	Percent
1 to 10 years	30	30
11 to 20 years	20	20
21 to 30 years	12	12
>30 years	37	37
Highest Academic Degree	n=114	Percent
Associate Degree: Dental Hygiene	56	52
Bachelor's Degree: Non-Dental Hygiene	16	15
Bachelor's Degree: Dental Hygiene	12	11
Master's Degree	20	19
Doctorate Degree	3	3
Primary Practice Setting	n=107	Percent
Solo/Group dental practice	53	50
Academic/University/College	19	18
Multiple practice settings/ Multi-specialty clinic	12	12
Community health clinic/ Public health agency	10	10
Independent dental hygiene practice	5	5
Not in clinical practice	5	5
*Other	3	3
Member of the ADHA	n=106	Percent
Yes	105	98
No	1	1

\*School based dental clinic, business, managed care/insurance

calaureate degree perceptions) were analyzed using Spearman's rank correlation coefficient. The Kruskal-Wallis test was used to identify differences between degrees held by participants and opinions about the baccalaureate degree as entry-to-practice.

## Results

### Demographics

Of the 800 electronic surveys mailed, 117 were returned, resulting in a 15% response rate, with 107 of those valid for analysis. The majority of respondents (n=67) were 49 years

Table II: Combined Level of Agreement with Statements of Perceptions on the BSDH

Statement	Strongly Agree/ Agree n (Percent)	Neutral n (Percent)	Disagree/Strongly Disagree n (Percent)
AD is sufficient preparation for practice challenges of in today's health care settings.	46 (43)	18 (17)	42 (40)
BSDH should be the entry-level degree for practice	54 (51)	18 (17)	34 (32)
BSDH is necessary to ensure the highest standards of service delivery	49 (46)	22 (21)	35 (32)
The BSDH degree is necessary to elevate the status of the dental hygiene profession to that of other mid-level health care providers.	76 (71)	13 (12)	17 (16)
A requirement for the BSDH degree might further limit diversity within the profession.	37 (35)	26 (24)	43 (40)
Those who are financially disadvantaged may not be able to afford the BSDH.	52 (49)	23 (22)	31 (29)
A BSDH offers more career opportunities.	78 (73)	18 (17)	10 (10)
Clinical experience is a better indicator of clinical competency than degree held.	69 (65)	19 (18)	19 (18)
A BSDH would increase professional recognition by other professionals.	75 (71)	24 (22)	7 (7)
A BSDH would improve overall professional competency.	55 (52)	30 (28)	21 (20)
A BSDH would increase individual self-esteem.	70 (66)	25 (23)	11 (10)
A BSDH would Increase salary levels for dental hygienists	31 (29)	28 (26)	47 (44)

Note: Percentages may not total 100% due to rounding

of age or older and more than a third of respondents graduated over 30 years ago. Fifty-two percent (n=56) had an associate degree as their highest academic credential, and a high majority of participants (88%) had attended a dental hygiene program in New York State. Nearly all respondents (98%) were members of the ADHA. Table I provides additional demographic characteristics of participants.

### Perceptions of the BSDH as Entry-level for the Profession

Agreement that an associate degree sufficiently prepares a candidate for practicing dental hygiene was almost evenly split between agree/strongly agree (43%) and disagree/strongly disagree (40%). More than half (51%) agreed or strongly agreed a BSDH should be the entry-level degree requirement for the practice of dental hygiene and 32% disagreed/strongly disagreed.

A majority of respondents (n=75, 71%) agreed/strongly agreed that a BSDH would increase professional recognition by others, as well as increase self-esteem (n=70, 66%). Slightly over half of respondents (n=55, 52%) perceived a BSDH as a benefit by improving professional competency. Seventy-three percent agreed or strongly agreed that a BSDH degree offers more career opportunities, however, 44% of participants disagreed/strongly disagreed that a BSDH would increase salary levels. Table II further summarizes respondents' level of agreement to statements regarding the BSDH as an entry-to-practice for dental hygiene.

### **Perceptions Correlated with Age, Years in Practice and Highest Level of Education**

Perceptions about the baccalaureate degree as entry-to-practice did not correlate to participants' demographics of age, or number of years in practice. Table III summarizes statistical analysis of participants' perceptions of the baccalaureate degree as entry to practice by education level. As can be seen from this table the following 2 statements were statistically significantly different among the different levels of education: The BSDH is necessary to ensure the highest standards of service delivery in the field of dental hygiene (p=0.024) and A BSDH would improve overall professional competency (p=0.001). Table III further summarizes participants' perceptions regarding the baccalaureate degree as entry-to-practice based on their reported highest level of education achieved.

## **Discussion**

Recently, the ADHA, in collaboration with the Santa Fe Group, held a conference on transforming dental hygiene education.<sup>18</sup> The Santa Fe Group is comprised of scholars, business leaders and members of health care professions who share a common desire to improve oral health. During this conference, considerable discussion ensued concerning advancing the minimum entry-to-practice. Advocates discussed the need to consider both BSDH and graduate level education as options for entry to practice. The need to support a higher entry-level degree requirement for the profession can be seen with the attention both the ADHA and ADEA have been giving to the topic. Although this study did not address an advanced degree for entry-to-practice, results did support the Santa Fe Group's option of the BSDH.

Another group that has taken an interest in the degree requirements for dental hygiene education is The New York State Dental Hygiene Educators' Association. The New York State Dental Hygiene Educators' Association, established in 1963, is a non-profit organization developed by the dental hygiene educators of New York. A main function of the organization is to provide a forum for issues related to the education of dental hygienists in New York State. During a 2010 meeting, a recommendation was made to move forward with investigating the possibility of increasing the entry-level requirement for the dental hygiene profession in New York State to a baccalaureate level. The investigation is still in its infancy and no legislative proposals have been put forth to the state board with regard to changing degree requirements. To date, there is no data regarding the opinions of practicing hygienists on degree elevation in a state where such a change is being considered. Results from this survey reinforce the New York State Dental Hygiene Educators' Association's recommendation of the baccalaureate degree as the entry-level degree for the profession as a majority of participants perceived it would improve professional competency.

Additionally, this study's results parallel those from 2 Canadian studies showing support of a baccalaureate degree as the entry-to-practice credential and identifying it as a perceived benefit to dental hygiene practice. Kanji et al explored the perceptions of diploma dental hygienists in Canada, who had continued with a baccalaureate degree completion program.<sup>19</sup> Participants perceived that obtaining a baccalaureate degree increased their self-confidence and gave them more credibility as a dental professional. Respondents also felt the baccalaureate degree offered them more career opportunities outside of the traditional clinic practice setting.<sup>19</sup> Imai and Craig conducted a survey of 28 dental hygienists who graduated from the University of British Columbia's Bachelor of Dental Science in Dental Hygiene Program from 1994 to 2003 and explored motivating factors for pursuing a BSDH.<sup>20</sup> Of the motivating reasons for pursuing a BSDH, the following were noted as being very important to survey participants: personal satisfaction (92.6%), increase knowledge (85.2%), work outside of traditional dental hygiene practice (44.4%) and for the status of the degree (37%). Although most participants viewed professional recognition as being "very important" it was much lower (22.2%) than the other categories.<sup>20</sup>

Across other allied health professions, there is

Table III: Means and Results of Kruskal-Wallis Test Comparing Levels of Agreement Across Highest Academic Degrees

Statement	Associate Dental Hygiene	Baccalaureate Dental Hygiene	Baccalaureate Other	Master's	Doctorate	**p-value
Associate degree is sufficient preparation for the challenges of practicing in today's health care settings	2.65	3.58	2.94	3.15	4.33	0.488
BSDH should be the entry-level degree for practice	2.82	1.67	3.06	2.5	1	.0065
The BSDH is necessary to ensure the highest standards of service delivery in the field of dental hygiene	3.05	1.75	2.81	2.4	1	.0024
The BSDH degree is necessary to elevate the status of the dental hygiene profession to that of other mid-level health care providers	2.29	1.42	2.38	1.75	1	0.1
A requirement for the BSDH degree might further limit diversity within the profession	2.93	3.67	3.06	3.15	4	1
Those who are financially disadvantaged may not be able to afford the BSDH	2.47	2.92	2.81	3.1	3.33	1
A BSDH offers more career opportunities	2.16	1.83	2.25	2.15	2	1
Clinical experience is a better indicator of clinical competency than degree held	2.02	2.92	2.63	2.75	2.33	0.146
A BSDH would increase professional recognition by other professionals	2.27	1.5	1.81	1.79	1.67	0.575
A BSDH would improve overall professional competency	2.95	1.58	2.06	2.05	2.33	0.001
A BSDH would increase individual self-esteem	2.36	1.5	2.19	1.9	1.67	0.5
A BSDH would increase salary levels for dental hygienists	3.24	2.83	3	3	3.67	1

\*\*Bonferroni Corrected p-value

information to support the advantages to a baccalaureate degree. Presently there is bill in the New York State Assembly that if passed will require associate degree prepared RN's to obtain a baccalaureate degree within 10 years of initial licensure.<sup>21</sup> This slow but steady change in nursing arises from a need to better prepare nurses for the challenges of providing better patient care to a more diverse and aging population. Within the nursing community, there is a growing body of research to support that baccalaureate degree prepared nurses equate to better patient outcomes. A meta-analysis completed by Johnson assessed the difference in clinical performance of associate degree nurses as compared to nurses with a baccalaureate degree.<sup>22</sup> The study revealed that the level of performance and professionalism demonstrated by baccalaureate prepared nurses to be significantly higher in the domains of communication, problem solving and professional role as compared to nurses with an associate degree.<sup>23</sup> These findings correspond to this study in that perceptions of New York State dental hygienists indicated the BSDH is necessary to provide the highest standards of care as well as increased professional competency. The additional education required for a baccalaureate degree may better prepare dental hygienists to assume the role of mid-level provider to meet the increasing demand for oral health care.

This study has several limitations that must be considered. The sample size was limited to only dental hygienists practicing in the state of New York who were accessible by email. While convenient for accessing dental hygienists, this process may have excluded other dental hygienists from the state who might have provided a different perspective. In addition, the response rate for the study was low, and results cannot be generalized to the entire population of practicing

dental hygienists within the state of New York or across the U.S. Furthermore, the vast majority of respondents were members of the ADHA and the dental hygienists who participated were self-selected. Therefore, the positive findings in this study may be attributed to the participants' inherent biases. Establishing a BSDH as the point of entry into the profession for New York State would not only impact dental hygiene students entering the profession but also dental hygienists who are currently practicing. It is vital to understand the objectives and interests of all those involved. To prepare dental hygienists for future roles in the changing health care system, dental hygiene education must prepare graduates with skills comparable to those of other mid-level health care providers. The transition to a baccalaureate degree as the entry-level degree requirement will not be without challenges, and resourceful leadership will be required to address this deficiency and assist the profession with successfully navigating the changing tide of the future.

## Conclusion

Overall, New York State licensed dental hygienists in our study held positive views regarding the baccalaureate degree as entry-to practice for the dental hygiene profession. The results from this survey may help with advancing initiatives and policies keeping in line with the goal of the ADHA.

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# Winner: Best Paper Award

## Oral Health-Related Complications of Breast Cancer Treatment: Assessing Dental Hygienists' Knowledge and Professional Practice

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The Journal of Dental Hygiene Best Paper Award was created to recognize the most outstanding research paper published from the previous year (2014). All original research papers published in 2014 were evaluated by a panel of judges, using specific criteria, to make the final selection. This manuscript first appeared in Volume 88, Issue Number 2 of the April 2014 issue of the Journal of Dental Hygiene.

### Introduction

Over 200,000 women are diagnosed with breast cancer in the U.S. annually.<sup>1</sup> Breast cancer occurs more frequently in postmenopausal women and the median age at diagnosis is 61 years.<sup>2</sup> The etiology of most breast cancers is unknown. However, risk factors for the disease have been established, including gender, increasing age, family history of breast cancer, early menarche, late menopause, ethnicity, alcohol use and genetic risk factors.<sup>3</sup> The majority of women diagnosed with breast cancer can expect an excellent outcome, with a 5 year survival rate above 80%.<sup>2</sup> Therefore, long-term survivorship issues, including those related to oral health, are important components of breast cancer care and follow-up.

#### Range of Breast Cancer Treatments

The rationale and selection of breast cancer treatments are complex and based on many prognostic and predictive factors, including tumor histology and grade, the clinical and pathologic stage, lymph node involvement, tumor hormone receptor content, tumor HER2 status, comorbid conditions, age and patient pref-

### Abstract

**Purpose:** Approximately 200,000 women are diagnosed with breast cancer in the U.S. every year. These patients commonly suffer from oral complications of their cancer therapy. The purpose of this study was to assess dental hygienists' knowledge and professional practice related to providing care for breast cancer patients.

**Methods:** A pre-tested 43-item survey was mailed to a random sample of 10% of all licensed dental hygienists in the state of Michigan (n=962). The survey assessed the respondents' knowledge of potential oral complications of breast cancer treatments as well as their professional practices when treating patients with breast cancer. After 2 mailings, the response rate was 37% (n=331). Descriptive and inferential analyses were conducted using SAS.

**Results:** Many dental hygienists were unaware of the recommended clinical guidelines for treating breast cancer patients and lacked specific knowledge concerning the commonly prescribed anti-estrogen medications for pre- and postmenopausal breast cancer patients. Over 70% of the respondents indicated they were unfamiliar with the AI class of medications. Only 13% of dental hygienists correctly identified the mechanism of action of anti-estrogen therapy. Dental hygienists reported increased gingival inflammation, gingival bleeding, periodontal pocketing, xerostomia and burning tissues in patients receiving anti-estrogen therapies. Less than 10% believed that their knowledge of breast cancer treatments and the potential oral side effects is up to date.

**Conclusion:** Results indicate a need for more education about the oral effects of breast cancer therapies and about providing the best possible care for patients undergoing breast cancer treatment.

**Keywords:** breast cancer, anti-estrogen therapy, dental hygienist, oral health, knowledge, professional behavior, chemotherapy, education

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.

Table I: Broad Treatment Options for Early Stage Breast Cancer Patients<sup>4</sup>

Menopausal Status	Estrogen Receptor Status*	Surgical Treatment#	Chemotherapy†	Radiation Therapy‡	Endocrine Therapy§
Premenopausal	ER+	Mastectomy or Breast conserving	Chemotherapy†	Radiation‡	Tamoxifen Ovarian suppression with or without an aromatase inhibitor
Postmenopausal	ER+	Mastectomy or Breast conserving	Chemotherapy†	Radiation‡	Tamoxifen or aromatase inhibitor
Premenopausal or Postmenopausal	ER-	Mastectomy or Breast conserving	Chemotherapy†	Radiation‡	–

\*Estrogen-receptor (ER) status (ER positive (ER+) or ER negative (ER-))

#Surgical Treatment: Considered based upon tumor size

†Chemotherapy: May occur either before (neoadjuvant) or after surgical treatment depending upon a variety of clinical, pathologic and genetic factor

‡Radiation Therapy: Considered based upon surgical procedures and stage of disease

§Endocrine Therapy: Considered when the tumor expresses either the Estrogen or Progesterone receptor

Table II: Oral Sequelae of Common Cancer Treatments

Cancer Treatment	Oral Complications
Chemotherapy	Mucositis Xerostomia Fungal Infection (Candida) Viral infection (HSV) Gingival Bleeding Periodontal Infection
Radiotherapy	Transient xerostomia
Intravenous Bisphosphonates*	Osteonecrosis

\*A rare condition which has generally been related to dento-alveolar surgery

erence.<sup>4,5</sup> Table I highlights how menopausal status and hormone receptor status influence care. The National Comprehensive Cancer Network provides comprehensive descriptions of currently accepted approaches for breast cancer treatment.<sup>4</sup>

Surgery for breast cancer addresses local control and provides tissue for analysis of staging and biomarkers. Depending upon the cancer stage, the histologic and molecular profile of the tumor, systemic adjuvant therapy may be recommended to decrease the risk of developing distant metastases.<sup>6</sup> Systemic therapies may include chemotherapy, trastuzumab or anti-estrogen therapy.<sup>7,8</sup> These therapies may be considered either before or after surgery based on the individual patient’s needs and goals. Ra-

diation therapy (radiotherapy) to the breast, chest wall and/or local lymph node regions may be provided as another means of obtaining local control, but does not replace surgery which is the foundation of the management of early stage breast cancer.

Approximately 75% of breast cancers express the estrogen and/or progesterone receptors (ER, PR).<sup>9,10</sup> Breast cancer can depend on ER/PR signaling for tumor growth and survival.<sup>11</sup> Targeting ER/PR with anti-estrogen therapies has been shown to decrease the risk of breast cancer recurrence.<sup>7</sup> In premenopausal women, therapy may ablate ovarian estrogen production by surgery, radiation or chemical means with luteinizing-hormone releasing-hormone inhibitors (goserelin or leuprolide).

More commonly, oral adjuvant systemic anti-estrogens, such as Tamoxifen, are used. Postmenopausal women may be prescribed either Tamoxifen or an aromatase inhibitor (AI) (FDA approved drugs: anastrozole, exemestane or letrozole).<sup>12</sup> While breast cancer occurs in only 1% of males, nearly 90% of their tumors are ER+. Male breast cancer patients are typically treated similarly to women with surgery, followed by systemic therapy (chemotherapy and/or anti-estrogen therapy) plus or minus radiation based on the tumor stage and biomarkers.<sup>13</sup>

### **Risks of Breast Cancer Therapy**

Acute side effects and long term complications of breast cancer therapies have a marked impact on the patients' oral health, oral health-related quality of life and on therapy compliance.<sup>14-16</sup> Cancer patients undergoing chemotherapy often suffer from oral complications including oral/pharyngeal mucositis, pain, xerostomia and dental caries, and are at an increased risk for opportunistic bacterial, fungal and viral infections as a result of chemotherapy-induced immune suppression.<sup>17-19</sup> Patients are also at risk for osteonecrosis and periodontal tissue changes including gingivitis, gingival bleeding and periodontal infection.<sup>20-24</sup> Patients undergoing radiotherapy may complain of transient xerostomia. Table II displays common oral side effects of breast cancer treatments.

Breast cancer therapies can impact skeletal bone mass. Chemotherapy is associated with premature ovarian failure and results in accelerated loss of bone mineral density (BMD).<sup>25-27</sup> In addition, anti-estrogen therapies are associated with stimulating bone loss. Changes in BMD depend on menopausal status as well as on the class of drug used.<sup>28,29</sup> Premenopausal breast cancer patients taking the estrogen receptor antagonist Tamoxifen are at an increased risk for reduced skeletal BMD.<sup>30</sup> In postmenopausal women, Tamoxifen has been shown to maintain or slightly increase BMD.<sup>31</sup> In contrast to the bone-preserving effect of Tamoxifen in post-menopausal bone, AI use is associated with significant loss of BMD.<sup>32</sup> To mitigate the bone loss effect of cancer therapies, bisphosphonates may be prescribed.<sup>33</sup> Importantly, an association has been established between estrogen deficiency, decreases in skeletal BMD, and oral health. Estrogen deficiency among postmenopausal women may increase risk for periodontal diseases, tooth loss, decreased sal-

ivary flow, oral dysesthesia, alterations in taste and burning mouth syndrome.<sup>34,35</sup> As estrogen plays a key role in maintaining bone and soft tissues of the oral cavity, drugs that affect the production and/or binding of estrogen to its receptor may also affect bone and/or soft tissue of the oral cavity.<sup>36</sup>

### **Provision of Oral Care to Breast Cancer Patients**

Dental hygienists often serve as primary oral health care providers for women undergoing breast cancer therapy.<sup>37</sup> As prevention specialists, dental hygienists are in a strategic position to provide information and care to women and men undergoing therapy for breast cancer.<sup>37</sup> Oral assessment prior to and during active treatment (chemotherapy and radiotherapy), and following therapy is a critical aspect of oral health care for cancer patients.<sup>38-40</sup> The National Institute of Dental and Craniofacial Research (NIDCR) indicates that an oral evaluation is necessary prior to cancer therapy for the identification of any outstanding dental needs that could increase the risk or severity of oral complications during breast cancer treatments. For patients undergoing chemotherapy, communication between the oncology and dental teams is essential for the safety of the patient.<sup>41</sup> It is important to determine the patient's hematologic status prior to treatment.<sup>41</sup> In addition, there are some cases where antibiotic prophylaxis may be recommended prior to dental procedures for patients with Port-A-Caths or indwelling central venous catheters to limit secondary infections associated with the immuno-suppression produced by cancer therapies.<sup>42,43</sup> As there appears to be a void in clinically validated premedication guidelines specific to these devices, interprofessional communication and collaborative practice is needed.

Obtaining blood pressure measurement is another important aspect of dental care for the breast cancer patient. Breast cancer patients who receive axillary surgery and/or radiation are at risk for lymphedema. Clinical recommendations include the avoidance of blood pressure measurements on the affected arm(s) of patients who have undergone lymph node removal to mitigate the risk of lymphedema associated with squeezing the lymph channels by a blood pressure cuff.<sup>44-46</sup>

While oral health guidelines for cancer patients have been in place for over 20 years,

research is scarce concerning dental hygienists' provision of dental care for breast cancer patients.<sup>47,48</sup> Currently, no information is available specific to dental hygienists' knowledge of the potential oral complications related to anti-estrogen breast cancer therapies. The aim of this study was to determine dental hygienists' knowledge and professional practice concerning care of patients undergoing treatments for breast cancer. In addition, this study also explored which demographic factors are associated with dental hygienists' knowledge of cancer therapies.

## Methods and Materials

### Study Design

This study was a cross-sectional survey of a random sample of licensed dental hygienists in the state of Michigan. Michigan was chosen due to the large numbers of registered dental hygienists residing in the state. This research was submitted and determined to be exempt from oversight by the Institutional Review Board for the Health and Behavioral Sciences at the University of Michigan.

### Sample Selection

A list of the 10,126 dental hygienists licensed in Michigan was obtained from the Michigan State Board of Dentistry in March of 2011. Dental hygienists with out-of-state mailing addresses were excluded from the sample (n=502) as they did not fit the inclusion criteria. A 10% random sample was selected for this study (n=962) from the remaining licensed dental hygienists.

### Instrument

The survey instrument was developed based on information from a literature search and the advice of several faculty members at the University of Michigan, School of Dentistry. Content experts in breast oncology, oral medicine and public health assessed the validity of the survey. The survey was pre-tested with 10 dental hygienists who worked in private dental practices in Michigan. The survey's test-retest reliability was evaluated by twice administering the survey 2 weeks apart. Pearson's correlation coefficient was used to determine the intra-class correlation (ICC) coefficient. Reproducibility was strong, with ICC values as follows:

- Anti-estrogen therapies - 0.76
- Provision of care - 0.83
- Breast cancer risk factors - 0.71
- Clinical recommendations - 0.81
- Overall - 0.88

The survey consisted of 43 questions concerning the respondents' demographic background, practice characteristics, care recommendations for breast cancer patients and a series of items assessing their knowledge concerning risk factors for breast cancer, knowledge of anti-estrogen cancer therapies and possible oral complications related to anti-estrogen cancer therapies, and the use of bisphosphonates as related to breast cancer therapy. Radiation therapy, other than for patients with head and neck cancer, has not shown a significant impact on oral health.<sup>49</sup> Therefore, no questions concerning potential oral complications or care recommendations were included. The survey contained both closed and open ended questions. Specific open-ended questions were asked concerning oral complications related to cancer therapy.

### Data Collection

Data were collected using a self-administered questionnaire mailed with a cover letter and a return stamped, addressed envelope to a random sample of registered dental hygienists in Michigan in May of 2011. Alternatively, participants had the option to respond to a web-based survey. Respondents were asked to return the questionnaire within 9 days of receipt. By returning the questionnaire, the dental hygienists implicitly provided their consent to participate in this research. Confidentiality for hygienists responding to the web-based survey was assured by using an SSL encrypted data network. Before being mailed, the surveys were coded with a unique number so that one-follow up mailing could be sent to the non-respondents. This second mailing, containing a different cover letter, a second copy of the questionnaire, and a self-addressed stamped return envelope, was sent approximately 4 weeks after the first mailing to all non-respondents.

### Statistical Analysis

The data were entered into Excel spreadsheets twice to allow for validation of correct data entry. The data were then imported into SAS for Windows, Release 11 (SAS). Frequency and percentile distributions as well as means

were calculated for all responses. Chi-square values and probabilities were calculated for appropriate questions to determine the independence of variables from each other. To measure dental hygienists' knowledge, Likert type items were used with a 5-point answer scale ranging from "strongly agree," "agree," "neutral," "disagree" to "strongly disagree." A "don't know" answer category was provided for these questions. For purposes of this study, the "strongly agree" and "agree" responses were added to identify the degree of agreement with the statements and the "disagree" and "strongly disagree" responses were added to identify any disagreement with a statement. Statistical significance was judged at the level of  $p < 0.05$ .

## Results

### Respondent Characteristics

Of the 962 surveys mailed to randomly selected dental hygienists in Michigan license list, 57 were returned due to invalid addresses. The total number of valid surveys returned was 331 (15 submitted by a secure web site and 316 hard copy surveys), which represented a final response rate of 37%. The demographic characteristics of the sample are summarized in Table III. The majority of the respondents were over 25 years of age, had a certificate/associate's level degree (69%), worked full time (72%) in a general dental practice (83%) and had graduated before 1999. Five percent of the respondents reported a diagnosis of breast cancer, and 21% had a family member with a history of breast cancer.

### Knowledge of Patient Care and Current Breast Cancer Therapies

Approximately 51% of the respondents knew that breast cancer is the most common cancer among women in the U.S. Overall, dental hygienists were knowledgeable about the risk factors for breast cancer and were aware that smoking, alcohol use and obesity were modifiable risk factors for breast cancer. Furthermore, only 6% of the respondents indicated distributing prevention literature related to breast cancer in their dental practice.

### Knowledge of Patient Care and Current Breast Cancer Therapies

Ten items assessed the respondents' knowledge concerning the care for breast cancer pa-

tients (Table IV). These items had a Likert-style format and were formulated in such a way that an agreement with the statement indicated a correct answer. Considerable percentages of respondents, ranging from 7 to 80%, indicated that they did not know the answers to these questions. While 56% of the dental hygienists knew that a consultation with an oncologist concerning a patient's cell count should be done prior to dental appointments, and 55% knew that breast cancer patients should not have blood pressure measurements taken on the side where lymph nodes were removed, only 25% were aware that breast cancer patients may develop breast cancer-related metastases as radiolucent areas in the mandible or maxilla. Only 20% were aware that breast cancer patients may need to be pre-medicated prior to dental treatment while having a port for chemotherapy.

In response to 4 statements concerning the respondents' knowledge of current anti-estrogen for breast cancer patients, only 21% knew that current guidelines indicate the use of Tamoxifen for pre-menopausal women with ER+ cancer, and that AIs and/or Tamoxifen are the current standards of care for postmenopausal breast cancer patients. The majority of the respondents did not know that potential side effects of AIs include increased musculoskeletal problems (83%), increased need for bisphosphonate use (77%), or that AIs act by severely decreasing anti-estrogen activity (87%).

While 81% of the respondents were aware that bisphosphonates are commonly prescribed for the prevention or treatment of osteoporosis, only 14% knew that bisphosphonates are commonly prescribed to breast cancer patients using AIs.

### Treatment Recommendations for Breast Cancer Patients

Several questions were asked about oral care recommendations that dental hygienists provide for breast cancer patients at different stages of cancer treatment (Table V). For patients receiving dental care during chemotherapy, the majority of respondents reported provision of oral hygiene instruction, use of mouth rinses, palliative care for xerostomia and use of fluoride rinses. However, only half provided nutrition counseling for breast cancer patients during this segment of their therapy. The most frequently recommended mouthwash

mentioned in the open-ended comment section was MI paste, a rinse containing the milk protein. Dental hygienists were less likely to provide treatment recommendations when providing care for breast cancer patients receiving anti-estrogen therapy. Oral hygiene instruction was provided by only 72% of the respondents and only 64% recommended mouth rinses or fluoride rinses for these patients.

**Knowledge of Potential Complications Related to Breast Cancer Therapies**

Figure 1 shows that 60% of dental hygienists knew that mucosal changes are a common oral complication of chemotherapy. Nearly 80% of respondents correctly stated that xerostomia was related to chemotherapy, and 71% noted a potential increased risk for gingival tissue changes during chemotherapy. While increased risk of osteoporosis was noted as a potential long-term complication of chemotherapy by only 32% of the respondents, even fewer respondents knew that osteoporosis could be related to Tamoxifen use (12%) or AI use (10%), depending on menopausal status. Few respondents knew that xerostomia or gingival changes, dental caries or mucosal changes are potential complications of the use of Tamoxifen or AIs.

**Specific Reported Conditions Related to Anti-Estrogen Cancer Therapy**

When respondents were asked to share specific oral/other complaints related to anti-estrogen therapy that either patients had reported or that they themselves had identified, 14% of dental hygienists reported oral side effects of Tamoxifen and only 7% reported oral side effects relat-

Table III: Overview of the Respondent Characteristics

Background Characteristic	Number* (n=330)	Percentages**
<b>Age (Years)</b>		
20-25	11	3%
26-35	66	21%
36-45	67	21%
46-50	49	15%
51-55	65	20%
>55	68	21%
<b>Level of Education</b>		
Diploma/Certificate/Associates	222	69 %
Bachelors	94	26%
Masters/Doctorate	15	5%
<b>Year of Graduation</b>		
Graduated before 1985	106	34%
Graduated between 1985-1998	101	33%
Graduated after 1998	104	33%
<b>Currently Employed</b>		
Yes - Full Time	238	72%
Part Time	73	22%
No	19	6%
<b>Type of Practice</b>		
General Practice	270	83%
Periodontal Practice	17	5%
Dental/Dental Hygiene School	12	4%
Community Health Agency	10	3%
Public School	5	2%
Hospital/Nursing Home	2	1%
<b>Treated Patient with Breast Cancer</b>		
Yes	314	95%
No	17	5%
<b>Diagnosis of Breast Cancer</b>		
Yes	18	5%
No	309	95%
<b>CE Course with Breast Cancer component</b>		
Yes	21	7%
No	298	93%
<b>Assess Family History of Cancer</b>		
Yes	65	21%
No	251	79%
<b>Assess patient history of cancer</b>		
Yes	288	90%
No	31	10%

\*Frequencies for a characteristic may not add to N=330 due to missing data.

\*\* Percentages for the characteristics may not add to 100% due to rounding.

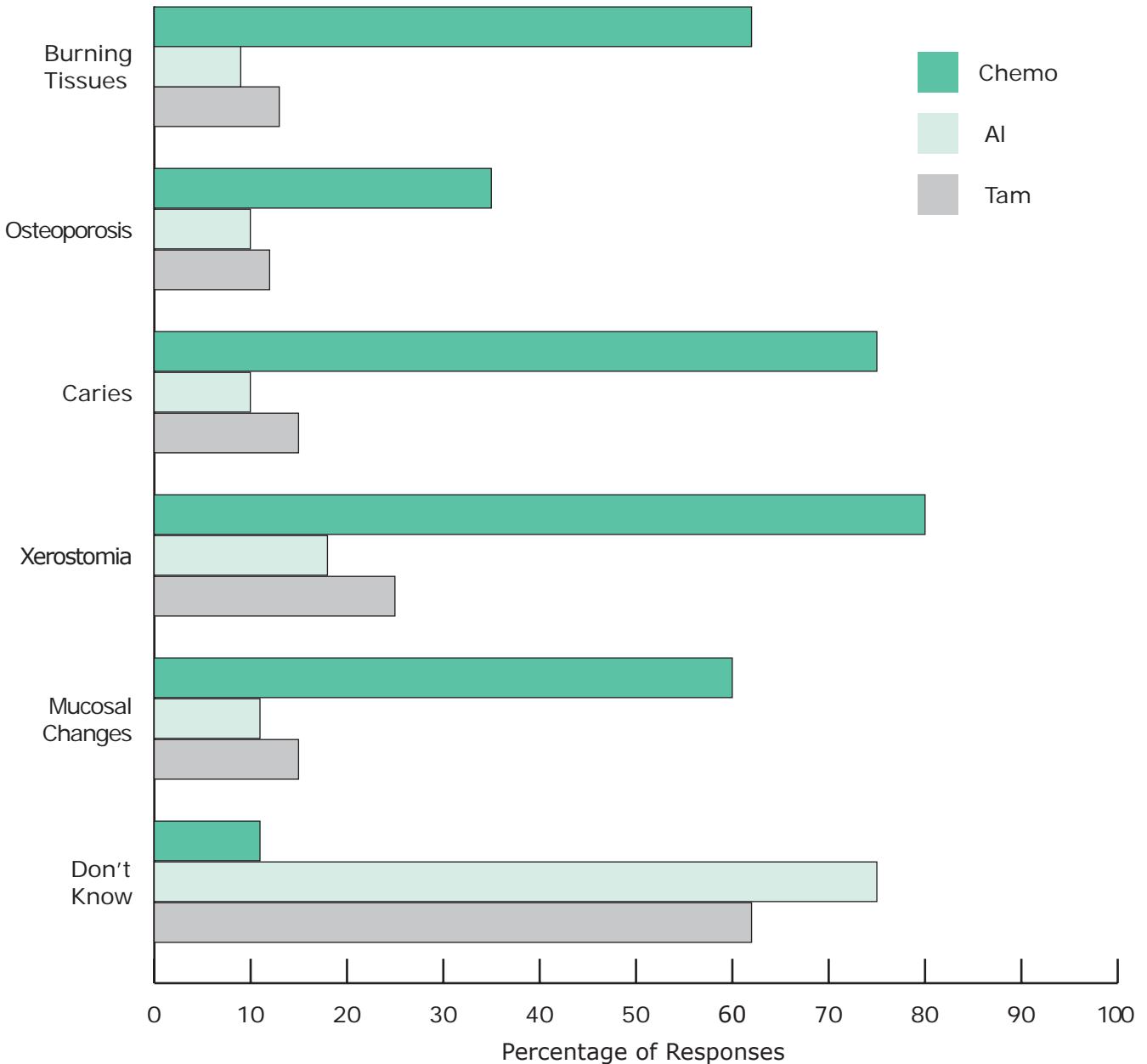
**Table IV: Dental Hygienists' Responses Concerning Their Knowledge of Breast Cancer Patient Care and Anti-Estrogen Cancer Treatments**

Patient Care	Strongly Agree/ Agree n (Percent)	Neutral n (Percent)	Strongly Disagree/ Disagree n (Percent)	Don't Know n (Percent)
Consultation with an oncologist concerning a breast cancer patient's white blood (neutropenia) cell count should be done prior to dental appointments to avoid potential dental infections.	180 (56%)	27 (8%)	33 (10%)	83 (26%)
Breast cancer patients should avoid having blood pressure measurements taken on side where lymph nodes were removed.	177 (55%)	16 (5%)	36 (11%)	93 (29%)
Breast cancer patients may develop breast cancer related metastases as radiolucent areas in the mandible or maxilla.	80 (25%)	27 (8%)	15 (5%)	198 (62%)
Breast cancer patients need to be pre-medicated prior to dental treatment while having a port for chemotherapy.	66 (20%)	14 (4%)	129 (40%)	113 (36%)
<b>Anti-estrogen Therapy</b>				
The current anti-estrogen therapy for premenopausal women with estrogen receptor + breast cancer is Tamoxifen.	69 (21%)	28 (9%)	19 (6%)	207 (64%)
The current anti-estrogen therapy for postmenopausal women with estrogen receptor + breast cancer is Tamoxifen and/or aromatase inhibitors.	66 (21%)	22 (7%)	10 (3%)	224 (70%)
Breast cancer patients may report increased musculoskeletal pain including decreased grip strength while on aromatase inhibitor drugs.	59 (18%)	24 (8%)	3 (1%)	235 (73%)
Aromatase inhibitors given to breast cancer patients act by severely decreasing anti-estrogen activity.	42 (13%)	13 (4%)	9 (3%)	257 (80%)
<b>Bisphosphonate Use</b>				
Bisphosphonates (Fosamax, Boniva, Actonel) are commonly prescribed for prevention and treatment of osteoporosis.	251 (81%)	13 (4%)	37 (12)	22 (7%)
Bisphosphonates are commonly prescribed to women prior/while using aromatase inhibitors.	45 (14%)	21 (7%)	6 (2%)	249 (77%)

ed to the use of AIs (Table VI). Common oral health-related complaints of patients using either an AI or Tamoxifen included increases in gingival inflammation, gingival bleeding, xerostomia, and burning sensations in oral tissues. An oral side effect unique to Tamoxifen use was the report of increased dental caries. Patient-

reported complaints specific to AI use included generalized joint pain and hand and wrist pain. This type of pain was related to difficulties with tooth brushing. A specific patient complaint related to Tamoxifen use was jaw pain (Table VI).

Figure 1: Dental Hygienists' Knowledge of Possible Complications Associated With Breast Cancer Treatments



**Perceptions of Continuing Education**

Less than 10% of respondents considered their knowledge about breast cancer risk factors and treatments up to date. Only 7% of dental hygienists reported having taken a continuing education class that had included information on potential oral complication of cancer treatments within the last 5 years. The majority of dental hygienists (95%) desired further education in this area. The most popular choices for updating knowledge were continuing education lectures (80%), reading journal articles (28%)

and receiving specific topic booklets with self-tests (41%).

**Socio-Demographic Characteristics, Practice Factors and Knowledge of Oral Consequences of Breast Cancer Treatment**

To assess the impact of background characteristics on dental hygienists' level of knowledge related to the effects of breast cancer treatments on their patients' oral health, bivariate analyses were performed (Table VII). Respondents who had been diagnosed with breast

**Table V: Dental Hygienists' Recommendations for Breast Cancer Patients During Chemotherapy and Anti-Estrogen Therapy (n=330)**

Provided/recommended treatment	Which clinical dental care do you provide/recommend for patients receiving:			
	Chemotherapy		Anti-estrogen Therapy (Tamoxifen and Aromatase Inhibitors)	
	n	Percentages	n	Percentages
Xerostomia alleviating strategies such saliva substitutes	293	93%	206	66%
Fluoride treatments/toothpastes/ rinses	291	92%	200	64%
Oral Hygiene instruction	287	91%	224	72%
Nutrition counseling	180	57%	132	42%

**Table VI: Responses Concerning Oral Conditions Associated With Anti-Estrogen Therapy (n=276)**

Anti-estrogen treatment	Dental Hygienists indicating treating patients with oral side effects		Specific reported side effects*
	n	Percentages	
Aromatase Inhibitors	17	7%	<ul style="list-style-type: none"> <li>• Gingival inflammation Xerostomia Burning tissues/ mouth</li> <li>• Joint pain Pain in hands – difficulty brushing</li> <li>• Increase in periodontal pocketing</li> </ul>
Tamoxifen	39	14%	<ul style="list-style-type: none"> <li>• Gingivitis Burning tissues/mouth Bleeding on probing</li> <li>• Xerostomia Increased caries Pain in jaws</li> <li>• Increase in periodontal pocketing</li> </ul>

\*Specific oral/other complaints identified by the dental hygienist or reported by a patient with breast cancer using endocrine therapy.

cancer (p=0.004) and respondents who asked their patients about their family history with cancer (p=0.026) were more likely to indicate that their knowledge in this area was up to date than other dental hygienists.

## Discussion

Over 2.5 million women in the U.S. have been diagnosed with breast cancer.<sup>50</sup> As the survival rate is increasing, long-term survivorship issues including oral health status are important components of breast cancer care and follow-up.<sup>2</sup> This is the first study examining dental hygienists' knowledge of anti-estrogen therapies and professional practice related to providing care for these patients.

## Knowledge of Patient Care and Anti-Estrogen Therapies

While 95% of the respondents indicated that they had treated a patient with a diagnosis of breast cancer, just over half knew that breast cancer is the most common cancer among women, aside from non-melanoma skin cancer.<sup>1</sup> In addition, quite a high percentage of respondents reported that they did not know the answers to the questions concerning patient care (26 to 62%), the consequences of using anti-estrogen therapy (64 to 80%) and bisphosphonate use (7 to 77%). A lack of knowledge concerning these issues can put patients at risk and should therefore be addressed both in dental hygiene programs, as well as in continuing education courses. For example, large percentages of dental hygien-

**Table VII: Associations Between Demographic/Professional Attributes and Dental Hygienists' Knowledge of Breast Cancer and Breast Cancer Treatments (n=318)**

Background Characteristic	Knowledge of Breast Cancer Treatments on Oral Health Up-to-date				
	Yes (n=29)	Yes %	No (n=289)	No %	P-Value
<b>Age</b>					
20 to 25	1	10%	9	90%	0.45
26 to 35	6	9%	58	91%	
36 to 45	4	6%	62	94%	
46 to 50	5	11%	42	89%	
51 to 55	8	13%	56	88%	
56+	5	8%	60	92%	
<b>Level of Education</b>					
Diploma/Certificate/Associates	17	8%	200	92%	0.28
Bachelors	10	12%	71	88%	
Masters/Doctorate	1	7%	13	93%	
<b>Year of Graduation</b>					
Graduated before 1985	6	5%	97	94%	0.29
Graduated between 1985 to 1998	12	12%	87	88%	
Graduated after 1998	9	9%	93	91%	
<b>Currently Employed</b>					
Full Time	14	7%	196	93%	0.07
Part Time	13	13%	90	87%	
<b>Type of Practice</b>					
General Practice	25	7%	237	93%	0.67
Other	4	13%	48	87%	
<b>Diagnosis of Breast Cancer</b>					
Yes	5	28%	13	72%	0.004
No	24	8%	276	92%	
<b>Knowledge of Breast Cancer prevalence</b>					
Yes	13	8%	143	92%	0.16
No	6	16%	32	84%	
Unsure	7	6%	110	94%	
<b>Assess Family Cancer History</b>					
Yes	10	16%	53	84%	0.026
No	17	7%	227	93%	

Frequencies for a characteristic may not total n=318 due to missing data

ists were not aware of the recommended clinical guidelines for treating breast cancer patient when taking blood pressure readings, for consultation with an oncologist for determining patient white blood cell counts before treatment and for the need for possible premedication of breast cancer patients who have a port for chemotherapy.

Dental hygienists' knowledge concerning anti-estrogen therapy for breast cancer patients showed significant deficiencies, with large majorities of respondents indicating that they did

not know the answers to the questions concerning these issues.<sup>21-25</sup> Only a small percentage (21%) were aware of the current anti-estrogen treatment standards for pre and postmenopausal women (21%), and fewer still responded correctly to the questions about the mechanism of action of anti-estrogen therapy (13%). These findings are of concern because the American Society of Clinical Oncology (ASCO) has developed clinical practice guidelines on adjuvant anti-estrogen therapy for postmenopausal women with hormone receptive positive (ER+ or PR+) breast cancer, which recom-

mend that, for optimal adjuvant anti-estrogen therapy for postmenopausal women with ER+ disease, an AI should be used either as initial therapy or following a course of Tamoxifen.<sup>51</sup> At present, the recommended duration of initial anti-estrogen therapy is 5 years, and extended anti-estrogen therapy for an additional 5 year period has proven beneficial for some patients.<sup>52</sup> In consideration of this long duration of anti-estrogen therapies for breast cancer patients, treatment-related adverse effects are not only relevant, but absolutely crucial for assuring patients' long-term oral health.

Over 75% of dental hygienists were unaware that patients on anti-estrogen therapies may develop potential musculoskeletal issues related to the use of AIs. Musculoskeletal toxicities occur in up to 50% of patients. Symptoms include joint stiffness, myalgias and arthralgias, especially of the wrists, hands, and fingers.<sup>53</sup> The etiology of AI-associated musculoskeletal symptoms remains unclear, but may be a result, in part, of estrogen deprivation.<sup>54</sup> Patients with these side effects may find maintenance of oral health difficult because of pain or inability to brush and floss their teeth. Dental hygienists need to be aware of these issues to provide educational interventions and treatments to support these patients.

These findings concerning dental hygienists' knowledge about standard cancer treatments and potential adverse effects of anti-estrogen therapy should serve as a call to action for dental educators involved in dental hygiene programs as well as in continuing education courses.

### **Oral Complications and Care Recommendation Related to Breast Cancer Treatments**

Most dental hygienists reported that chemotherapy places patients at an increased risk for xerostomia, and mucosal and gingival changes (Figure 1). Fewer respondents were knowledgeable about the oral complications associated with anti-estrogen therapies. A similar pattern emerged regarding patient care recommendations given to breast cancer patients during different stages of cancer treatment. While the majority of dental hygienists provided or recommended xerostomia alleviating strategies, mucosal rinses and oral hygiene education for patients undergoing chemotherapy, only about two-thirds of the respondents provided or rec-

ommended these treatments for patients undergoing anti-estrogen therapies.

Gingival inflammation, gingival bleeding, periodontal pocketing, xerostomia and burning tissues were reported by the small number of respondents who had been told by patients or had observed themselves consequences of using Tamoxifen (n=39) and AIs (n=17). More than twice as many dental hygienists reported Tamoxifen-related oral side effects as compared to AI side effects. The low number of responses may be attributable to the fact that 75% of the respondents indicated they were unfamiliar with AI medications, which may have limited the reporting of oral side effects related to their use.

As the majority of dental complications that occur in cancer patients are related to changes in saliva production and function, knowledge of potential side effects of anti-estrogen therapies is important.<sup>55</sup> Sex hormone receptors have been detected in the oral mucosa and salivary glands.<sup>56,57</sup> Estrogen deficiency among post-menopausal women has been associated with decreased salivary flow unrelated to medications.<sup>58</sup> Decreased saliva flow can result in xerostomia, gingival bleeding, increase in dental caries, and may be responsible for an increased prevalence of oral dysesthesia and alterations in taste.<sup>59-62</sup>

Breast cancer treatments, such as chemotherapy and anti-estrogen therapies, which may promote a low estrogen status, have also been linked to an increased risk of osteoporosis, which is known to be a risk factor for periodontitis.<sup>31,63,64</sup> Therefore, cancer therapies may be risk factors for periodontitis as well as for osteoporosis. Consequently, women with a diagnosis of cancer, especially postmenopausal cancer survivors, may experience higher levels of xerostomia and dental caries as well as a possible increase in their risk for periodontal disease due to the substandard estrogen levels associated with the use of AI medications.

An important finding in this study is that less than 10% of respondents believed that their knowledge of breast cancer treatments and their oral side effects are up to date. It is not surprising that nearly all respondents indicated an interest in taking a continuing education course on this subject. Educational interventions in which dental, dental hygiene, nursing and medical professionals learn about these is-

sues together may be the optimal path to promoting understanding of the impact of breast cancer treatments on oral health and the treatment needs of these patients.

Overall, these findings suggest the need to increase the educational material about breast cancer survivorship issues in dental hygiene and continuing education programs. In addition, it would be helpful to conduct a study to determine the scope of information provided within the entry-level dental and dental hygiene curricula.

In this survey, dental hygienists with a diagnosis of breast cancer as well as those who assessed the patients' family history of cancer were more confident about breast cancer treatments and their impact on oral health. These dental hygienists may have more knowledge or may have a practice philosophy of incorporating systemic health evidence into their dental hygiene practice.

One limitation of this study is that only 37% of the dental hygienists who received a mailing responded to this survey. However, recent research concerning survey response rates in studies with dentists showed that this response rate is actually higher than the response rate in most surveys. This recent study compared the response rates of postal mail surveys and electronic surveys used to collect data from practicing dentists. It found that the response rates for mailed surveys were 28% and those for web-based surveys were 11%.<sup>51</sup> The response rate in this study is therefore acceptable. Nevertheless, future research should replicate this study in other geographical locations to assure that these findings can be generalized to dental hygienists in other parts of the U.S.

## Conclusion

Our results suggest that dental hygienists lack knowledge concerning the oral health-related effects of common drugs used in breast cancer treatment, including AIs and Tamoxifen. Given the high number of women undergoing these treatments over the course of many years, it is important that dental care providers

are aware of the issues related to breast cancer treatment and have the skills to provide the best possible care for these patients to assure their oral health in the long run. Careful monitoring of the oral health of women with breast cancer is important during all stages of cancer therapy to prevent, detect and treat complications as soon as possible.

The majority of dental hygienists surveyed thought that their own knowledge concerning the management of breast cancer patients was not current and wished to learn more about this topic. Developing interdisciplinary educational interventions for dental hygiene programs as well as continuing education courses about dental care and breast cancer treatments is important. Further research is needed concerning the long-term oral health-related consequences of breast cancer treatments, as is research into the best practices that would provide optimal care for these patients.

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# Runner-Up: Best Paper Award

## North Carolina Cardiologists' Knowledge, Opinions and Practice Behaviors Regarding the Relationship between Periodontal Disease and Cardiovascular Disease

Megan Mosley, BSDH, MS; Steven Offenbacher, DDS, MS, PhD; Ceib Phillips, MPH, PhD; Christopher Granger, MD; Rebecca S. Wilder, BSDH, MS

The Journal of Dental Hygiene Best Paper Award was created to recognize the most outstanding research paper published from the previous year (2014). All original research papers published in 2014 were evaluated by a panel of judges, using specific criteria, to make the final selection. This manuscript first appeared in Volume 88, Issue Number 5 of the October 2014 issue of the Journal of Dental Hygiene.

### Introduction

Oral systemic health has been a topic that is gaining more attention in the U.S. The Institute of Medicine (IOM) 2011 report on Advancing Oral Health in America concluded that in order to enhance the delivery of oral health care across the U.S., a collaborative effort across multidisciplinary health related fields is necessary.<sup>1</sup>

The U.S. Surgeon General's report noted that there is an association between chronic oral infection and diseases such as diabetes, heart disease and pre-term low birth weight babies.<sup>2</sup> The IOM report along with the report from the U.S. Surgeon General regarding oral health in America discusses the association between oral health and other systemic conditions. The report also states that there is a lack of knowledge or training of non-dental health care providers in the area of oral health care. The IOM committee concluded that non-dental health care providers could have an increased role in oral health care. It also stated that interprofessional, team-based care could provide the best care to patients.<sup>1</sup>

Periodontal disease is a common oral disease that affects approximately 47.2% of the adult popula-

### Abstract

**Purpose:** There has been an increase in awareness of the link between oral health and systemic health in recent years. While questions exist about the relationship of oral disease to cardiovascular conditions, no published study to date has addressed cardiologists' knowledge and opinions about this area of science. This study examined North Carolina cardiologists' knowledge, opinions and practice behaviors regarding periodontal disease and cardiovascular disease.

**Methods:** A survey was developed, revised, pilot tested and mailed to 625 licensed, practicing cardiologists' in North Carolina. A total of 3 mailings were conducted. Data were analyzed using descriptive statistics.

**Results:** The response rate was 19% (n=119). Respondents were mostly males (86%) and working in private group practice (48%) or academia (32%). Sixty three percent correctly identified the first sign of periodontal disease; however, only 18% choose the correct etiology of periodontal disease. Sixty percent of respondents stated that medical students and dental students should be trained to work collaboratively. Half of cardiologists' surveyed were unsure that treatment of periodontal disease can decrease a patient's risk for cardiovascular disease. The majority were interested in learning more about the relationship between cardiovascular disease and periodontitis.

**Conclusion:** The majority of cardiologists surveyed were unclear about the etiology of periodontal disease and would like to have more information about the potential oral-systemic link regarding cardiovascular disease. It is important for educators and administrators in higher education to examine the need for interprofessional education and collaboration between medicine and dentistry. This study may provide valuable information about ways to implement more effective interprofessional education and collaboration between dental and dental hygiene professionals and cardiologists to improve oral health.

**Keywords:** cardiovascular disease, dental education, interdisciplinary education, oral-systemic health, periodontitis

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Assess strategies for effective communication between the dental hygienist and client.

tion in the U.S. In adults aged 65 and older the prevalence increases to 70%.<sup>3</sup> Periodontitis is a bacterial induced, chronic inflammatory disease that destroys the supporting tissues surrounding teeth. A general dentist or periodontist clinically diagnoses periodontal disease using variables such as tooth loss, recession, clinical attachment loss, periodontal pocket probing, tooth mobility and radiographic bone loss.<sup>4-10</sup> Factors such as smoking, type 1 and 2 diabetes mellitus, cardiovascular disease, and obesity have also been linked to the risk associated with developing periodontal disease.<sup>6,10-17</sup>

Cardiovascular disease is the leading cause of mortality in the U.S., with approximately 11.5 % of Americans having been diagnosed. High blood pressure, low-density lipoproteins and smoking are all risk factors associated with cardiovascular disease.<sup>18</sup> The Center for Disease Control and Prevention (CDC) estimates that coronary heart disease costs the U.S. \$108.9 billion dollars each year.<sup>19</sup> Several studies have reported that periodontal disease pathogens and inflammatory markers are common between cardiovascular disease and periodontal disease.<sup>6-9,20,21</sup>

### **Cardiovascular Disease and Periodontal Disease**

Cardiovascular disease and periodontal disease have many of the same contributing risk factors such as smoking, diabetes and age. It has been suggested that periodontal disease is a direct pathway by which the 2 diseases could be associated. Mucci et al hypothesized that inflammatory mediators that react in response to periodontal pathogens could have a possible effect on the systemic inflammatory response to the development of atherosclerotic plaque.<sup>16</sup> Periodontal infections could be a casual pathway to cardiovascular disease though bacteremia or inflammatory mediators provoked in response to the pathogen. Therefore, this systemic inflammatory response may induce the development of atherosclerotic plaque.<sup>16</sup>

Blaizot et al conducted a meta-analysis of observational studies using a methodological process of reviewing 215 epidemiological studies.<sup>5</sup> The meta-analysis examined the association between exposure to periodontitis and cardiovascular disease. Of the 215 studies, 22 case-control and cross sectional studies along with 7 cohort studies were selected to use in the analysis. The results supported an association between persons with periodontal disease and cardiovascular dis-

ease. This analysis provided evidence that many of the risk factors associated with cardiovascular disease and periodontal disease are independent of each other. It concluded that further research is needed to examine the pathophysiological process between the two.

Poor oral hygiene is the major cause of periodontal disease. This chronic oral infection is related to a systemic inflammatory response. Periodontal disease has been reported to cause an increase in the C-reactive protein levels in patients. Systemic inflammation could signify the mechanism that links periodontal disease and cardiovascular disease. de Oliveira et al conducted a survey to measure if self-reported tooth brushing and oral hygiene was associated with an increase in cardiovascular disease.<sup>21</sup> The results indicated that persons with reported poor oral hygiene had a higher risk of cardiovascular disease and low-grade inflammation but the causal nature was yet to be determined.

Another meta-analysis focused on prospective cohort studies conducted among the general population. The purpose of this meta-analysis was to determine the relationship between periodontal disease and coronary heart disease. This analysis also reported that biological markers such as C-reactive protein serve as an indicator for additional coronary heart disease. It reported that periodontal disease results in approximately a 24 to 35% increased risk for coronary heart disease.<sup>8</sup>

With the potential effect for periodontal disease to increase risk for cardiovascular disease, it is important for the dental and medical professions to work together to help reduce the risk for adverse outcomes for patients. In 2009, a set of clinical recommendations for patients with periodontal disease and/or cardiovascular disease was published.<sup>22</sup> These recommendations were established to provide guidance to both cardiologists and periodontists regarding the link between cardiovascular disease and periodontitis and a potential approach to reducing the risk for cardiovascular disease in patients who have periodontitis. The recommendations were important because they represented the first of its kind between cardiologists and periodontists.

In 2012, the American Heart Association (AHA) issued a scientific statement regarding the association between cardiovascular disease and periodontal disease. Health care professionals from dentistry, infectious diseases, cardiology and epi-

demology formed a group to assess and measure the scope of evidence for an association or causality between the 2 diseases. A total of 282 peer-reviewed publications were selected for a literature review.<sup>23</sup> The AHA statement suggests that there are significant gaps in the scientific understanding of the interaction of oral health and cardiovascular disease. Therefore, it is stated that while there is an association between cardiovascular disease and periodontal disease, there is not a causal relationship.<sup>23</sup>

### **Health Care Practitioners' Knowledge and Practices Regarding Oral Systemic Diseases**

The area of oral systemic health is continuing to grow in the U.S. It is important to assess the current knowledge and practices of health care practitioners' regarding oral systemic diseases. It is also imperative to examine the roles of both medical providers and oral health care providers in assessing the practice behaviors regarding patient care.

Lewis et al assessed pediatricians' knowledge, attitudes and professional experience regarding oral health and to determine pediatricians willingness to incorporate fluoride varnish into their practices.<sup>24</sup> They conducted a survey of 1,600 randomly selected pediatricians using the American Medical Association list of pediatricians. The survey assessed the knowledge, current practice and opinions on their role as a pediatrician to promote oral health. The response rate was 62% with 1,386 eligible survey recipients. Two-thirds of respondents observed caries in their school-aged patients. While the majority of respondents referred patients to a dental office or clinic, 55% reported difficulty in achieving referral for uninsured patients, and 90% agreed that they played an important role in promoting and educating patients on the importance of oral health.

Owens et al surveyed 1,000 internists and 115 endocrinologists to determine their knowledge, opinions and practice behaviors regarding periodontitis and diabetes.<sup>25</sup> The survey received a 34% response rate. Knowledge about periodontal disease was high and the respondents agreed that physicians should be taught about periodontal disease and be trained to do screenings for periodontal disease. The majority of respondents indicated that there is a link between periodontal disease and diabetes; however, the majority were not familiar with studies regarding the relationship between the 2 diseases.

Wooten et al surveyed 404 nurse practitioners' and certified nurse midwives' to determine their knowledge, opinions and practice behaviors regarding periodontal disease and adverse pregnancy outcomes.<sup>26</sup> The results indicated that nurse practitioners and certified nurse midwives had limited knowledge about oral health. Both the Owens and Wooten surveys concluded that collaborative efforts between healthcare providers and oral health care providers would benefit patients in various areas of health care.<sup>25,26</sup>

### **Oral Health Care Practitioners' Knowledge and Practices Regarding Oral Systemic Diseases**

Collaborative efforts made by the dental team and cardiologists could help to identify and reduce oral/systemic diseases. The dental hygienist is an essential component to the dental team. Dental hygienists receive extensive training on medical histories and systemic diseases, as well as oral diseases such as periodontal disease. The dental hygiene process of care is multifaceted to include assessment, implementation and evaluation of outcomes.<sup>27</sup> Bell et al stated that it "is the responsibility of the dental hygienist to make assessments based on patients' systemic health to promote a healthy lifestyle in addition to providing safe and effective dental hygiene care."<sup>28</sup> The Bell et al study also reported on practice behaviors of dental hygienists incorporating oral systemic evidence into patient care. In this study, a survey was conducted to assess whether dental hygienists updated medical histories at every appointment, assessed blood pressure and obtained blood sugar readings. During the assessment phase of care, 84% of the respondents reported that it is the dental hygienist who performs a periodontal exam on new patients. The survey also indicated that 64% of the respondents performed periodontal examinations at every visit for periodontal maintenance patients. Sixty-eight percent of respondents reported that medical histories were updated at every visit, and 92.9% discussed medications and medical diagnoses with all patients. However, very few record blood sugar levels. The results from this survey exhibited that respondents are incorporating some aspects of oral systemic evidence into patient care.<sup>29</sup>

Although there is some evidence that there is an association between periodontal disease and cardiovascular disease, little is known about medical providers' knowledge about the link. The purpose of this study was to examine the knowl-

edge, opinions, and practice behaviors of North Carolina cardiologists' regarding the association between cardiovascular disease and periodontal disease.

## Methods and Materials

A cross-sectional survey was designed to assess North Carolina cardiologists' knowledge, opinions and practice behaviors regarding the relationship between cardiovascular disease and periodontal disease. The survey was adapted from a questionnaire developed at the University of North Carolina that focused on a similar topic regarding oral and systemic health. The survey was modified to address the current research questions. Thirty four questions were included and divided into 6 sections that included the following topics:

1. Practice setting
2. Oral examinations
3. Oral and systemic health
4. Opinions about periodontal disease
5. Education
6. Demographics

A list of cardiologists was obtained from the North Carolina Medical Board. Although the list contained the names of 1,160 registered cardiologists in the state of North Carolina, only 625 were actively practicing cardiology, so surveys were mailed to 625 cardiologists. The selection criteria included cardiologists practicing full time or part time in a public, private or government practice in North Carolina. Retired cardiologists, pediatric cardiologists or cardiologists practicing outside of the state were excluded from the study.

The survey was reviewed and approved by the Institutional Review Board. Following the approval, the survey was pilot tested with 5 practicing cardiologists. After minor changes, the survey was produced using Teleform, a scannable format that simplifies data entry. The survey, along with a cover letter explaining its purpose and business reply envelope was mailed using the Salent and Dillman method.<sup>30</sup> There were 2 mailings in the fall of 2012 and a final mailing in January 2013. To maintain confidentiality, there were no identifiers on the surveys and random identification numbers were assigned to each subject. All data was stored in a password-protected database that was only accessible to the research team and statistician. The data were analyzed using SAS version 9.1 (SAS Institute Inc., North Carolina) using descriptive statistics.

Table I: Demographics of North Carolina Cardiologists (Respondents)

	n	Percent of respondents
<b>Age (in years)</b>		
30 to 40	18	16
41 to 50	40	35
51 to 60	32	28
61 to 70	18	16
>70	6	5
<b>Gender</b>		
Female	15	13
Male	97	87
<b>Practice setting</b>		
Private group practice	54	48
Solo practice	10	9
Academia	36	31
Other	13	12
<b>Years providing care to patients with cardiovascular disease</b>		
<5 years	8	7
5 to 10 years	22	19
11 to 15 years	13	11
16 to 20 years	28	23
>20 years	45	40
<b>Hours per week providing patient care</b>		
<10 hours	7	6
11 to 20 hours	10	9
21 to 39 hours	7	6
>40 hours	84	79

## Results

A total of 119 surveys were completed as requested and were useable for data analysis, resulting in a 19% response rate. Demographic data is reported in Table I. Seven percent of respondents have been providing patient care for less than 5 years, and 40% reported providing more than 20 years of care to patients with cardiovascular disease. Eighty-six percent were male and 78% were 60 years old or younger. Eighty-five percent reported receiving dental care within the last year, and 90% reported their oral health as "good" or "excellent." Eighteen percent had been told that they have periodontal disease. (Table II)

### Practice Behaviors and Oral Examinations

Forty-one percent of cardiologists refer patients to a dental facility when they express concerns about their mouth, and 31% refer if

**Table II: North Carolina Cardiologists' Oral Health Status**

	n	Percent of respondents
Last time received dental care		
<1 year	97	85
1 to 2 years	13	11
>2 years	4	4
Never	0	0
Last time received a periodontal examination		
<1 year	94	83
1 to 2 years	15	13
>2 years	4	4
Never	0	0
How would you rate your oral health		
Excellent	44	39
Good	59	51
Fair	11	10
Poor	0	0
Very Poor	0	0
Ever been told you have periodontal disease		
No	92	82
Yes	20	18
Maybe	0	0

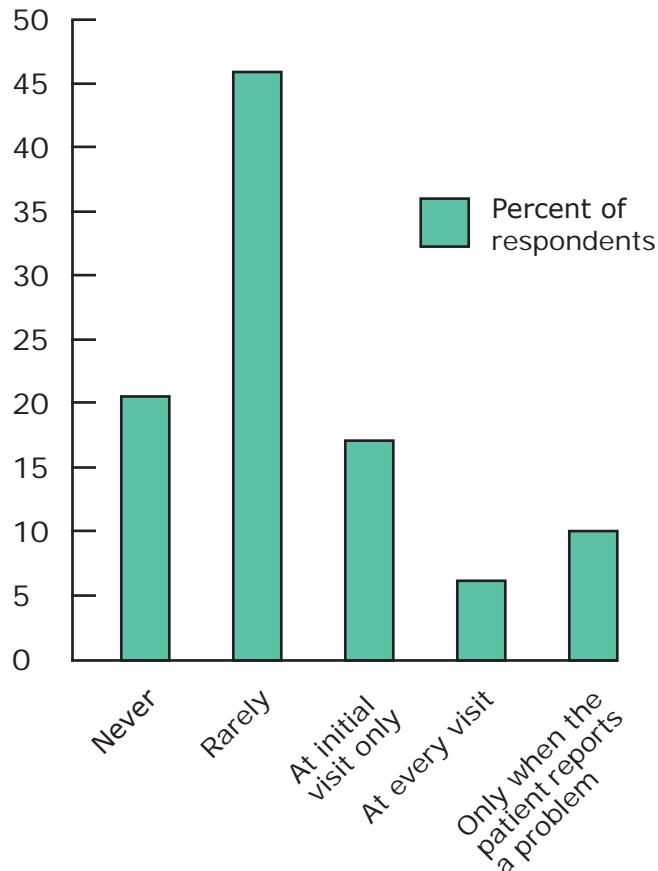
**Table III: Survey Respondents' Patients with Cardiovascular Disease Referred to Dental Facility within the Past Year**

	n	Percent of respondents'
Patients referred with periodontal disease		
0	46	41
≤5	53	46
≥6	15	13
Patients referred for tooth decay		
0	49	45
≤5	47	43
≥6	14	12
Patients referred to you from a dentist/dental facility		
0	67	60
≤5	21	19
≥6	24	21

they see something that should be further examined. However, 22% never refer patients to a dental clinic or facility. In the past year, 46% of respondents reported referring between 1 to 5 patients to a dental facility due to periodontal disease, and 13% referred more than 6 patients within the last year. Respondents' answers were similar for referring a patient for tooth decay, with 43% referring between 1 and 5 patients to a dental facility for tooth decay, whereas 12% referred 6 or more patients (Table III).

Physicians were asked how often they perform oral examinations on their patients, and 18% responded that they perform an oral exam at the initial visit, while 21% never perform oral examinations on their patients (Figure 1). When asked the reasons for not doing so, 46% responded that it is the responsibility of the dental professional and 45% were not sure what type of exam to perform (Figure 2)

**Figure 1: Frequency Survey Respondents Perform Oral Health Exams on Patients with Cardiovascular Disease**

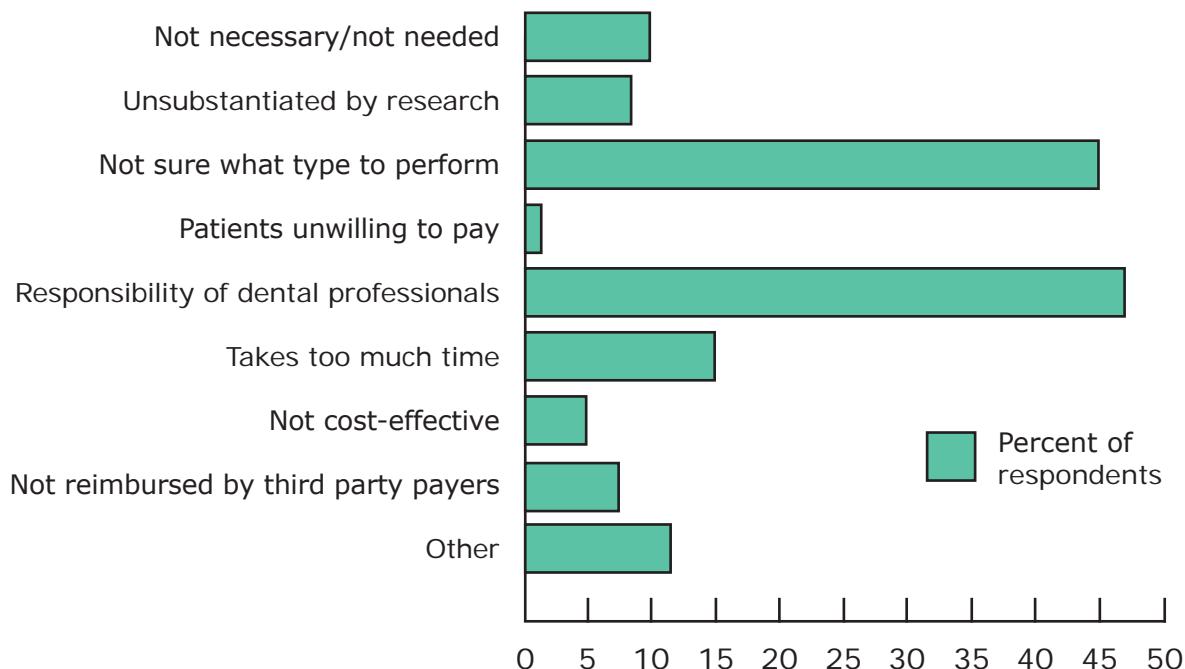


**Knowledge and Opinions about Periodontal Disease and Systemic Health**

Cardiologists' knowledge about periodontal disease was moderate, with 70% reporting that bone loss describes periodontal disease. Sixty-

three percent of respondents answered correctly about the first sign of periodontal disease as being bleeding gums, and 50% were aware

Figure 2: Survey Respondents' Reasons for Not Performing Oral Exams



that periodontal disease is an infection in the gums. Conversely, 18% described tooth decay as a sign of periodontitis, and 31% recognized reversible redness/inflammation as a clinical indication of periodontitis.

The majority (92%) of cardiologists agreed or strongly agree that inflammation is a key component between periodontal disease and cardiovascular disease, and 66% agree that controlling infection and inflammation is important for managing cardiovascular disease. When asked about their knowledge about the studies regarding an association between cardiovascular disease and periodontal disease, 50% agreed and 50% were unsure or disagreed. When asked if patients with periodontal disease were more likely to have increased atherosclerosis and risk for myocardial infarction and stroke, 72% agreed (Table IV).

Only 39% agreed that treatment of periodontal disease could decrease a patient's risk for cardiovascular disease. However, 72% were interested in learning more about the relationship between cardiovascular disease and periodontal disease. The majority of physicians (71%) agreed it is important for cardiologists' and periodontists to work together to educate their patients about oral systemic disease risks (Table IV).

Cardiologists were asked if they were famil-

iar with the 2009 clinical recommendations regarding the relationship between cardiovascular disease and periodontal disease.<sup>17</sup> Sixteen percent were slightly familiar while 78% were not familiar. When asked if these recommendations changed the way they treat their patients, 76% indicated they had not changed procedures. Twenty-two percent of respondents were familiar with the recent 2012 statement from the AHA and 86% said that the statement has not changed their opinion about the importance of oral health to overall health.<sup>23</sup>

### Physicians' Education

Physicians reported that 20% of their professional education included oral health content. However, 80% reported not receiving any education on oral health care. For the majority of physicians who did receive oral health education, 90% received less than 3 hours. Twelve percent reported having clinical requirements regarding assessments of the teeth or gums, while only 5% reported observing a dentist or dental hygienist. When asked to rate the quality of their oral health education, 69% reported it as poor. Sixty percent of cardiologists believe that medical and dental students should be trained to work collaboratively, and 39% responded that "maybe" they should be trained to do so (Table V).

Table IV: Opinions About Periodontal Disease and Systemic Health

	Strongly Agree	Agree	Unsure/ Don't Know	Disagree	Strongly Disagree
	Percent (n)	Percent (n)	Percent (n)	Percent (n)	Percent (n)
Inflammation is a key component between periodontal disease and cardiovascular disease.	28 (31)	64 (71)	5 (6)	3 (3)	0 (0)
Good oral health is important to the rest of the body.	36 (39)	58 (63)	5 (5)	1 (1)	0 (0)
I am knowledgeable regarding the studies linking periodontal disease and cardiovascular disease.	7 (7)	44 (49)	21 (23)	23 (26)	5 (6)
Patients with periodontal disease are more likely to have increased atherosclerosis and risk for myocardial infarction and stroke, even after adjusting for traditional cardiovascular disease risk factors.	14 (15)	58 (64)	20 (22)	7 (8)	1 (1)
Controlling infection and inflammation is important for managing cardiovascular disease.	17 (19)	49 (54)	30 (33)	4 (5)	0 (0)
Patients diagnosed with cardiovascular disease are more likely to have periodontal disease.	6 (7)	40 (44)	49 (54)	5 (6)	0 (0)
Treatment of periodontal disease can decrease a patient's risk for cardiovascular disease.	7 (8)	32 (36)	46 (51)	13 (14)	2 (2)
I am interested in learning more about the relationship about cardiovascular disease and periodontal disease.	15 (17)	58 (65)	22 (24)	5 (5)	0 (0)
It is important for cardiologists and periodontists to work together to educate their patients on these diseases.	17 (19)	54 (60)	24 (27)	4 (4)	1 (1)

## Discussion

This study was the first of its kind to question cardiologists about their knowledge and behaviors regarding periodontal disease and the potential association with cardiovascular diseases. While studies have been conducted with other health care providers, cardiologists have not been investigated.<sup>25,26,31,32</sup> It has been determined that individuals who have cardiovascular disease and periodontal disease share many of the same risk factors such, as smoking, diabetes, obesity and age.<sup>6,10-17</sup> But how this evidence is translated into the clinical practice of cardiologists has not been studied until this investigation.

There is evidence that periodontal bacteria and the byproducts of the bacteria have a detrimental effect on distant sites.<sup>21,22</sup> Although the specific mechanism has yet to be confirmed, scientists agree that there is an association between periodontitis and cardiovascular diseases.<sup>23</sup> When other health care providers have been questioned about their knowledge regarding the etiology of periodontal disease, most have some knowledge of the bacteria and their detrimental effects. For example, a recent study of internists and endocrinologists found physicians knew that bacteria was related to the etiology of periodontal disease (86%) and bone loss around teeth is a description of periodontal disease (77%).<sup>25</sup> Sixty-six percent knew that

bleeding gums were a first sign of periodontitis. But the physicians also thought that tooth decay was a sign of gum disease (30%). The current study found similar results, with 63% of cardiologists reporting bleeding gums as a first sign of disease, and 70% knowing that bone loss is congruent with periodontal disease. Sixty-six percent reported the first sign of periodontitis as bleeding gums, and 18% also thought that tooth decay was a sign of periodontitis. While their knowledge is high in some areas, they are confused in other oral health topics. Most studies of other health care providers have reported that they view their oral health education in professional school as being poor and they are interested in learning more about oral disease.<sup>25,26,32</sup>

The research team for this study anticipated that more than 16% would be familiar with the guidelines. The most recent statement from the AHA regarding the association of periodontal disease to atherosclerotic vascular disease has gained much attention since it was published in May, 2012; however, the cardiologists in this study did not seem aware of the statement and indicated it had not changed the way they view the importance of oral health. While a cause and effect has not been established between periodontal disease and cardiovascular disease, the statement does support an association between the 2 conditions.<sup>23</sup> Clearly more work needs to be done to educate cardiologists about periodontal disease and the potential detrimental effects to systemic health.

The relationship between oral health care providers and medical providers is an area that needs improvement. Wooten et al reported that 62% of nurse practitioners and certified nurse midwives conduct an oral exam as part of routine care at initial visits.<sup>26</sup> The current study concluded that only 18% of North Carolina cardiologists' conduct an oral exam at the initial visit. Practitioners stated that it is the responsibility of the dentist to perform the exam. Another reason for not doing an exam is that they simply do not know what it entails. This is an area that could be incorporated into medical school education through interprofessional education.

With an increase in oral systemic disease, it is important to examine the need for interprofessional education. Wilder et al recommended that faculty development, curricular changes and interprofessional education initiatives

Table V: Physicians' Education Regarding Oral Health

	n	Percent of Respondents'
Did your professional education include oral health content in the curriculum?		
Yes	23	21
No	88	79
How many hours of content regarding oral health/periodontal health were covered in the curriculum?		
<1 hour	12	40
1 to 3 hours	15	50
>10 hours	3	10
Did you have any clinical requirements regarding assessments of the gums or teeth?		
Yes	11	13
No	77	87
Did you receive any clinical experiences with dentists or dental hygienists?		
Yes	4	5
No	83	95
Regarding your medical training, rate the quality of oral health education you received		
Very good	3	3
Good	3	3
Fair	21	24
Poor	40	46
Very Poor	20	24
Do you believe that medical and dental students should be trained to work collaboratively?		
Yes	54	60
No	1	1
Maybe	35	39

be incorporated into dental education. Dental schools should seek relationships with local clinics and private practice dentists and other health professionals.<sup>33</sup> The paper reinforces the Commission on Dental Accreditation recommendation that states students should be encouraged and participate in service learning (Haden, personal communication, December 2007). Lopes et al reported that only 21% of diabetes educators received formal education on oral health.<sup>31</sup> The current study reported similar findings and concluded that while the majority of respondents did not receive oral health education, they believe it is an important area for students to work collaboratively. An interprofessional education curriculum would provide the atmosphere for collaboration to occur.

Interprofessional practice can be improved by providing options for continuing education in the area of oral systemic health. Higher education administrators and leaders should begin examining these areas and incorporating them into health professions curricula. In 1989, Rutgers School of Biomedical and Health Sciences began implementing oral health modules into the second, third and fourth years of medical school. Modules in head/neck examination and oral cancer screenings were incorporated into the curriculum along with rotations throughout the dental school to learn more about oral conditions.<sup>34</sup> This study, along with other studies, concluded that oral health is an important part of overall health.<sup>25,26,31-34</sup> To provide the best care and practices for patients, multidisciplinary fields need to collaborate.

Limitations of this survey include a low response rate. Cartwright investigated response rates of physicians from 19 professional groups. The response rate varied from 56 to 99%.<sup>35</sup> Factors affecting response rates included length of questionnaire and the available time to complete it. While the method used for the conduct of the survey was a recommended procedure for survey research,<sup>30</sup> it is also recognized that busy physicians may not take the time to complete a longer questionnaire or the physicians may not actually see the survey if they do not review the mail. In addition, this sample of North Carolina cardiologists may not be representative of all cardiologists, thus limiting the external validity. However, the study does provide a view of how oral health is incorporated (or not incorporated) into the clinical practices of cardiologists.

Future studies should investigate how oral health content can be incorporated into the curricula of medical providers. Other studies might evaluate scenarios where oral health care (dentists and dental hygienists) and medical providers work collaboratively in providing patient care.

## Conclusion

This study found that North Carolina cardiologists' have some knowledge about periodontal disease but are unclear in other areas. Half of cardiologists' surveyed were unsure that treatment of periodontal disease can decrease a patient's risk for cardiovascular disease. Approximately half of respondents referred 1 to 5 patients to a dental facility for either tooth decay or periodontal disease. Further education in oral diseases will help physicians refer patients to the appropriate oral health care provider. Though North Carolina cardiologists' were not implementing the published clinical recommendations into practice, the majority were interested in learning more about the association between the 2 diseases. Respondents agreed that it is important for health care providers to work together to educate patients on systemic diseases.

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# Third Place: Best Paper Award

## The Origins of Minnesota's Mid-Level Dental Practitioner: Alignment of Problem, Political and Policy Streams

Anne E. Gwozdek, RDH, BA, MA; Renee Tetrick, MSW, MPP; H. Luke Shaefer, PhD

The Journal of Dental Hygiene Best Paper Award was created to recognize the most outstanding research paper published from the previous year (2014). All original research papers published in 2014 were evaluated by a panel of judges, using specific criteria, to make the final selection. Below is a reprinting of the abstract of the third place recipient. This manuscript first appeared in Volume 88, Issue Number 5 of the October 2014 issue of the Journal of Dental Hygiene.

### Abstract

**Purpose:** Using John Kingdon's agenda-setting model, this paper explores how Minnesota came to legislate a mid-level dental practitioner to its oral health workforce. Using a pluralist framework embracing the existence of various interests and convictions, this analysis highlights the roles of issue formation, agenda setting and politics in policymaking.

**Methods:** Using Kingdon's agenda-setting model as a theoretical lens, and applying case study methodology, this paper analyzes how Minnesota came to legislate a mid-level dental practitioner to its oral health workforce. Data have come from scholarly research, governmental and foundation agency reports, interviews with leaders involved in the mid-level dental practitioner initiative, news articles, and Minnesota statute.

**Results:** After 2 years of contentious and challenging legislative initiatives, the problem, policy and political streams converged and aligned with the compromise passage of a bill legalizing mid-level dental practitioner practice. The Minnesota Dental Therapist Law was the first-in-the-nation licensing law to develop a new dental professional workforce model to address access to oral health care.

**Conclusion:** The Minnesota mid-level dental practitioner initiative demonstrates the important convergence and alignment of the access to oral health care problem and the subsequent collaboration between political interest groups and policymakers. Through partnerships and pluralist compromise, mid-level dental practitioner champions were able to open the policy window to move this legislation to law, enhancing the oral health workforce in Minnesota.

**Keywords:** Kingdon's agenda-setting model, mid-level dental practitioner, access to care, policy, dental therapist, advanced dental therapist, dental health aide therapist

This study supports the NDHRA priority area, **Health Services Research:** Evaluate strategies dental hygienists use to effectively influence decision-makers involved in health care legislation (e.g., to provide direct access to dental hygiene care, autonomy and self-regulation of dental hygienists).



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