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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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The Impact of Leadership and Research on Decision Making: The Power of Knowledge

Ann Battrell, MSDH

In my role as Chief Executive Officer of the American Dental Hygienists' Association (ADHA), I have had the honor and privilege of working alongside many dental hygiene leaders in a variety of professional roles. What I have observed in these leaders is that each has their own unique style of leadership that has allowed them to leave a lasting impression on our profession and on ADHA. In this way, each leader is like a fingerprint, showcasing their individuality and creativity.

Thinking about leadership as a fingerprint helps to understand what it takes to be a great leader. In order for that uniqueness and creativity to have a lasting impact, leaders need to possess certain skills. A crucial leadership skill is the ability to influence others. Influence can occur through having excellent communication skills, and the confidence to communicate ideas and goals to others. Additionally, great leaders will often find other leaders to emulate, identifying leadership behaviors that speak to them. We often see dental hygiene students emulating the leadership behaviors of their faculty, and many of us can bring to mind a faculty member early on in our education that planted and nurtured the seeds of our own leadership. It is important that leaders create a vision of the person they want to be, and that they have the mentors to do so.

However, individuality and communication are only two pieces to the puzzle. Leaders are often called upon to make decisions on a variety of matters, and dental hygiene leaders are no exception. The complexities of the issues we face and decisions that must be made are considerable. Therefore, in order to make sense of complex issues and to make decisions in the best interest of the organization, today's leaders (as well as our future leaders) need to possess critical thinking skills that enable sound decision making.

Several years ago, the ADHA Board of Trustees made a significant decision to use a knowledge-based decision making model, provided by Tecker International Consulting, for all of their governing responsibilities.¹ The knowledge-based decision making model asks:

1. What do we know about our stakeholders' needs, wants and preferences, that is relevant to this decision?
2. What do we know about the current realities and evolving dynamics of our environment that is relevant to this decision?
3. What do we know about the capacity and strategic

position of our organization that is relevant to this decision?

4. What are the ethical implications of this decision?

Notice that each of these questions begins with the phrase, "What do we know about...?" Our role as ADHA staff is to gather the evidence for each of these questions that will provide the "knowledge" upon which the Board of Trustees will deliberate and debate to make their final decisions. Utilizing a knowledge-based decision model enables the board member's critical thinking skills, and reduces the incidents of emotional decision making or anecdotal decision making.

No matter which professional role dental hygienists choose as their career choice, daily decisions need to be made. The underpinning of the decision making process is evidence and knowledge. Evidence and knowledge provides the answer to the fundamental question of "What do I know about..." Dental hygienists in a clinician role have the responsibility for using the dental hygiene process of care to ultimately determine a dental hygiene diagnosis and treatment plan, and evaluate the oral health outcomes for their patients. Scientific evidence, or knowledge, is the underpinning upon which oral health care providers should make their decisions.

It is through our commitment to research and the quest to build the dental hygiene knowledge base that our profession grows and our ability to provide evidence-based care to our patients. Simply asking ourselves the question "What do I know about..." is the starting point to searching for knowledge, information and scientific evidence for the critical thinking necessary for leaders in all of the professional roles of a dental hygienist.

Sincerely,

Ann Battrell, MSDH
CEO, American Dental Hygienists' Association

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Interprofessional Collaboration between Dental Hygienists and Registered Nurses: The Time is Overdue

Jacqueline E. Sharpe, RN, MSN, CHES, PhD; Muge Akpinar-Elci, MD, MPH

The recent publication of an article that is listed as a Critical Issue in the *Journal of Dental Hygiene*¹ deserves strong letters of endorsement from nursing professionals.² It has been twelve years since the Institute of Medicine called for interprofessional education to be adopted by the health professional education community. The increasing numbers of dentists in dental programs and the decreasing numbers of physicians in medical programs lend itself for dentists and physicians to be supportive of such interprofessional collaborations. There is so much potential for registered nurses and dental hygienists to work together to improve the health of the public. This recent publication serves to refuel the question raised by Jackie Fried in 1987, "Interprofessional Collaboration: If not now, when?"³ And additionally, the Editorial remarks made by Lisa Mallonee in 2012, "The Need for Inter-Professional Collaboration."⁴ The dental hygienists and registered nurses of today need to develop inter-professional relationships – now! The growing numbers of the population and because of people living longer demands it. The educational preparation for a registered nurse, does determine the degree of ability to provide oral care to a patient, other than just handing the person a toothbrush and some toothpaste. For example, a clinical master's degree in nursing preparation and that of a doctorate degree in nursing provides the knowledge and skills for physical assessment skills for the entire body for diagnostic purposes. But the need being addressed in this article pertaining to registered nurses is examining oral complications of xerostomia, dysphagia, and trismus. Even educating the nursing staff on the care of patients with dentures would help decrease their unnecessary losses and breakages when hospitalized. It takes more than a toothbrush, a suction tip, and toothpaste to meet the needs of certain kinds of patients that mandates specialized oral care; the examples mentioned are just a few where the expertise and the skills of a dental hygienist can provide assistance. We must first begin interprofessional collaboration by breaking down barriers to effective communication, misperceptions of occupational roles, and out of touch curricula in the training of these two professional groups that still are addressing the human body as if it is separate and not one unit that works together. Programs for con-

tinuing education for registered nurses must realize that there are gaps in the educational preparation of nurses due to program variations for knowledge and skills required. Diverse educational preparation can lead to differences in skill training that can later be obtained through continuing professional education. Opportunities to close this gap to enhance care for meeting the oral needs of patients can be met by dental hygienists through continuing professional education as well as interprofessional educational initiatives between students of dental hygiene and Bachelor of Science in nursing degree students.⁵ Recent research conducted by the dental hygiene and dental professionals have consistently shown that there is need for inter professionalism among other groups and not just with nursing. However, results of such research must also be widely published in communities other than just the dental medium.

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CRITICAL ISSUES IN DENTAL HYGIENE

Parallels between the Development of the Nurse Practitioner and the Advancement of the Dental Hygienist

Heather Taylor, MPH, LDH

Abstract

Purpose: Dental hygienists have often been described as the registered nurses of the dental field. Similar parallels also exist between the development of the nurse practitioner from the nursing profession and the evolution of the dental hygiene practice and profession. This article explores 3 major similarities between the professions of nurse practitioner and dental hygienist. Public health issues, educational constructs, and the social and political environments shaping each profession are discussed to inform dental hygienists of their potential career options for future expanded therapeutic care roles.

Keywords: dental hygiene, nurse practitioners, mid-level provider, public health

This study supports the NDHRA priority area, **Professional Education and Development:** Investigate how other health professions have established the masters and doctoral levels of education as their entry level into practice.

INTRODUCTION

Dental hygienists have often been described as the registered nurses (RN) of the dental field. Today there are many more advanced nursing roles beyond that of the RN. For example, nurses have expanded their education and career options through the introduction of the nurse practitioner.¹ The political, social and educational environments that existed when nurse practitioners were first introduced to the U.S. health care system have striking similarities to the environment that dental hygienists find themselves in today as they work toward advancing their profession. Although there is constant change in health care, the public health issues driving changes have remained the same over the last 50 years and across all health professions (e.g., access to care, lack of affordable care, provider shortages).² Political, educational and social issues were key in the development of the nurse practitioner and will continue to be paramount in the advancement of the dental hygienist.¹ Understanding how the nursing profession addressed public health issues, expanded their education, and confronted political and social challenges through the introduction of the nurse practitioner will help dental hygienists gain perspective about their role in health care.¹⁻³ Recognizing the pathways of progress and the historical background of the nurse practitioner may allow dental hygienists to better direct their own expanded roles in therapeutic health care. This critical issues paper evaluates similarities between the professions as related to historic and current public

health issues, the educational constructs for both health care providers, and the social and political environment that continues shaping both professions.¹⁻³⁷ Growth potential for the dental hygiene profession can be further examined.

Public Health Issues

Nurse practitioners were introduced into the U.S. health system in the 1960s in response to the public's concern over physician shortages as well as the demand for affordable primary health care services to underserved populations and groups.¹⁻⁴ At the time, the number of primary care providers was insufficient to support the demand and need for medical care. Physician specialization contributed to a decrease in the number of primary care providers.² Vulnerable populations, including rural and poor urban populations, women, children, and the elderly had the greatest difficulty accessing medical care.² A real public health need for a new workforce model emerged as a result of access issues. The evolution of the independent nurse practitioner from existing nursing educational models was the result.¹

Just as in the 1960s when medical care concerns focused on physician shortage and rising costs, dentistry faces similar issues. According to the U.S. Department of Health and Human Services, the number of traditional dental health professional shortage areas has tripled in the last 25 years.⁵

Currently, about 5,000 areas in the U.S. are designated as dental health professional shortage areas (a ratio of 5,000 or more people to 1 dentist in the area). Reportedly, it would require roughly 7,300 more dentists to eliminate the designation of these shortage areas.⁶ Approximately 5,200 students graduated from dental schools across the U.S. in 2013, but 3,500 dentists retired last year and that number is expected to rise with the aging workforce population.^{7,8} The Health Resources and Services Administration (HRSA) released a report in February of 2015 concluding that all 50 states in the U.S. will experience a shortage of dentists by 2025.⁹ The shortage of primary dental care providers is clearly evident in epidemiologic data.⁵⁻⁹

Dental health shortage areas typically are populated by some of the most vulnerable populations.⁶ Disproportionately distributed dentists, coupled with the low numbers of dentists who participate in Medicaid, equates to millions of low-income children with inadequate dental care.¹⁰ The PEW Charitable Trusts reported that in 2011, less than half of the Medicaid-enrolled children received dental care in 22 states.¹⁰ These facts are significant since lower income children are twice as likely to develop cavities as their affluent counterparts.¹⁰ Low provider numbers and unmet needs of the underserved are 2 substantial parallels between the development of nurse practitioners and the future expansion of the dental hygienist's roles.^{1-6,9} Low numbers of direct access dental care providers and underserved populations are now also prompting discussions about expanding roles for dental hygienists, educating more mid-level providers and making legislative changes to treat underserved populations.⁹

Rising dental costs also parallel the rising health care costs that occurred during the introduction of the nurse practitioner.¹¹⁻¹³ During World War II, health care expenditures accounted for 0.38% of the nation's Gross Domestic Product (GDP).¹¹ By 1961, it had risen to 1%, and resulted in concern over the lack of affordable care for the elderly, children and women.¹¹ This encouraged the development of a different workforce model in primary care, the nurse practitioner.¹¹ Economic costs are significantly higher today. In 2012, health care expenditures accounted for 17.2% of the GDP, meaning that, on average \$8,915 is spent per person for health care.¹² Cost of dental services reached \$110.9 billion in 2012 and continues to increase.¹³ Ultimately much like the introduction of the nurse practitioner, the introduction of new dental hygiene-based workforce models across the nation are being driven by similar public health issues (e.g., insufficient dental care providers, lack of dental care for vulnerable populations and rising dental care costs).^{9,10,13}

Constructs of Education

Registered nurses must obtain a master's or doctoral degree and then seek additional licensure in order to become a nurse practitioner.¹⁴ Today, there are over 350 academic nurse practitioner programs in the U.S.¹⁵ These programs started when nursing pioneers Loretta Ford and Henry Silver responded to demands for more health care access.² Ford and Silver recognized the need for nurses to have additional education and training to allow for more patient responsibility in expanded roles of care.² The new program would prepare nurses to assume more responsibility in treating underserved populations.^{2,3} To fulfill such roles, these pioneers understood that education of the nurse practitioner needed to go beyond a bachelor's degree.¹⁶

State licensing boards for nurses recognize both the associate and baccalaureate entry points.¹ The same is true of dental hygiene, thus adding to educational inconsistency among practicing professionals. Such inconsistency can adversely influence graduate education for advanced-practice dental hygienists because there can be "no expectations for a student's consistent knowledge and skill level on admission or after program completion."¹ The American Dental Education Association (ADEA) recognized the implications of varying entry-level programs in dental hygiene back in 2011. A brief entitled *Bracing for The Future: Opening Up Pathways to the Bachelor's Degree for Dental Hygienists* stressed the value of a bachelor's degree so that dental hygienists could enter master's-level programs to ensure safe provision of services in expanded roles.¹⁷

Economically, it is most feasible to train mid-level or advanced providers by supplementing the education of licensed dental hygienists just as nurses did with the nurse practitioner model. Advanced dental hygiene roles would require more education, and consequently the American Dental Hygiene Association (ADHA) and dental hygiene educators are establishing accreditation standards for advanced practice dental hygiene educational programs and new workforce models. The Commission on Dental Accreditation (CODA) assigned a task force to recommend standards for educating dental therapists, that is, mid-level providers. Initially, however, it did not seem that the standards recommended by the task force in December of 2013 were inclusive of dental hygiene-track advanced providers. The response, which was provided by the dental community, ADHA and the Federal Trade Commission, encouraged revisions to these recommendations.¹⁸ As of February 2015, CODA approved standards that allow for accreditation of dental hygiene-track advanced providers.¹⁹ Just like pioneers in nursing responded in 1965 with the introduction of the

nurse practitioner model, so too today, ADHA and dental hygiene educators are supporting new workforce models and accreditation standards addressing the shortage of dental providers and concerns over rising dental care costs.^{4,16,20} With expanded roles for dental hygienists, educational paths and specialized graduate degree programs must be established.¹⁶

Social and Political Environments

The introduction of the new nurse practitioner workforce model to primary medical care did not come without substantial battles. As the profession grew, nurse practitioners faced restrictions on practice, resources and reimbursement.^{1,14} These legal and political barriers were often driven by physicians' territorialism, needs for status and culture.^{1,2} Organized medicine viewed this new type of workforce model with suspicion, and expressed concerns about nurses practicing without direct supervision of a physician.²

Despite opposition, nurse practitioners documented expertise in disease prevention, public health promotion, the ability to increase access to care and patient satisfaction.¹ Substantial literature exists documenting that primary care outcomes do not differ between the delivery of care offered by a nurse practitioner and a physician.²¹⁻²⁵ Despite this, nurse practitioners are hindered by "inconsistent state laws, insurance reimbursement practices and a medical community that clings to outmoded notions of a physician-nurse hierarchy."¹⁴ Continued research in areas of patient satisfaction and care documenting further beneficial outcomes may assist nurses to move forward in practice and acceptance.²

Similar to the nurse practitioner, the expansion of roles and education for dental hygienists has received resistance. Since regulations and scope of practice definitions fall under state laws, there are a variety of differences regarding how dental hygienists can practice within each state.²⁶ For instance, in Colorado dental hygienists are legally able to perform several dental preventive procedures independently, without the supervision of a dentist.²⁷ These procedures include dental prophylaxis, exposure of radiographs, topical anesthesia, fluoride application, sealants, and dental hygiene diagnosis and treatment planning. In contrast, Indiana is a state where dental hygienists cannot perform a simple non-invasive procedure such as placing a caries-preventive sealant on a patient's tooth without the direct supervision or written authorization of a dentist.^{26,28} Despite the evidence of patient safety and satisfaction with direct access dental hygiene care, there are many states with restrictive practice acts.²⁹⁻³²

As the profession of dental hygiene advances into the future, research will be needed to document quality care and satisfaction achieved under new dental hygiene workforce models. Such data could validate the continued development of new oral health care delivery models. Just as equivalency of many outcomes has been documented between nurse practitioners and physicians, outcome assessments will compare the care provided by dentists and dental hygienists.

DISCUSSION

Table I provides additional parallels between the professional advancement of nurses and dental hygienists. These key advancements in both the nursing and dental hygiene professions allow health care providers to see similarities and the benefits of strategically moving the profession forward in education, political, social and public health arenas.

Notably, however, it is crucial for the profession of dental hygiene to recognize that unlike the nursing profession, which is self-regulated, dental hygienists are primarily regulated by their employers, dentists.³³ Nursing first established self-regulation in 1903 and later outlined the practice of registered nurses between the 1930s and 1950s through state Nurse Practice Acts (NPAs).³⁴ These NPAs define nursing practice as independent of physicians, and allow state boards controlled by nurses to determine licensure requirements and codes of ethics for the profession.³⁴

Unlike nurses, the profession of dental hygiene does not have autonomy, which allows state legislators and dental boards to suppress dental hygienists from practicing to the fullest extent of their training. Wanchek suggested that by expanding educational opportunities and reducing scope of practice restrictions on dental hygienists, states could reduce oral disparities and increase access to dental care.³³ As with other health professionals who are self-regulated, "dental hygienists possess the knowledge, skill and judgment to best regulate the profession."³⁵ Therefore, self-regulation will be important for the profession of dental hygiene to obtain to further develop advanced workforce models and greater scope of practice nationwide. Conducting and publishing additional research documenting quality of care and patient safety, along with dental cost savings, should also encourage new regulation standards and advanced practice models in dental hygiene, as has happened in nursing.^{26,36} The development of advanced educational models is currently moving forward so that the profession is adequately educated and capable of delivering care in expanded practice settings treating underserved populations.^{16,19} Ad-

Table I: Key Advancements within the Nursing and Dental Hygiene Professions of the U.S.^{2,25,26,36-41}

Advancement	Year	Nursing Profession	Year	Dental Hygiene Profession
Education	1873	First nursing educational program opens - Bellevue School of Nursing, New York	1913	First school for dental hygiene opens - Fones School of Dental Hygiene, Connecticut
Political and Social	1896	Formation of professional association representing nurses known today as the American Nurses Association (ANA)	1923	Formation of the American Dental Hygienists' Association (ADHA)
Education	1900	Publication of the journal, American Journal of Nursing - 1900	1927	First publication of what is known today as Journal of Dental Hygiene
Political and Social	1938	New York becomes the first state to require licensure for nursing practice	1920	Six states have established licensure for dental hygienists
Education	1965	First nurse practitioner program created at the University of Colorado	1947	American Dental Association (ADA) and ADHA set accreditation standards for dental hygiene educational programs
Education	1973	ANA published accreditation standards for nursing education	1951	ADA Council on Dental Education establishes accreditation standards for dental hygiene education
Political and Social/ Public Health	1977 to 1983	Multiple studies published comparing nurse practitioner care to that of physicians Institute of Medicine documents cost reductions and economic feasibility of care provided by nurse practitioners	1996 to 1997	Studies published on independently practicing dental hygienists show safety and high quality of care
	1992	Yale Journal of Regulation publishes journal issue on cost-effective and high quality care of nurse practitioners - a call is made to eliminate regulatory restrictions	2014	National Governors Association publishes article on increased access to care by dental hygienists - a call is made to allow dental hygienists to be reimbursed by Medicaid and to decrease practice and supervision restrictions

vanced dental care practitioners can help address the complex dental public health problems in the U.S., just as nurse practitioners have done for the nursing profession.^{26,36}

CONCLUSION

Dental hygiene is facing a paradigm shift for changing and advancing professional education and practice. The profession can learn from studying the history of the nurse practitioner, including the fact that although nurses faced opposition, they were able to establish higher educational lev-

els within nursing to educate nurse practitioners adequately for expanded roles.¹ The progress of the nursing profession via the development of the nurse practitioner within public health, education, and social and political environments illustrates the potential growth of the dental hygiene profession by way of advanced education and practice models.

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RESEARCH

The Frequency of Dietary Advice Provision in a Dental Hygiene Clinic: A Retrospective Cross-Sectional Study

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Abstract

Purpose: The aim of this retrospective, cross-sectional study was to assess the frequency of dietary advice provision by dental hygiene students.

Methods: Data was obtained from clinical records of third-year Bachelor of Oral Health students at the University of Newcastle. Frequency of dietary advice was recorded by students over a 12-month period. The study investigated associations between demographics, treatment provided and frequency of dietary advice.

Results: The results indicated dietary advice was provided infrequently by dental hygiene students, with only 6.48% of all patients seen during the 12-month period receiving dietary advice. A statistically significant correlation was observed between dietary advice and age, with children under the age of 18 being 2.5 times more likely than adults to receive dietary advice. Additionally, patients who received oral hygiene instruction were 2.5 times as likely to receive dietary advice. Strong correlations were also observed between topical and concentrated fluoride application and dietary advice.

Conclusion: The findings indicate dietary advice is provided infrequently by dental hygiene students. Further research is required to strengthen the findings and to investigate barriers to dietary advice provision, as well as perceptions of dental practitioners regarding dietary advice.

Keywords: dental hygienist, dietary advice, students

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

INTRODUCTION

The close relationship between diet and oral health is well-established, with a wealth of information demonstrating the impact that diet has on dental diseases, in particular dental caries and erosion.¹⁻³ Dental caries occurs when bacteria in the oral cavity metabolize fermentable carbohydrates and organic acids are produced, causing demineralization of hard tooth structure.¹ This process depends on the presence of fermentable carbohydrates, thus being directly associated with diet. While dental caries incidence in Australia has decreased significantly over the last 30 years, this trend seems to have reached a plateau, and the caries incidence in many population subgroups remains unacceptably high.⁴ Early Childhood Caries (ECC) is particularly concerning as it is characterized by severe, rampant caries in the teeth of young children and is closely associated with infant feeding practices.⁵ Dental erosion is the loss of hard tooth structure due to acid destruction, the most common cause being dietary acids.¹ Dental erosion appears to be a growing issue and it has been hypothesized that this rise in prevalence is due to an increased consumption of acidic drinks.⁶ As well as contributing to the development of oral

health problems, diet also has a direct effect on general health. Poor diet has been shown to contribute to systemic health problems such as obesity, diabetes and cardiovascular disease.⁷ With an increasing body of evidence linking oral health to general health the issue of diet and oral health is a major concern for dental professionals and should become a major focus in the treatment of patients.⁸

Watt et al suggest that dietary advice is likely to be more effective if a team approach is adopted.⁹ Dental hygienists traditionally have a preventive role in the dental team and may be ideally suited to providing dietary advice. While dentists often face time constraints, dental hygienists commonly see patients for longer appointments on a somewhat regular basis, which puts them in an ideal position to assess patients' dietary habits and to provide appropriate advice.¹⁰ A recent study examining the attitudes of dental hygienists in North Carolina established that 95% of respondents believed that dental hygienists should play a role in helping patients make dietary changes.¹¹ Interestingly, a study investigating the self-reported dietary counselling practices of Oregon dental hygienists ob-

served that only 53% of dental hygienists provided any dietary advice to patients.¹⁰ These results were reiterated by a more recent survey of Maryland dental hygienists which established that nutritional counselling was only provided by 65% of respondents in the prevention of ECC.¹² These results are concerning, considering the crucial role that diet plays in the development of ECC.¹³ It appears that while the majority of dental hygienists agree that they should have a role in providing dietary education it is implemented infrequently in practice.

Despite the belief that they should be providing dietary advice, the infrequent provision of dietary advice by dental hygienists leads to the speculation that barriers exist to dietary advice provision. Research demonstrates that there is a correlation between the perceived extent of training and dental hygienists' confidence in providing dietary advice.^{10,11} Therefore, it would be valuable to review the content and application of dental hygiene curricula to ensure that dental hygienists are adequately trained and experienced in dietary counselling. Barriers to the provision of dietary advice identified by dental hygienists include minimal observed financial gain, dietary advice not fitting into routine patient scheduling and lack of financial reimbursements from health insurance companies.¹⁰ In addition to practice barriers, patient factors may also limit the frequency with which dietary advice is provided. Sarmadi et al reported that girls received dietary advice slightly more frequently than boys; however, this relationship was not significant.¹⁴ Minimal research has examined whether provision of dietary advice by dental hygienists is influenced by different patient factors such as age and gender.

A recent Cochrane Review which investigated the effectiveness of one-to-one dietary interventions found that a significant change in dietary behavior was observed in participants in 4 of the 5 studies reviewed.¹⁵ However, due to the limited research available, strong evidence is lacking. While the Cochrane review provides a useful overview of the effectiveness of dietary interventions, the question of frequency of dietary advice provision by dental hygienists seems to be a somewhat overlooked issue.

Dental hygiene students are a useful group to research as they are a group who are closely supervised by clinical faculty and are required to follow strict guidelines about the treatment they provide. It can be assumed dental hygiene students' treatment follows the current body of research and, therefore, that students frequently incorporate dietary advice into their practices. In Australia, where this study was conducted, the Australian Dental Council requires newly gradu-

ated dental hygienists to be able to "identify the impact of environmental and lifestyle factors and the determinants of health on oral health and implement strategies to positively influence these interactions" as per the Professional Attributes and Competencies.¹⁶ Thus, the aim of this study was to assess the frequency of dietary advice provision by dental hygiene students and to investigate factors influencing the frequency that dietary advice is provided.

METHODS AND MATERIALS

Study Design

This study used a retrospective cross-sectional design to examine the frequency that dietary advice was provided by students in their third year of a Bachelor of Oral Health at the University of Newcastle. In addition, the study also examined whether different patient factors were associated with the frequency of dietary advice provision. Ethics approval was obtained from the University of Newcastle Ethics Committee in 2013.

Setting

Individuals wishing to register as a dental hygienist in Australia must complete a 3-year Bachelor of Oral Health degree or 2-year Advance Diploma. The Oral Health program at the University of Newcastle is based at the Ourimbah campus on the New South Wales (NSW) Central Coast and involves an integration of oral health sciences and clinical placements, with a focus on population health.

Participants

Participants included in the study were all third year Bachelor of Oral Health students who were currently enrolled at the Ourimbah campus of the University of Newcastle, as well as all patients seen by this cohort at the University clinic in 2012. No exclusion criteria were applied to the selection of students or patients to reduce selection bias.

Within the curriculum, all participants had completed sessions on diet and nutrition, and its impact on oral health, and were encouraged during clinical sessions to explore the role of diet and oral disease with their patients. All data was de-identified by a third party, with patient names, times and identifiable details removed from the extracted data before analysis. As the data was de-identified no information about any of the participants or patients was accessible and therefore, no participants were identifiable in the results. Students were not advantaged or disadvantaged by the study, as they

were not identifiable in the data and were not directly involved in the study.

Data Collection

The study used de-identified data retrieved from Dental4Windows, an electronic dental program used in the university dental clinic. Dental4Windows is a popular dental program which allows dental practitioners to enter clinical notes, item numbers and make appointment bookings for patients. This study was interested in examining the age and gender of patients, and the treatment they received on each visit to the clinic.

The dependent variable was the frequency of the use of the item number 131 (representing dietary advice, where at least 15 minutes of dietary advice is provided). This was measured by assessing how frequently the item number was entered into Dental4Windows by third year dental hygiene students over the study period. Dental item numbers are used in Australia as a uniform system of recording services provided by dental practitioners and are utilised by private health insurance companies, as well as Medicare, to allow efficient processing of dental claims.

The independent variables measured included other services provided at that appointment (in the form of item numbers), as well as the age and gender of patients. The reason for recording these variables is to get an understanding of which, if any, patient factors influenced whether or not different patients receive dietary advice and how frequently.

Data Analysis

Data analysis was completed using the statistics program STATA® version 12 (Statcorp, Chicago, Ill). Frequencies were displayed as percentages. More complex analysis of data was completed using regression analysis. Regression analysis was used to describe the relationship between dietary advice and variables including age, gender and other treatment provided; logistic regression allows the dependant variable to be defined and correlating predictions to be made.¹⁷

RESULTS

Patient Demographics

Data was extracted from Dental4Windows in August, 2013. The data comprised information about all patients seen by third year Oral Health students during 2012. The extracted data consisted of de-identified patient information, including year-of-birth, gender and treatment provided, in the form of

Table I: Appointments by Gender and Age

	Frequency	Percentage
Gender		
Female	722	60.72
Male	467	39.28
Age		
Under 18	162	13.62
18 to 65	723	60.81
Over 65	304	25.57

item numbers. A total of 1,189 patients were seen by third year oral health students over the 12-month study period. Of these, 722 patients were female and 467 were male. Table I describes the gender distribution of patients seen over the 12-month study period. The ages of patients seen were categorized into 3 age ranges; less than 18 years old, 18 to 65 years old and greater than 65 years old (Table I). The largest proportion of patients seen during the 12 months were adults aged 18 to 65 (n=723, 60.81%). Approximately one-quarter of patients who attended the university clinic were aged over 65 (n=304, 25.57%). Patients seen least frequently were children or adolescents under the age of 18 (n=162, 13.62%).

Treatments Provided to Patients

The treatment provided most often by dental hygiene students was oral hygiene instruction (n=754, 63.41%), with the least frequent treatment provided being saliva testing (n=11, 0.93%). Dietary advice was provided to 77 patients, only 6.48% of all patient appointments. Comparably, oral hygiene instruction was provided to almost 10 times as many patients (n=754, 63.41%). The frequency of each of the treatments provided by third year oral health students over the 12 months is listed in Table II.

Statistical Correlations

Logistic regression analysis was used to determine if statistically significant correlations existed between dietary advice and other treatment provided at the same appointment. There was a statistically significant link between dietary advice and oral hygiene instruction, with patients who received oral hygiene instruction 2.5 times as likely to also receive dietary advice at that appointment (OR:2.51, 95%CI 1.41 to 4.47, p<0.003). Patients who received prophylaxis were also more likely to receive dietary advice than those who did not (OR: 3.16, 95%CI 1.85 to 5.40, p<0.001). Topical fluoride application (gel) significantly increased the likelihood for a patient to receive dietary advice. Patients who received topical fluoride were 7.8 times as likely to receive dietary

advice (OR: 7.80, 95%CI 4.39 to 13.86, $p < 0.001$). A correlation was also found between concentrated fluoride application (varnish) and dietary advice (OR: 2.59, 95%CI 1.23 to 5.47, $p < 0.013$), however this correlation was not as strong. Alternatively, no statistically significant correlations were found between dietary advice and debridement or periodontal charting. Table III reports statistical correlations between dietary advice and other treatment provided.

Logistic regression analysis was also carried out to examine possible correlations between dietary advice and age or gender of patients. The data demonstrated patients under the age of 18 were more likely to receive dietary advice than adult patients. Patients less than 18 years old were more than 2.5 times as likely to receive dietary advice. No statistically significant correlations were discovered between dietary advice and gender.

DISCUSSION

This study examined the frequency that dietary advice was provided by dental hygiene students to patients seen over a 12-month period. The results demonstrated that dietary advice is provided infrequently by dental hygiene students. These results are consistent with the findings of McKinney et al, indicating that dietary advice may be overlooked by a wide range of dental professionals.¹⁸

The findings from the present study have demonstrated dietary advice was only provided to 6.48% of patients. These results are quite concerning and may indicate a need to review dental hygiene curricula. Comparably, 52% of dental hygienists in Oregon reported providing dietary advice in their practices, however, over half of those surveyed provide dietary advice to fewer than 10% of patients.¹⁰ The low proportion of patients receiving dietary advice could be attributed to barriers such as time constraints or limited training and/or practical experience in providing dietary advice.¹⁹ Given the results from the present study, it may be necessary for further research to be carried out to examine barriers to providing dietary advice. Future research may also be required to examine the content and application of dietary advice training for dental students.

A statistically significant correlation was observed between dietary advice and age, with children less than 18 years of age being 2.5 times as likely as older patients to receive dietary advice. These findings may be attributed to current policies and guidelines on appropriate feeding practices for children, indicating a view that children are in greater need of dietary advice than adults.²⁰

A number of close associations were discovered between dietary advice and other treatment provided

Table II: Frequency of Treatments Provided During Patient Visits Over 12 Months

Treatment	Frequency	Percentage
Comprehensive Examination	386	32.46
Periodic Examination	188	15.81
Limited Examination	114	9.59
Radiograph	119	10.01
OPG	118	9.92
Saliva Testing	11	0.93
Plaque Disclosing	475	39.95
Prophylaxis	139	11.69
Debridement First Visit	385	32.38
Debridement Second Visit	235	19.76
Topical Fluoride Application	72	6.06
Concentrated Fluoride Application	63	5.30
Dietary Advice Provision	77	6.48
Oral Hygiene Instruction	754	63.41
Smoking Cessation Advice	41	3.45
Periodontal Charting	286	24.05
Subgingival Debridement	130	10.93
Photographs	47	3.95

Table III: Statistical Correlations Between Dietary Advice and Other Treatment Provided

Description	Odds Ratio	p-value	95% CI
Prophylaxis	3.16	<0.001	1.85 to 5.40
Topical fluoride application (gel, foam)	7.80	<0.001	4.39 to 13.86
Concentrated fluoride application (varnish)	2.59	<0.013	1.23 to 5.47
Oral hygiene instruction	2.51	<0.003	1.41 to 4.47
Age (under 18 years)	2.62	<0.012	1.24 to 5.55

to patients. Patients who received oral hygiene instruction were 2.5 times as likely to also receive dietary advice, indicating that oral hygiene instruction is often provided in conjunction with dietary advice. The authors hypothesize that dental hygiene students may provide both dietary advice and oral hygiene instruction to patients they identify as high-caries-risk patients. Similarly correlations were observed between topical and concentrated fluoride application (varnish) and dietary advice provision, again indicating a possibility that patients identified as being at a greater risk of developing caries are deemed to require dietary advice. Interestingly, provision of prophylaxis was also positively associated with dietary advice, with patients who received prophylaxis more than 3 times as likely to receive

dietary advice during the same appointment. It may be that prophylaxis is provided more frequently to children, explaining the association with dietary advice. No correlations were present between dietary advice and debridement or periodontal charting.

Given that hygiene students see patients for lengthy appointments, and are supervised and supported by clinical faculty, it was surprising that they were not providing dietary advice more regularly. It is important for dental professionals to recognize the importance of dietary advice, not only for its role in oral health, but also for prevention of diet-related systemic diseases such as diabetes and heart disease. Dental hygienists typically see patients quite frequently for somewhat long appointments, arguably making them ideally suited to counsel patients about the link between diet and disease.

Most studies examining the frequency of dietary advice provision obtain data from self-reporting of dental practitioners.^{10,21} One disadvantage of using self-reporting is that dental practitioners are essentially required to estimate their dietary advice practices, potentially causing the results to be affected by over-reporting. Therefore, it is likely that studies relying on self-reporting do not accurately reflect the true dietary advice practices of dental professionals. This study used data taken directly from clinical records; thus, having the potential to be much more accurate.

Diet-related oral health problems such as dental erosion and dental caries pose a significant challenge to oral health care professionals. Dietary advice appears to be a valuable strategy in influencing eating and drinking habits, in turn having the potential to prevent or manage dental caries and erosion.²² Dental hygienists may be ideally suited to providing dietary advice to patients as part of their preventive role and therefore present an interesting area for research. Dental hygiene students offer a valuable insight into the practices of dental practitioners and educators should consider whether students receive adequate training in dietary advice. These results suggest dietary advice may be overlooked or possibly under-valued as a component of the preventive oral care regime. Further research may be useful to investigate barriers to dietary advice provision, as well as the perceived importance of dietary advice to dental practitioners.

It is important to recognize limitations to the present study. The conditions for entering the item number 131 specify that at least 15 minutes of dietary advice are to be provided. It is possible that students may have provided dietary advice which lasted less

than 15 minutes and was, therefore, not recorded in the clinical records. This would influence the results of the study, potentially leading to under-reporting of dietary advice. In future studies, it may be valuable to produce a "dummy" item number for dietary advice provision of less than 15 minutes. Further, information on the caries risk for each patient was not available when extracting the data; it would have been interesting to determine if correlations exist between caries risk and the provision of dietary advice. As the study sample consisted of dental hygiene students at one university in Australia the findings may have limited generalizability. However, the study has provided useful data to help us understand the practices of dental hygiene students in NSW, Australia. Further research is required to examine the dietary advice practices of a wide range of dental practitioners. As the study used a retrospective design the data was reliant on accurate record keeping. However, as the clinical records were recorded at the time of the appointment and students are required to enter the item numbers corresponding with treatments provided, the records appear to be accurate and reliable.

CONCLUSION

In summary, the findings from the present study have demonstrated that dental hygiene students in NSW, Australia provide dietary advice very infrequently to patients. These results are important, as diet is a key risk factor for many oral diseases, yet it appears that dietary advice is an overlooked component of the preventive oral health care practices of dental hygiene students. The research also demonstrates that there is a relationship between patient age and students deciding whether or not to provide dietary advice to patients. These results strongly suggest the need for a review of dental curricula to ensure that dietary advice is a major component of the preventive services offered by dental hygienists. Recommendations for further research include identifying barriers to dietary advice provision, perceptions of dental practitioners and students in regard to dietary advice and further research examining the frequency of dietary advice provision by dental practitioners in a range of different settings and its association with caries risk.

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Association between Early Childhood Caries, Feeding Practices and an Established Dental Home

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Abstract

Purpose: Early Childhood Caries (ECC) is a significant public health concern disproportionately affecting low-income children. The purpose of this study was to assess the association between the establishment of a dental home and ECC prevalence in a group of Medicaid-enrolled preschool children, and to explore feeding practices associated with an increased prevalence of ECC in Medicaid-enrolled preschool children with an established dental home was evaluated.

Methods: A cross-sectional survey was conducted among Medicaid-enrolled children (n=132) between 2 and 5 years of age with an established dental home and no dental home to compare feeding practices, parental knowledge of caries risk factors and oral health status.

Results: Children with an established dental home had lower rates of biofilm ($p<0.05$), gingivitis ($p<0.05$) and mean decayed, missing and filled teeth (DMFT) scores ($p<0.05$). Children with no dental home consumed more soda and juice ($p<0.05$) daily, and ate more sticky fruit snacks ($p<0.05$) than children with an established dental home. Establishment of a dental home had a strong protective effect on caries and DMFT index (odds ratio=0.22) in both univariate and confounding adjusted analyses.

Conclusion: The results suggest establishment of a dental home, especially among high-risk, low-income populations, decreases the prevalence of ECC and reduces the practice of cariogenic feeding behaviors.

Keywords: caries risk assessment, caries, diet, feeding methods, socio-economic status, Medicaid, preventive dentistry

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Assess the use of evidence-based treatment recommendations in dental hygiene practice.

INTRODUCTION

Dental caries is an infectious, transmissible, bacterial disease affecting children and adults of all races, ethnicities and socio-economic levels.^{1,2} It is a major public health problem both within the U.S. and around the world, and has devastating effects including pain, infection, nutritional insufficiencies, learning and speech problems, and even death.³ While disturbances in the balance between bacteria and host are the factors traditionally responsible for caries development, factors such as family, economic and social conditions also have a substantial impact on the development of the disease.^{4,5} Current research has demonstrated that multiple risk factors are responsible for the occurrence and prevalence of caries, including frequent sugar consumption, improper oral hygiene, high levels of oral bacteria, cariogenic feeding practices, socio-economic status, minority status and inconsistent oral health care access.^{3,4,6-10}

Early childhood caries (ECC) is defined as caries in children younger than 72 months of age, and disproportionately affects low-income fami-

lies.^{4,11-14} Populations with low-income levels and high utilization of Medicaid insurance have been shown to have an increased risk of ECC development.¹⁵ Preventive dental care and education is critical for parents of high-risk children to identify current dental health concerns and prevent future problems.¹² However, within the U.S., only 40% of low-income children have received preventive dental care compared to 54% of higher income children.¹⁶ Many barriers affect access to dental services for disadvantaged children including a lack of providers, cost of services, as well as culture and oral health beliefs.^{12,17} Consequently, the prevention of ECC in high risk, Medicaid-enrolled children remains a challenge for health care personnel in the fields of dentistry and medicine.^{5,8}

An anticipatory approach emphasizing oral health promotion is likely to have the greatest positive effect on children's oral health.⁵ Preventive care visits can be utilized to educate parents and caregivers on proper oral hygiene techniques as well as known behavioral and social risk factors for

ECC development.^{6,9} Nutritional education should be provided during preventive care visits in order to ensure cariogenic feeding practices are avoided and proper dietary guidelines are being followed for optimal oral and overall health. The goal of providing anticipatory guidance for the caregiver is to modify or eliminate practices and behaviors known to increase caries disease risk for the child.^{4,8}

The American Academy of Pediatric Dentistry (AAPD) policy statement indicates the following should be provided by a dental home:¹⁸

- Comprehensive assessment
- Individualized preventive care based on caries and periodontal risk
- Anticipatory guidance related to growth and development including care of the child's soft and hard tissues
- Education of parents/caregivers on management of acute dental trauma
- Nutrition assessment and counseling
- Comprehensive care including preventive services according to AAPD guidelines
- Referral as needed to specialists

There is a lack of evidence evaluating the impact of an established dental home (as defined by the AAPD as "an ongoing relationship between the dentist and the patient, including all aspects of oral health care delivered in a comprehensive, continuously accessible, coordinated, and family-centered way") on ECC prevalence and risk, particularly in high-risk populations.¹⁹ The purpose of this cross-sectional study was to explore:

1. The association between the establishment of a dental home and ECC prevalence in Medicaid-enrolled preschool children
2. Feeding practices associated with an increased prevalence of ECC in Medicaid-enrolled preschool children with an established dental home

METHODS AND MATERIALS

An observational, cross-sectional study using a survey instrument was conducted at a dental center providing care to primarily children and adolescents in Manchester, NH. Data from the 2010 Census estimates 13.8% of Manchester residents have incomes at or below the Federal Poverty Level (FPL).²⁰ The New Hampshire Department of Health and Human Services (NHDHHS) indicates that of the 135,012 New Hampshire residents enrolled within the Medicaid program in 2010, 24,080 reside in Manchester, accounting for 12% of its total population.²⁰ Overall, from 2009 to 2010, there was a 5% increase in Medicaid enrollments throughout the state and the percentage of children enrolled reached 60.2% of all enrollees.²¹

The dental center used for the present study adheres to the policy of the AAPD regarding the expectations of care within an established dental home. Patients receive a prophylaxis and examination on a bi-yearly basis during 45-minute appointment times. The 4 general dentists and 5 dental hygienists provide all aspects of this policy including:²²

- Individualized preventive dental health plans, specific to a child's caries risk assessment
- Anticipatory guidance about growth and development
- Education regarding proper oral hygiene techniques
- Individualized nutritional counseling

This study population consisted of a convenience sample of 132 Medicaid-enrolled male and female children between 2 and 5 years of age attending their scheduled preventive appointment at the dental center during the study period. The established dental home group (n=101) inclusion criteria were those children who had preventive care and anticipatory guidance as outlined by the AAPD policy on a dental home within the last year at the dental center.¹⁹ The no dental home group (n=31) inclusion criteria for children were those who had no history of preventive or restorative dental visits. Parental or guardian informed consent was obtained for the child's participation. The institutional review board at the affiliated university approved and oversaw the administration of the study.

Sampling Procedure and Data Collection

A survey instrument was adapted from the demographic, diet and nutritional sections of the National Health and Nutritional Examination Survey (NHANES) III.²² The instrument consisted of questions regarding the child's demographics (2 items), feeding practices (14 items), dental history (3 items) and current parental knowledge of caries risk factors (1 item). The survey instrument was completed by the parent or guardian during the child's preventive appointment.

The validity of the questionnaire was assessed using a content validity index (CVI). Six experts in the fields of dentistry and nutrition evaluated the survey and determined the questions were an adequate representation of the study's research questions. Each expert employed a 4-point scale to calculate a value on the individual content (I-CVI) as well as the overall content (S-CVI). The content validity was deemed excellent if the I-CVI was 0.78 or higher for 3 or more experts and the S-CVI was 0.90 or higher.²³ For the study questionnaire, 4 or more experts agreed with each

item giving an overall I-CVI of 0.97. The S-CVI for the questionnaire was 0.93 indicating an overall excellent content validity.

A pilot survey (n=10) was conducted to pre-assess parent or caregiver survey completion time and ease of comprehension. Additionally, the pilot screenings were used to assess and implement standard practices for the dental hygienists providing the survey. The results of the pilot assessments were not included in the final study results.

The child's current dental health status was coded using an examination meeting the guidelines from the dental center and forms adapted from the World Health Organization's Basic Model of Oral Health Surveys.²⁴ Documented information included active caries, treated caries and oral hygiene status. All of the clinicians were calibrated prior to the beginning of the study to ensure accurate recording of data. Each clinician performed the data retrieval process on at least 5 patients and the results were compared and discussed, and methods modified until 100% agreement was attained to ensure consistent documentation. This training practice was modified from the CDC's Dental Examiners Procedures Manual developed for the NHANES.²²

During the prophylaxis appointment, the dental center's odontogram was utilized to document any existing restorations and/or missing teeth. Throughout the clinical exam performed by the dentist, the areas of active caries were also recorded on the odontogram form. The data was then transferred from the odontogram to the decayed, missing and filled teeth (DMFT) index at the end of the questionnaire. The DMFT index for primary teeth was employed due to the age of the study participants. The clinical assessment form was also used to document the child's oral hygiene, indicating the presence of dental biofilm and/or gingivitis. The prophylaxis and exam was conducted using either the knee-to-knee technique with the parent or guardian or with the child in the dental chair, dependent upon patient behavior. A mouth mirror was utilized to identify dental biofilm, gingivitis, restored caries and missing teeth. The dental examination was conducted using an explorer, mouth mirror and radiographs, if possible, to diagnose active carious lesions.

The general dentists at the dental center employed visual, tactile (using an explorer) and radiographic (using bitewing and/or occlusal radiographs) means for caries detection. These techniques of caries detection are dependent upon patient behavior and, consequently, not all means were utilized for every patient. Surface demineralization or a white-spot lesion was not doc-

umented as a carious lesion but rather used as an educational tool for parents in terms of improving or modifying their child's nutrition or oral hygiene. Following the prophylaxis and exam, the child received a fluoride varnish application, oral hygiene instructions and nutritional counseling.

Data Analysis

To investigate the association between ECC prevalence in Medicaid-enrolled preschool children and the establishment of a dental home, general and demographic characteristics data were compared between the 2 groups (established dental home vs. no dental home) (Table I). Categorical and binary variables were compared utilizing global chi-square tests of independence, with continuous variables compared using nonparametric Mann-Whitney U tests.^{25,26} Feeding practices were compared between the 2 groups using chi-square tests of independence (Figures 1, 2, 3). Note that adjustments for multiple comparisons were not performed due to a priori specification of comparisons.²⁷

As an indicator of the presence of caries, DMFT index was dichotomized into DMFT>0 and DMFT=0. Univariate logistic regression associating dichotomized DMFT index with establishment of a dental home was performed, with "Multivariate Model I" including age and gender as covariates using multivariate logistic regression (Table II).²⁸ For "Multivariate Model II," a model selection procedure was performed among candidate covariates age, sex, child breastfed, age bottle usage ended, usage of a sippy-cup, daily servings of milk, soda, and juice, partaking in snacking, age of first dental appointment, presence of biofilm, and presence of gingivitis. To assess and control for potential confounding as well as identify strong predictors of outcome, inclusion in the "Multivariate Model II" required meeting one or more of the following criteria: whether inclusion or exclusion of the variable from the univariate model changed the adjusted odds ratio for established dental home by $\geq 10\%$, or inclusion in a stepwise logistic regression model met the pre-specified alpha threshold ($\alpha=0.05$).^{29,30} Variables that changed the adjusted odds ratio by $\geq 10\%$ were forced into the stepwise model. The final model included age, gender, daily serving of juice, age of first dental appointment, presence of biofilm, and presence of gingivitis (Table II). To investigate the associations of feeding practices on DMFT index in the established dental home group, over-dispersion corrected univariate Poisson regressions via a scaling factor were performed (Table III).³¹ Statistical analyses were performed in STATA[®] statistics/data analysis software version 11.2.

Table I: Demographic and Characteristic of Study Population

	No Dental Home (n=31)	Established Dental Home (n=101)
Mean Age, Months (SD)	47.77 (13.92)	48.77 (13.87)
Gender, n (Percent Male)	17 (54.8%)	54 (53.5%)
Ever Breastfed, n (Percent)	17 (54.8%)	35 (34.7%)*
On-Demand, n (Percent)	14 (45.2%)	29 (28.7%)
Stopped Breastfeeding*		
1 To 12 Months, n (Percent)	15 (48.4%)	33 (32.7%)
13 To 24 Months, n (Percent)	2 (6.5%)	2 (2.0%)
Bottle Feeding		
Still Using, n (Percent)	4 (12.9%)	3 (3.0%)
Stopped Bottle Feeding		
1 To 12 Months, n (Percent)	17 (54.8%)	72 (71.3%)
13 To 24 Months, n (Percent)	8 (25.8%)	22 (21.8%)
>25 Months, n (Percent)	2 (6.5%)	2 (2.0%)
Child Put To Bed With Sippy Cup		
With Milk, n (Percent)	14 (45.2%)	30 (29.7%)
With Juice, n (Percent)	8 (25.8%)	15 (14.9%)
With Milk and Juice, n (Percent)	6 (19.4%)	9 (8.9%)
Child Drinking Throughout The Day		
Milk, n (Percent)	13 (41.9%)	28 (27.7%)
Juice, n (Percent)	11 (35.5%)	26 (25.7%)
Child Snacking Throughout The Day		
Time To Finish Drink ≥1 Hour	7 (22.6%)	14 (13.9%)
Age At First Dental Visit*		
<1 Year, n (Percent)	0 (0%)	24 (23.8%)
1 To 2 Years, n (Percent)	8 (25.8%)	67 (66.3%)
3 To 4 Years, n (Percent)	9 (29.0%)	7 (6.9%)
4 To 5 Years, n (Percent)	14 (45.2%)	3 (3.0%)
Frequency Of Dental Visits		
Every 6 Months, n (Percent)	n/a	96 (95.0%)
Dental Biofilm Present, n (Percent)	30 (96.8%)	80 (79.2%)*
Gingivitis Present, n (Percent)	22 (71.0%)	45 (44.6%)*
New Caries, n (Percent)	n/a	30 (29.7%)
Mean DMFT Index (SD)	5.19 (4.32)	1.80 (2.90)**
DMFT=0, n (Percent)	7 (22.6%)	58 (57.4%)*

*p<0.05 No Dental Home compared with Established Dental Home via global Chi-square test of independence

**p<0.05 No Dental Home compared with Established Dental Home via Nonparametric Mann-Whitney U test

RESULTS

As per the descriptive univariate analyses comparing the established dental home and no dental home groups, the mean age for the 2 groups were similar at 48.7 months and 47.7 months, respectively (Table I). Additionally, both groups had comparable distributions by gender, with 53.5% male in the established dental home group and 54.8% male in the no dental home group. Questions re-

garding breastfeeding and bottle usage revealed multiplicative univariate differences. A larger percentage of children in the no dental home group were breastfed on-demand (45.2%) and were still using a bottle (12.9%) compared to the established dental home group (28.7% and 3%, respectively). In regards to age at first dental appointment, 66.3% of the established dental home group visited

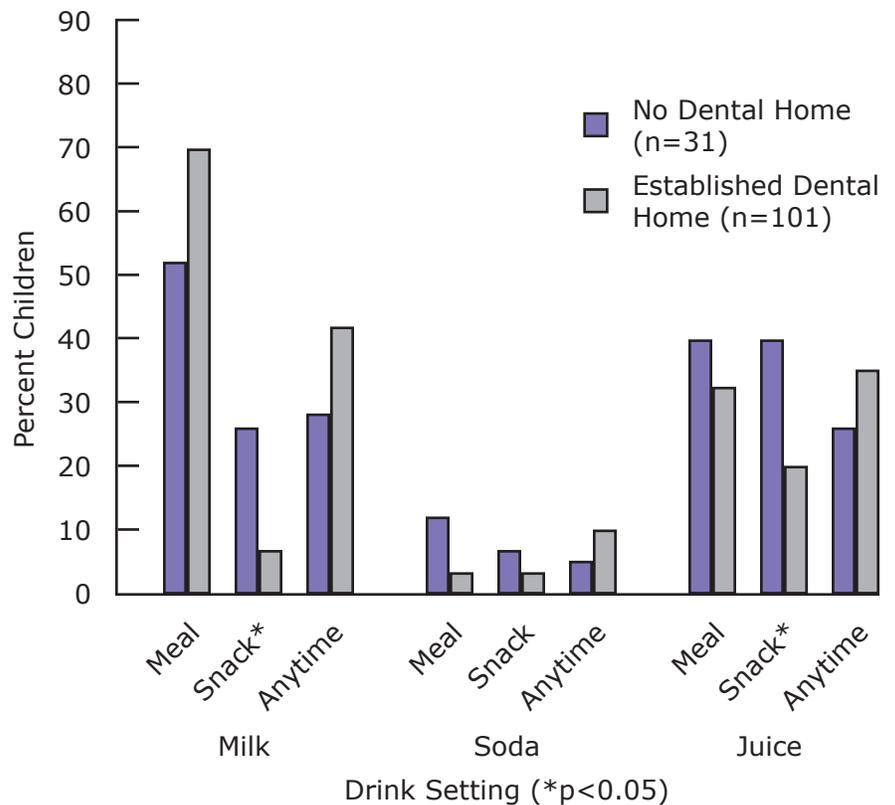
the dentist for the first time between 1 and 2 years of age, whereas the greatest percentage of the no dental home group had their first visit between 4 and 5 years of age, 45.2% ($p < 0.05$). A greater percentage of the no dental home group presented with dental biofilm (96.8%) and gingivitis (71%) compared to the established dental home group (79.2% and 44.6%, respectively) ($p < 0.05$). Mean DMFT index scores differed significantly, with index 5.19 for the no dental home group and 1.8 for the established dental home group ($p < 0.05$). A total of 57.4% of children with an established dental home had DMFT scores of zero, compared with 22.6% in the no dental home group ($p < 0.05$).

Comparing feeding practices in the 2 groups revealed statistically significant multiplicative differences. Children with no dental home were more likely to drink milk and juice during snack time ($p < 0.05$) (Figure 1), to have more than 6 servings of sodas per day and drink more than 4 servings of juice per day ($p < 0.05$) (Figure 2). Figure 3 illustrates those in the no dental home group more likely to consume 3 servings of sticky snacks, including dried fruit or gummy fruit snacks, per day ($p < 0.05$).

Univariate logistic regression associating dichotomized DMFT index (DMFT > 0 vs. DMFT = 0) with establishment of a dental home (yes vs. no) produced a statistically significant odds ratio (OR) of 0.22 with 95% Confidence Interval (CI) 0.08 to 0.55 (Table II), showing a very strongly associated protective effect of establishment of a dental home on presentation of caries. Adjustment for age and gender via multivariate logistic regression further lowered the OR for establishment of a dental home to 0.15 (95% CI: 0.05 to 0.42) shown as "Multivariate Model I" in Table II. As per the model selection procedure to identify strong predictors of outcome and adjust for confounding, the OR for establishment of a dental home was further lowered to 0.10 (95% CI: 0.02 to 0.40) after adjusting for age, gender, daily serving of juice, age of first dental appointment, presence of biofilm and presence of gingivitis, shown as "Multivariate Model II" in Table II.

Of the over-dispersion corrected univariate Poisson regressions performed to assess the associations of feeding practices on DMFT index in the established dental home group, several practices were found to be strongly statistically associated

Figure 1: Comparison of Setting for Beverage Consumption between Groups



with a multiplicative increase in DMFT index. Such feeding practices include: drinking juice frequently during the day ($e\beta = 1.19$, 95% CI: 1.04 to 1.36), eating candy frequently during the day ($e\beta = 1.21$, 95% CI: 1.01 to 1.45) consuming milk at meal-time ($e\beta = 1.80$, 95% CI: 1.25 to 2.59), having juice during snack time ($e\beta = 1.78$, 95% CI: 1.33 to 2.38) and drinking from a glass ($e\beta = 1.82$, 95% CI: 1.29 to 2.58), as shown in Table III. Drinking from a sippy cup also showed a univariate multiplicative decrease in DMFT index ($e\beta = 0.44$, 95% CI: 0.24 to 0.80).

DISCUSSION

Oral health is essential to general health and well-being.³² However, significant oral health disparities remain among certain socioeconomic groups within the U.S. population.^{3,32} The disparities in access to both medical and dental care have significant and lifelong effects on the oral and overall health of children and adolescents.³² Since family, economic and social conditions have a substantial impact on the development of ECC, an approach emphasizing health-promoting behaviors at the individual level is likely to have the greatest positive effect on children's oral health.^{4,5} Consequently, the establishment of a dental home, especially for high-risk, low-income children is critical for educating parents and caregivers on the known risk factors associated with ECC

Figure 2: Comparison of Frequency of Beverage Consumption Between Established Dental Home and No Dental Home

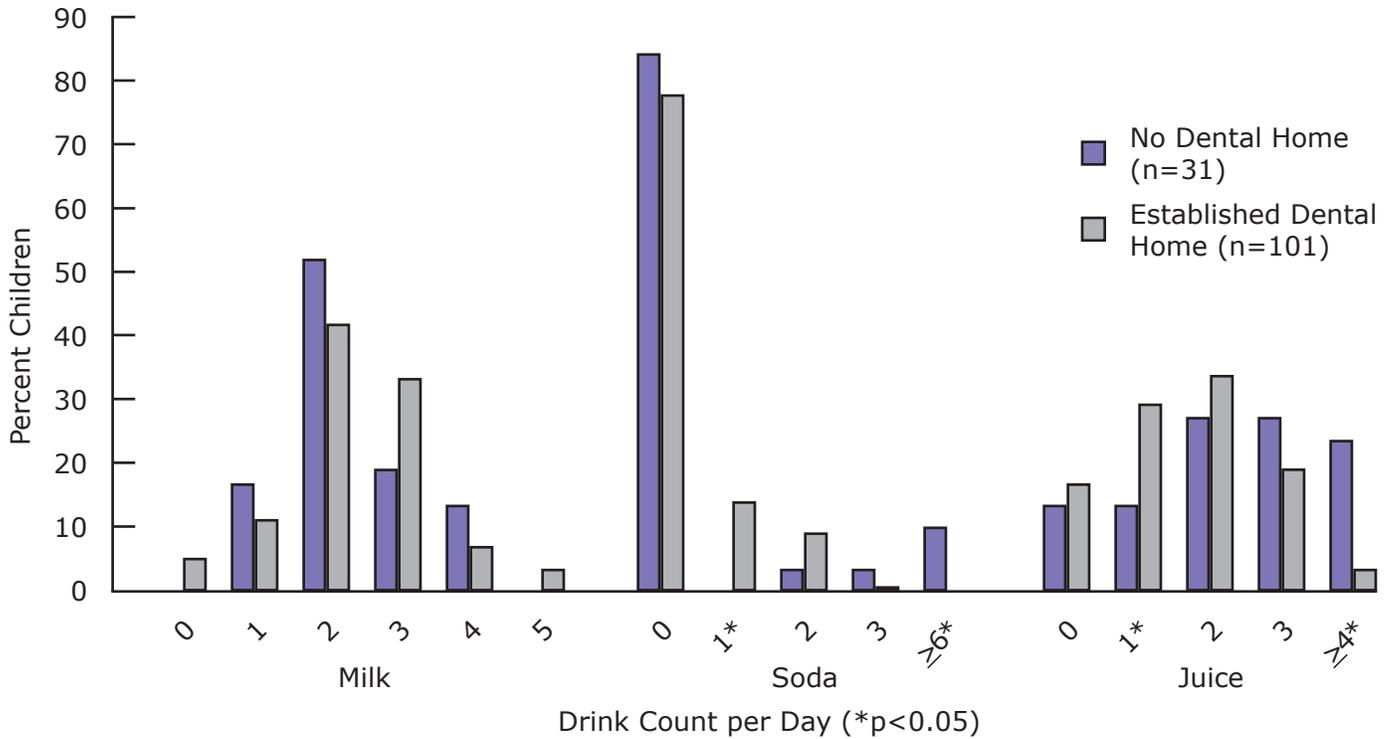
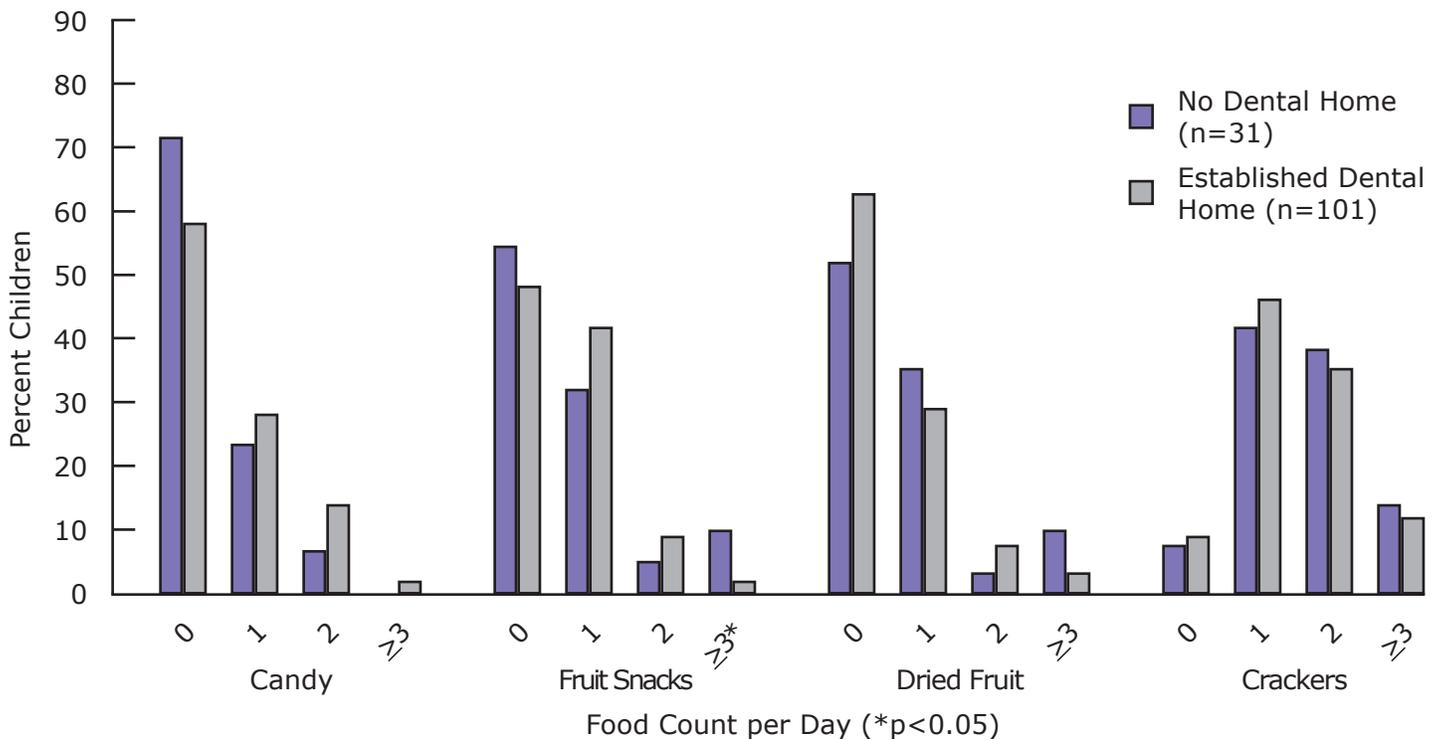


Figure 3: Comparison of Snacking Practices Between Established Dental Home and No Dental Home



development, including frequent sugar consumption, inadequate oral hygiene, high levels of oral bacteria and cariogenic feeding practices.^{3,4,6-10} The care provided through a dental home may also decrease the prevalence of recurrent caries. The current research has indicated over 50% of

low-income children exhibit recurrent caries post restorative treatment.³³ However, among the patients in the established dental home group with DMFT scores of 1 or higher, only 29.7% presented with new carious lesions.

Table II: Univariate and Multivariate Logistic Regression Models for Caries Prevalence (DMFT>0 vs DMFT=0); Recall Patients (n=101)

Univariate Model	
	Odds Ratio (95% CI)
Established Dental Home	0.22 (0.08 , 0.55)*
Multivariate Model I	
	Odds Ratio (95% CI)
Established Dental Home	0.15 (0.05 , 0.42)*
Age	1.07 (1.04 , 1.11)*
Female	0.78 (0.35 , 1.72)
Multivariate Model II	
	Odds Ratio (95% CI)
Established Dental Home	0.10 (0.02 , 0.40)*
Age	1.09 (1.04 , 1.14)*
Female	0.84 (0.35 , 2.01)
Juice serving per day	1.34 (0.92 , 1.95)
Age at first dental visit	0.53 (0.27 , 1.04)
Presence of Biofilm	3.29 (0.73 , 14.76)
Presence of Gingivitis	1.10 (0.47 , 2.61)

*p<0.05 for parameter estimate

This study explored the association of an established dental home on ECC prevalence and cariogenic feeding practices in high-risk populations. While it revealed significant consistencies with the current literature about specific feeding practices and ECC prevalence in high-risk populations,^{3,4,7} it also investigated the association of dental home establishment and oral hygiene, caries status, and cariogenic feeding behaviors. In accordance with the literature, the results demonstrated significant relationships between higher DMFT scores and a frequent consumption of sticky snacks (candy) and sugary drinks (juice), as well as prolonged drinking sessions.^{3,4,6,7,10} Children with an established dental home had a lower prevalence of caries, and lower rates of biofilm and gingivitis. Logistic regression analysis showed a very strong protective effect for establishment of a dental home on caries status. The above findings add further evidence for the effectiveness of oral hygiene education and anticipatory guidance provided at preventive care visits on prevention of adverse oral health outcomes.

The current study also reveal significant differences in specific feeding behaviors between the 2 groups, with the no dental home group exhibiting more cariogenic practices than the established dental home group. This finding suggests the anticipatory guidance and nutritional counseling implemented at the children's' routine preventive

Table III: Association Between Feeding Practices and DMFT Score Among Established Dental Home Group (n=101) (Univariate Poisson Regression for DMFT index)

Parameter Estimates: Outcome DMFT Index	
Food/Drink Count per Day	
Milk	0.87 (0.76 to 1.01)
Soda	0.80 (0.62 to 1.03)
Juice	1.19 (1.04 to 1.36)*
Candy	1.21 (1.01 to 1.45)*
Fruit Snacks	0.90 (0.73 to 1.14)
Dried Fruit	1.04 (0.86 to 1.26)
Crackers	1.03 (0.87 to 1.22)
Drink Setting	
Milk	
Meal	1.80 (1.25 to 2.59)*
Snack	1.03 (0.74 to 1.44)
Anytime	0.88 (0.63 to 1.23)
Soda	
Meal	0.67 (0.39 to 1.13)
Snack	0.23 (0.07 to 0.70)*
Anytime	0.73 (0.36 to 1.48)
Juice	
Meal	1.25 (0.93 to 1.68)
Snack	1.78 (1.33 to 2.38)*
Anytime	0.74 (0.51 to 1.06)
Drinking Session ≥1 Hour	0.56 (0.32 to 0.98)*
Clinical Knowledge	
Juice	1.58 (1.01 to 2.47)*
Milk	1.28 (0.87 to 1.88)
Brush	1.16 (0.81 to 1.66)
Bottle	0.93 (0.68 to 1.27)
Snack	0.93 (0.68 to 1.27)
Food	0.85 (0.61 to 1.18)
Drinking Method	
Glass	1.82 (1.29 to 2.58)*
Sippy Cup	0.44 (0.24 to 0.80)*
Straw	1.26 (0.79 to 2.00)
Glass and Straw	0.69 (0.28 to 1.67)
Glass and Sippy Cup	0.27 (0.07 to 1.09)
Glass, Sippy Cup and Straw	0.041 (0.13 to 1.27)

*p<0.05 for univariate parameter estimate

dental appointments may play an important role in feeding practices adopted by parents, particularly in high-risk populations.

However, there was one finding regarding a dietary practice that did not coincide with what has been demonstrated in the literature. The regression analysis showed consuming milk at mealtime was associated with a multiplicative increase in DMFT score ($e\beta=1.82$, 95% CI: 1.29 to 2.58). One possible explanation could be that the consumption of milk at mealtime had an added amount of sugar, such as flavored milk, soy, rice or almond milk. This is an area that would benefit from further research and investigation.

It is important to address the limitations in this study. Like any observational study, structural biases including residual confounding, selection bias, and data misclassification and misspecification are a possibility. The present study may lack statistical power to identify important statistical associations due to the study's limited sample size. The study cohort was created using a convenience sample, calling into question the generalizability of the study results to broader populations. The present study was also a cross-sectional study, greatly limiting the ability to "tease-out" the direction of causality and limiting the analysis to associational measures. Additionally, the definition of a dental home within the study population was operationalized as having made at least one previous visit to the dental center. The goals of the dental home may not be achievable with one visit to the dental office.

The results suggest the establishment of a dental home, especially among high-risk, low-income populations, is strongly associated with a decreased prevalence of ECC and reduced cariogenic feeding practices. Consequently, the collaboration between dentistry and medicine is a significant aspect in the prevention and management of ECC and the education of its risk factors. Therefore, in accordance with recommendations from the CDC, the AAPD and the American Academy of Pediatrics (AAP), all children should establish a dental home no later than 1 year of age.³⁴⁻³⁷ The AAP also advises that a child's first caries risk assessment be completed by their health professional at 6 months of age, especially if they are considered high risk for dental caries.^{35,36} Pediatricians and physicians must also be aware

of the clinical manifestations of dental disease and be prepared to educate families on its risk factors and consequences.⁴ It is also beneficial for pediatric health professionals to understand the etiological caries process, including enamel demineralization, and have the ability to identify the behavioral and dietary habits putting a child at higher risk of dental disease.⁴

CONCLUSION

The findings of this study will not only aid in developing a stronger partnership between medicine and dentistry in promoting oral health, but also in the implementation of new policies regarding protocols of preventive dental care. General and pediatric dentists can use the current research to design policies specific for their pediatric population to strengthen their preventive program's nutritional counseling, parental anticipatory guidance and oral hygiene instruction.

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Readability Levels of Dental Patient Education Brochures

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Abstract

Purpose: The objective of this study was to evaluate dental patient education brochures produced since 2000 to determine if there is any change in the Flesch-Kincaid grade level readability.

Methods: A convenience sample of 36 brochures was obtained for analysis of the readability of the patient education material on multiple dental topics. Readability was measured using the Flesch-Kincaid Grade Level through Microsoft Word. Pearson's correlation was used to describe the relationship among the factors of interest. Backward model selection of multiple linear regression model was used to investigate the relationship between Flesch-Kincaid Grade level and a set of predictors included in this study.

Results: A convenience sample (n=36) of dental education brochures produced from 2000 to 2014 showed a mean Flesch-Kincaid reading grade level of 9.15. Weak to moderate correlations existed between word count and grade level (r=0.40) and characters count and grade level (r=0.46); strong correlations were found between grade level and average words per sentence (r=0.70), average characters per word (r=0.85) and Flesch Reading Ease (r=-0.98). Only 1 brochure out of the sample met the recommended sixth grade reading level (Flesch-Kincaid Grade Level 5.7). Overall, the Flesch-Kincaid Grade Level of all brochures was significantly higher than the recommended sixth grade reading level (p<0.0001).

Conclusion: The findings from this study demonstrated that there has generally been an improvement in the Flesch-Kincaid grade level readability of the brochures. However, the majority of the brochures analyzed are still testing above the recommended sixth grade reading level.

Keywords: health literacy, oral health literacy, readability, Flesch-Kincaid grade level, patient education materials

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

INTRODUCTION

Health literacy has been at the forefront of a national discussion and has been determined to be essential for improving not only the health of the nation as a whole, but individual health as well.¹ Defined by the Institute of Medicine, health literacy is the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions.²⁻⁴ Understanding written materials (informed consent, patient education brochures and medication instructions) provided by health care providers is just one aspect of health literacy. According to the Institute of Medicine, "Health literacy is not simply the ability to read. It requires a complex group of reading, listening, analytical and decision-making skills, and the ability to apply these skills to health situations."² Patients not only need to be able to understand written materials, but also be able to communicate with health care providers adequately about their health care needs. Inadequate health literacy can not only act as a barrier for obtaining, comprehending and managing health related information, but can also act as an obstacle to accessing necessary health care.¹

In the Surgeon's General Report Healthy People 2010, health literacy is identified as an important component of health communication, medical product safety and oral health.² Efforts remain steady to educate and inform health care providers as to methods and strategies for improving health literacy to their patients. As evidenced in the most recent report, Healthy People 2020, Health Communication and Health Information Technology also address health literacy.⁵ The goal simply stated, is to use health communication strategies and health information technology (IT) to improve population health outcomes, health care quality and to achieve health equity. Objectives to reach this goal include: delivering accurate, accessible, and actionable health information that is targeted or tailored to a specific audience, increasing health literacy skills, and providing personalized self-management tools and resources.⁵

Literacy rates in the U.S. are staggering considering 24 million Americans (8.7%) are not proficient in English.⁶ In regards to health literacy, that number is even higher. In 2003, the National Center for

Education Statistics conducted a nationally representative assessment of English literacy among American adults (age 16 and older) titled the National Assessment of Adult Literacy (NAAL). The NAAL health literacy levels were categorized into 4 performance levels determined by the U.S. Department of Education: Proficient, Intermediate, Basic and Below Basic (Figure 1).⁷ There is also a fifth level (Nonliterate in English) which includes adults who were unable to take the test because they could not speak English or Spanish. This study found 14% of adult Americans demonstrated “below” basic literacy levels. Regarding health literacy, the NAAL study found that only 25 million (12%) have proficient health literacy. The majority of the adults (53%) scored in the intermediate level and the remaining 77 million fell in either the basic or below basic literacy levels.⁸ This statistic indicates that approximately 47% of adult Americans have problems in understanding complex health information given to them by health care providers.¹

There is a wide range of demographics that are affected by low health literacy. Older adults (65 years and older) were found to have the lowest health literacy scores when compared with other groups, with 23% falling below basic prose literacy range.^{7,9} Along with older adults, individuals with limited education, low English skills, low income, and those of ethnic or racial minority backgrounds are more commonly found to have lower health literacy.¹ One-third of adults in the U.S. have difficulty reading and following through on health related information.¹⁰ Patients with limited health literacy reported having lower-quality communication with health professionals and confusion regarding medical terminology.⁶ Even individuals at the intermediate or proficient literacy levels can still have difficulty comprehending the “medical jargon” and the technical aspect of health information. Comprehension levels have been found to be about 2 or more grade levels below reading or education level, and when a person is under stress, the level drops even lower.¹¹ What is more alarming is that patients with limited health literacy are less likely to use preventive services⁶ and have inaccurate knowledge about preventive measures such as water fluoridation, dental care visits and oral health-related quality of life.¹²

There is evidence to suggest that there is a strong correlation between a person’s health literacy level and health outcomes.⁶ Specifically, those with limited health literacy are at a reduced capability to read labels and health messages, limits their ability to take medications, and lowers their likelihood of receiving preventive care and using emergency services instead. Studies also indicate that these individuals in turn have more hospitalizations and that among elderly people with limited health literacy skills, a poorer overall health status and higher mortality rates.⁶ The American Medical Association (AMA) also

Figure 1: Levels of Literacy

Below Basic: Only the most simple and concrete literacy skills are obtained
Basic: Skills necessary to perform everyday simple literacy activities
Intermediate: The ability to perform moderately challenging activities
Proficient: Skills necessary to perform more complex and challenging activities

Source: U.S. Department of Education, Institution of Education Sciences, National Center for Education Statistics, 2003 National Assessment of Adult Literacy

Table I: How U.S. Adults Obtain Health Care Information

Source	Reading Level	
	Below Basic	Basic
Internet	19%	42%
Magazine	60%	79%
Books or Brochures	60%	80%
Newspapers	63%	77%
Family and Friends	77%	85%
Health care Providers	82%	89%
Radio or TV	86%	92%

Source: U.S. Department of Education, Institution of Education Sciences, National Center for Education Statistics, 2003 National Assessment of Adult Literacy

supports these findings through its report Health Literacy and Patient Safety: Help Patient Understand.^{4,5} It states, “Health literacy is a stronger predictor of person’s health than age, income, employment status, education level, and race.”⁴

Much of what we need to know or do regarding preventing, maintaining or improving our health is found in the written format.^{1,6} According to the 2003 NAAL report, most U.S. adults at the basic reading level obtained their health care information from these top 3 sources: radio or TV (92%), health care providers (89%) and family/friends (85%) (Table I). Yet, books or brochures (80%), magazines (79%) and newspapers (77%) were referenced almost as often as even health care providers (Table I). Thus, patients are obtaining their health care information from written materials or other sources as well as from their health care providers. Written patient education materials that are given to the patient may not be at an appropriate reading level and therefore should not be used alone for educating and or informing the patient. With patient education materials being distributed by health care providers, the readability of the documents should be looked at closely to determine if the patient can read, understand and re-

tain this information for their health benefit. Regarding written patient education materials, the National Institutes of Health (NIH), the National Work Group on Cancer and Health, and the American Medical Association (AMA) all recommended the readability of patient education materials should be no higher than the sixth grade level.¹³

In 2000, a similar study was conducted by Alexander, and published in the Journal of the American Dental Association.¹⁴ The author selected 24 patient education materials from several sources and determined the Flesch-Kincaid readability level using a computer-based program. The conclusions from this study found that the readability was higher (41.7%) than the recommended reading level of seventh to ninth grade. The author concluded there needs to be more attention on the preparation of patient education materials by making the documents easier to read and understood by the lay person.¹⁴

The purpose of this study was to evaluate dental patient education brochures produced since 2000 to determine if there has been any change in the readability levels of the brochures that are currently being distributed to dental patients.

METHODS AND MATERIALS

A convenience sample of 36 dental patient education brochures was obtained from private dental practices, a dental school and research facility to determine the readability level. The inclusion criteria were brochures produced between 2000 and 2014, from professional organizations American Dental Association (ADA), American Academy of Periodontology (AAP), American Academy of Pediatrics (AAPD), American Academy of Orthodontists (AAO), and only in English. Each brochures text was inputted into Microsoft Word to determine the readability using the Flesch-Kincaid grade formula. The Flesch-Kincaid formula calculates the reading grade level with the following formula:

1. The total words are divided by the total sentences and multiplied by 0.39
2. The total syllables are divided by the total words and multiplied by 11.8
3. The resulting numbers from steps 1 and 2 are added together
4. Finally, 15.59 is subtracted from the resulting number of step 3

This formula was chosen since it is easily accessible to users and widely used on both PC and Mac computers as a built-in readability tool for Microsoft Office Word software. Other readability statistics were also calculated through this tool since it contributed to the overall readability of the document. These included: word count, characters count, paragraphs

count, sentences count, average sentences per paragraph, average words per sentence, average characters per word, readability (passive sentences percentage), and readability Flesch Reading Ease. The Flesch Reading Ease formula calculates:

1. Average sentence length which is multiplied by 1.015
2. Average number of syllables per word multiplied by 84.6
3. Both these products are subtracted and the difference is subtracted from 206.835 to determine the reading ease of a document

The Flesch Reading Ease score correlates with an estimated reading grade level. The score index range is 0 to 100, the higher the score equates to text that is easier to read. Conversely, a score that is lower than 30 is considered to be at the college graduate reading level.¹

Descriptive statistics were conducted based on the publications by professional organizations (ADA, AAP, AAPD, AAO) as well as the mean and standard deviation of the Flesch-Kincaid grade level for all 36 brochures collectively. Correlations between readability statistics were performed using the Pearson's correlation. A one-sample t-test was used to determine the Flesch-Kincaid grade level of all the brochures. Lastly, model building using a backward model selection was performed on these statistics to determine factors associated with the Flesch-Kincaid grade level. A p-value of <0.05 was considered significant. Data analysis was performed with the Statistical Package for the Social Science (SPSS version 22, IBM SPSS, Inc., Chicago, Ill).

RESULTS

A convenience sample of 36 dental education patient brochures was collected and analyzed (Table II). These brochures consisted of bifold, trifold and booklet designs. Topics included were diverse and consisted of specific information about diseases, conditions or procedures. All brochures included were produced by professional organizations with the breakdown of publications as follows: ADA (26), AAPD (3), AAP (4) and AAO (3). Descriptive statistics were performed for each professional organization publication set. Focusing on the Flesch-Kincaid grade level, the average mean grade level for total brochures was calculated as well as per professional organization. The average mean grade level for all 36 brochures was 9.15 with a standard deviation of 1.77. For each professional organization, the average mean grade level and standard deviations were: ADA – grade level 8.67 (SD 1.63), AAPD – grade level 8.90 (SD 1.05), AAP – grade level 11.30 (SD 1.70) and AAO – grade level 10.70 (SD 0.61). It is worth noting that the collective Flesch-Kincaid grade level

Table II: Summary of Dental Patient Education Brochures

	Article Title	Publication	Year	Word Count	Flesch Reading Ease	Flesch-Kincaid Grade Level
1	Healthy mouth healthy body - Making the connection	ADA	2000	851	47.1	11.5
2	Ask your dentist about tooth whitening	ADA	2002	956	39.7	12.2
3	What are dental veneers?	ADA	2003	807	57.1	9.1
4	Why does my filling need replacing?	ADA	2003	376	58.5	8.8
5	Understanding root canal treatment	ADA	2003	924	59.5	9.1
6	Temporomandibular disorders (TMD)	ADA	2003	919	62.7	7.8
7	Temporomandibular disorders (TMD)	ADA	2009	552	55.6	8.7
8	Your wisdom teeth	ADA	2004	604	53.8	9.9
9	What is crown lengthening?	ADA	2004	221	64.4	8.4
10	Periodontal maintenance procedures	ADA	2004	1,012	45.4	10.8
11	Why do I need a crown?	ADA	2006	433	65.0	8.1
12	Why do I need a bridge?	ADA	2006	513	75.1	5.7
13	Do you grind your teeth?	ADA	2007	423	65.8	7.7
14	Do you grind your teeth?	ADA	2010	314	70.3	6.8
15	Do you have a cracked tooth?	ADA	2007	450	77.0	5.7
16	Snack and sip all day? Risk Decay!	ADA	2008	490	56.8	8.4
17	Oral piercing - Is it worth it?	ADA	2008	527	55.9	9.6
18	Periodontal maintenance - Preserve the progress you have made	ADA	2008	934	47.1	10.8
19	Scaling and root planing - Treatments for periodontal disease	ADA	2008	1,288	52.0	9.7
20	Your child's teeth 0 to 6	ADA	2009	1,655	63.5	8.1
21	Scaling and root planing - Periodontal therapy without surgery	ADA	2011	820	54.9	9.4
22	Dental implants - Are they an option for you?	ADA	2011	1,139	66.0	7.6
23	Dental implants - Are they an option for you?	ADA	2014	1,088	68.9	6.8
24	Periodontal disease - Don't wait until it hurts	ADA	2011	1,789	53.3	9.4
25	Periodontal disease - Don't wait until it hurts	ADA	2014	1,147	60.1	8.0
26	Your child's first visit to the dentist	ADA	2012	592	70.0	7.2
27	Ask your dentist about x-ray use and safety	AAPD	2008	357	47.8	9.9
28	Ask your dentist about thumb, finger and pacifier habits	AAPD	2009	341	67.2	7.8
29	Ask your dentist about regular dental visits	AAPD	2009	406	53.9	9.0
30	Dental implants	AAP	2000	578	58.2	9.0
31	Periodontal diseases - What you need to know	AAP	2005	1,278	37.7	12.2
32	Targeting tobacco use	AAP	2006	957	47.6	11.1
33	Periodontal health - Maintaining periodontal health throughout a woman's life	AAP	2006	1,825	36.6	12.9
34	Your child's first orthodontic check-up: No later than age 7	AAO	2004	1,626	46.1	11.1
35	All about orthodontics - Helping people achieve healthy, beautiful smiles	AAO	2008	599	48.0	10.0
36	Tobacco use and your orthodontic treatment	AAO	2013	308	46.7	11.0

readability of all brochures was significantly higher than the eighth grade reading level ($p < 0.0001$).

Pearson correlations were computed to determine the strength of relationship between pairs of readability statistics (word count, characters count, paragraphs count, sentences count, average sentences per paragraph, average words per sentence, average characters per word, readability - passive sentences percentage, and readability-Flesch Reading Ease). Weak to moderate correlations between word count and grade level ($r = 0.40$) as well as with characters count and grade level ($r = 0.46$) were noted. Strong correlations were found between grade level and average words per sentence ($r = 0.70$), average characters per word ($r = 0.85$) and Flesch Reading Ease ($r = -0.98$). Word count, characters count, paragraphs count and sentences count are highly correlated to each other, and the Pearson's correlation coefficients among them are from 0.86 to 0.996.

There were 4 groups of brochures ($n = 8$) that were nearly identical in text but were produced in different years. A descriptive analysis showed that within the groups, the mean reading grade level reduction was between 0.8 and 1.4. The one exception being the brochure, Temporomandibular Disorders - TMD (ADA 2003, 2009), that had an increase in the Flesch-Kincaid reading level of almost an entire grade, 7.8 (2003) to 8.7 (2009). The brochure, "Periodontal Disease - Don't Wait Until it Hurts" (ADA, 2011, 2014) reported a Flesch-Kincaid reading grade level of 9.4 and 8.0, respectively. The brochure, "Do You Grind Your Teeth" (ADA, 2007, 2010) had a Flesch-Kincaid reading grade level reduction from 7.7 to 6.8, and the brochure, "Dental Implants - Are They an Option for You?" (ADA, 2011, 2014) reduced the Flesch-Kincaid grade reading level from 7.6 to 6.8. Within these 4 groups of brochures, the most current version in 3 of the 4 groups demonstrated a reduced grade level readability. Only 1 brochure, the 2014 ADA version of "Dental Implants - Are They an Option For You?" was able to reduce the reading grade level to the recommended sixth grade level (Flesch-Kincaid 6.8). Overall, the reading grade level of all the brochures collectively was found to be statistically significantly higher than the recommended sixth grade or below reading level ($p < 0.0001$).

Lastly, model building using a backward model selection was performed to see what variables were associated with grade level. Average words per sentence ($p \leq 0.0001$) and Flesch reading ease ($p < 0.0001$) were left in the final model. No multicollinearity was noted between these 2 factors with all variance inflation factors for each variable being less than 2.15. The adjusted R-squared is 0.996, which indicates the final model is adequate for this data.

DISCUSSION

The importance of health literacy and its relationship to an individual's health status has been documented in the literature.^{1,6} Health professionals including dental care providers still utilize written patient education materials as a method to inform and educate patients.¹⁶ With an estimated 90 million U.S. adults who have limited health literacy, 50 million are reading between the sixth and eighth grade level while the other 40 million have literacy skills scoring at or below the fifth grade level.^{2,4,7,13} It is imperative that the health care community be cognizant of the potential disparity between an individual's literacy level and their actual health literacy. Research has shown that written patient education materials are still a common tool given to patients as a means of informing and educating the patient. Health care providers including members of the dental team need to take into account that the patient education materials they may give to a patient describing a condition or procedure may be above their health literacy reading level and therefore should not be solely relied on for adequately educating and informing the patient.

A study conducted in 2005 evaluating the reading level of patient education materials from various health journals found that 50% of the sample had a reading level of eighth grade determined by the Flesch-Kincaid readability formula from Microsoft Word.¹⁷ Alexander's study from 2000 also found that the Flesch-Kincaid reading levels of the patient education materials that were evaluated were above the recommended reading grade level at that time.¹⁴ Both of these studies illustrated that not only is the Flesch-Kincaid computer formula often used for determining the readability level of a document, but also many of the patient education materials that are often distributed to patients may be above the recommended reading level.

Utilizing Microsoft Word Flesch-Kincaid computer formula, the data from this study showed that the mean range for reading grade level was between 8.67 to 11.30. Brochure topic areas of periodontics, orthodontics and tooth whitening had the highest reading level compared to brochures that were about implants, sealants, cracked teeth, the first dental visit or needing a bridge. Per publication, brochures produced by the AAP and the AAO had the highest readability level compared to those written by the ADA and the AAPD. There was a strong correlation between the Flesch Reading Ease and the Flesch-Kincaid grade level, but weak to moderate correlations with word and character count in regards to the reading grade level. Therefore, word and/or character count alone cannot be a predictor of overall reading ability. The use of Microsoft Word is one way to evaluate the readability of patient education brochures. It is considered an easy and

convenient method, but Plain Language experts do not consider computer tests as a reliable tool used solely by themselves. The Flesch-Kincaid computer formula has been found to calculate lower readability measures compared to other computer tests and also when compared to calculating the readability by hand.

The findings from this study demonstrated that there has generally been an improvement in the readability level of the brochures that were sampled since Alexander's study in 2000. However, the majority of the brochures analyzed are still testing above the recommended sixth grade reading level.

Limitations of This Study

The 36 brochures that were collected and analyzed were a convenience sample of what was available at the time of collection in the summer of 2014. Therefore, it is not reflective of every patient education material that is currently available. A larger sample size would increase the statistical power of this study. Another limitation is utilizing a computer program for determining the readability level of a document. The Flesch-Kincaid formula determines the readability of a text based on the average syllables per word and

average words per sentence. It does not take into account the layout or design features of the documents which are other factors that can impact the overall readability level.

CONCLUSION

Great strides are being made by professional dental organizations to reduce the readability level of written dental patient education brochures. However, the data from this research shows that there is still a need to continue to reduce the readability level so that written patient education materials will be more easily understood by a larger segment of the population.

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Analysis of Phone Calls Regarding Fluoride Exposure made to New Jersey Poison Control Center from 2010 to 2012

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Abstract

Purpose: The American Association of Poison Control Center's annual reports demonstrate that acute fluoride exposure is not an uncommon occurrence. Despite its prevalence, there has been little published research on the topic in the last 10 years. The purpose of this study was to calculate the incidence of acute fluoride toxicity and lethality as it occurs in New Jersey and provide a descriptive epidemiology of acute fluoride exposures.

Methods: The study design was retrospective in nature. Records of phone calls made by individuals reporting excessive fluoride exposure (in an amount greater than directed/prescribed) to New Jersey's poison control center, known as Poison Information and Education System from the years 2010 through 2012, were extracted from Toxicall® (Computer Automatic Systems, Inc.) database. A total of 2,476 human-only exposure records met the inclusion criteria and were analyzed. Incidence rates were calculated, and population characteristics, circumstances and medical outcomes of acute fluoride exposure cases were assessed and categorized.

Results: A total of 2,476 phone call records met the inclusion criteria. The fluoride exposures reported were from toothpaste with fluoride (49%, n=1,214), mouth rinse with fluoride (21.6%, n=536), multivitamin with fluoride (21.4%, n=530) and pure fluoride (0.08%, n=199). Medically speaking, 94.75% of calls were asymptomatic cases (n=2,346), 4.24% were symptomatic (n=105) and 1.01% were informational inquiries (n=25). Adverse symptoms reported were mostly minor (83.9% of symptomatic cases, n=88) and moderate (16.1% of symptomatic cases, n=17). The age group 18 months to 3 years of age showed the highest incidence of acute fluoride exposure (53.2%, n=1,317). There was a slightly higher incidence of acute fluoride exposures among males (n=1,317) vs. females (n=1,159). Most incidences occurred in the home (93.1% of records, n=2,305) and occurred unintentionally (96.7%, n=2,394). Calls were mainly made by the subject's mother (67.5%, n=1,671).

Conclusion: Based on the data, there were no reports of lethality or toxicity due to acute fluoride exposure in New Jersey from 2010 through 2012. Symptomatic reports and informational inquiries were few. All adverse outcomes due to excessive fluoride intake were remedied with calcium as the antidote. Dental hygienists should educate patients on safety measures of fluoride-containing products and evaluate overall fluoride exposure prior to making recommendations. However, findings in this study suggest that levels of fluoride in available commercial products will not produce life-threatening events, even if taken in doses higher than recommended.

Keywords: fluoride, poisoning, dentifrice, toothpaste, children

This study supports the NDHRA priority area, **Occupational Health and Safety:** Investigate methods to decrease errors, risks and or hazards in health care and their harmful impact on patients.

INTRODUCTION

The introduction of fluoride as a preventative measure against tooth decay dates back to the early 20th century, during a time when dental caries were ubiquitous among children of all classes.¹ Today, fluoride is considered, by many, the best defense against dental caries. Fluoridation of water was named by the Centers for Disease Control and Prevention (CDC) as 1 of the 10 most important public health measures.² There has been significant support for dental products with fluoride, including toothpaste, mouthwash, multivitamins, dietary supplements and in-office treatments.³ With the combination of topical and systemic fluoride, a decline in caries has been

seen globally.⁴ Studies also show that the benefits of fluoride are lifelong and not restricted to children with developing teeth.⁵

Despite the benefits of fluoride, there is a potential for harm resulting from chronic and acute exposure to fluoride. Chronic exposure to fluoride can lead to fluorosis, which is systemic in nature and caused by disruptions in enamel formation that occur during tooth development.⁴ Long-term exposure can also cause crippling skeletal fluorosis, which is characterized by increased density of bone (osteosclerosis) and the formation of bony outgrowths.⁶

Acute fluoride poisoning is contingent upon several factors and can cause a variance of symptoms. When products are used in the volumes or weights indicated, there is usually little danger of serious, systemic acute toxicity. However, when topical gels are applied to small children incorrectly or ingested in quantities that exceed recommended doses, symptoms of toxicity and potential for serious toxicity is present.⁷ Acute ingestion of fluoride can lead to nausea and gastrointestinal irritation. Large amounts of ingestion of fluoride can lead to organ damage and even death.⁸

Acute fluoride toxicity depends not only on the amount of fluoride intake but the patient's weight.⁴ Children tend to be more susceptible to harm from fluoride toxicity than adults. The dose-response relationship is important to understand that health response is chemical, dose and organ specific.⁴ The values of acute fluoride toxicity can be seen in Table I.⁹ An average 2-year-old child weighing 30 pounds would require 67 mg of fluoride to reach the acute toxic dose, and an adult weighing 180 pounds would require 400 mg.

As fluoride is a drug, the U.S. Food and Drug Administration (FDA) is responsible for approving prescription and over-the-counter fluoride products in the U.S. and for setting standards for labeling.¹⁶ The amount of fluoride permitted in dental products is under the ongoing regulatory authority of the FDA to prevent fluoride toxicity. The American Dental Association (ADA) sets criteria for products to gain the voluntary ADA Commission on Scientific Affairs Seal of Acceptance, which is in compliance with the FDA regulations. To meet FDA regulations, over-the-counter toothpastes must have less than 276 mg F per tube.²¹ If needed for therapeutic reasons, toothpastes containing more fluoride are available but usually obtained only with a prescription. The amount of fluoride contained in a dental product is sometimes given as a percent of volume or in "parts per million" fluoride (ppm F) in the labeling to make it more consumer relatable.²¹

Most current research on fluoride toxicity has focused on chronic exposure. There are a limited number of publications on acute fluoride toxicity, despite its common occurrence as demonstrated by the national-based American Association of Poison Control Center (AAPCC). According to the AAPCC National Poison Data System's (NPDS) 29th report (2011), 30,000 calls regarding excessive fluoride exposure were made to poison control centers across the nation.¹⁰ The report reveals that most acute fluoride exposures were in children 5 years and younger. Almost all of the cases had no medical outcomes, however, there were a couple cases resulting in moderate and major adverse medical outcomes, such as major gastrointestinal symptoms, and indirect deaths.¹⁰ Al-

Table I: Values and Effects of Acute Fluoride Toxicity^{1,9}

Threshold Amounts of Fluoride	Toxicity
3 to 5 mg/kg	Gastrointestinal symptoms (minor and moderate symptoms)
5 mg/kg	Acute toxic dose; requires immediate medical intervention (major symptoms)
32 to 64 mg/kg	Acute lethal dose (death)

though statistics about fluoride overexposure as reported to poison control centers across the nation is published in AAPCC's annual report, the specific widespread issue is not explored or analyzed further. The lack of recent data in literature has undermined the importance to study and analyze current trends in acute fluoride exposure. Fluoride plays a prominent role in current preventative practices against caries; therefore, it is important oral health care professionals remain current on the topic.

A study of fluoride toxicity is also important to help in light of recent controversies in the media regarding the safety of fluoride. While numerous studies establish a causal relationship between fluoride and the prevention of dental caries,³ anti-fluoride proponents argue that fluoride is a "potent poison."¹¹ They argue that the warning label on fluoridated products required by the FDA (as is for all drugs under its regulatory authority) is reason to believe that fluoride is dangerous.¹⁶ The label states: "If more than recommended is accidentally swallowed, get medical help or contact a poison control center right away."¹⁶ Anti-fluoride proponents also use the fact that there are thousands of calls made to poison control centers every year as a result of excessive ingestion of fluoride, "many of which result in emergency treatment at a medical facility" as evidence to support their claims.¹¹

The ADA, however, states that most media coverage has not revealed that the ADA limited the amount of fluoride allowed in ADA-accepted dentifrices years ago. To reduce the likelihood of accidental poisoning among children, the ADA requires that no more than 120 mg of fluoride, or 264 mg of sodium fluoride, be dispensed in one container of fluoride rinse, gel or supplement.⁸ This is less than what is mandated by the FDA (which is 276 mg F).⁹ The CDC and ADA encourages practitioners to evaluate all potential fluoride sources and conduct a caries risk assessment prior to prescribing fluoride supplements. ADA argues that the warning label "greatly overstates" any danger posed by fluoridated products.¹³

The purpose of this study was to explore the issue further to unearth some of these controversies and update current literature on acute fluoride exposures. An additional purpose was to calculate the incidence of acute fluoride toxicity and lethality as reported to New Jersey's Poison Control Center. The study will follow a descriptive epidemiological format to provide insight on commonly affected groups and medical outcomes of excessive fluoride exposure.

For purposes of this study, acute exposure/excessive exposure is defined as the amount taken to be greater than what has been prescribed, suggested or thought to be normal. This is not necessarily a toxic or poisonous amount. This can include cases of acute on chronic exposure, but not chronic exposure alone.

METHODS AND MATERIALS

The research design is a retrospective cohort study. Collaborative Institutional Training Initiative training was completed by all investigators. The study obtained institutional review board approval and funding was provided by Rutgers School of Public Health Exploratory Grant Program. Records of phone calls made by individuals reporting excessive fluoride exposure to New Jersey Poison Information and Education System were extracted from Toxicall electronic database.

New Jersey Poison Information and Education System is the regionally certified poison center in the state of New Jersey that receives calls related to fluoride exposure from all 21 counties. Toxicall is used at New Jersey Poison Information and Education System to collect and record data on calls made to the center regarding possible poisoning and overexposure to substances, in addition to any questions related to medical substances, chemicals, foodborne illness, etc. The trained Specialist in Poison Information (SPI) with a background in pharmacology answers calls made to New Jersey Poison Information and Education System and collects as much information as possible about the suspected overexposure. This information includes date and time of call, type of substance, patient's age and gender, reason for exposure, county of caller, caller's zip code, relationship of caller to patient, location of exposure, and medical outcome of exposure (none, minor effect, moderate effect, major effect or death). Medical advice is provided according to the details of the case presented. The SPI handling the call documents all pertinent data and enters it into the database in accordance to the poison control center coding handbook. For fluoride exposure, the SPI determines toxicity based on a calculation to determine the ratio of mg/kg. For example, a child who ingested 50 tablets of 0.25 mg fluoride with a weight of 11.36 kg has ingested 1.1 mg/kg fluoride. To demonstrate:

Figure 1: Inclusion/Exclusion Criteria of Data for Study

Inclusion Criteria
<ul style="list-style-type: none"> • New Jersey area code • Calls made 1/1/10 12:00 AM to 12/31/12 11:59 PM • Human exposures/questions • Fluoride exposures/questions • Males and females • Ages 0 to 100 years • Recorded medical outcome, if any • "Closed" classification (no follow-up required and no further information available)
Exclusion Criteria
<ul style="list-style-type: none"> • Non-fluoride exposures • Animal exposures

$$50 \text{ tablets} \times 0.25 \text{ mg/tablet} = 12.5 \text{ mg NaFl} / 11.36 \text{ kg} = 1.1 \text{ mg/kg NaFl}$$

Figure 1 lists the inclusion and exclusion criteria of the extracted data. Classifications were deemed and coded by SPI's. No personal identifying information was assigned to any data and adherence to all pertinent federal and state regulations concerning the protection of the rights and welfare of all subjects were honored.

Approximately 210,000 total poison-related phone call records were searched for a subset of inclusion criteria cases, with 2,476 records meeting inclusion criteria. Information on the following parameters was obtained: age, gender, location of exposure, relationship of caller to patient, reason for exposure, type of fluoride-containing dentifrices involved in acute exposure, and medical outcomes of exposures. Data was then categorized by medical outcomes (Figure 2).

The medical outcome categories were defined by the parameters used by the AAPCC 2011 report. Those who were deemed to be "asymptomatic" did not develop any signs or symptoms as a result of the exposure. Individuals who were deemed to be "symptomatic" showed minor, moderate or major medical effects. "Minor effect" is defined as the patient developing some signs or symptoms as a result of the exposure, but they were minimally bothersome and resolved rapidly with no residual disability. "Moderate effect" is defined as the patient exhibiting signs or symptoms as a result of the exposure that were more pronounced or more prolonged. Usually, some form of treatment is indicated. Symptoms were not life-threatening and the patient had no residual disability. "Major effect" is defined as the patient exhibiting signs and symptoms as a result of the exposure that were life-threatening or resulted in residual disability or disfigurement. "Death" was defined as a

patient dying as result of the exposure or as a direct complication of the exposure.¹⁰

Additionally, each case report was searched and reviewed individually to obtain specific information on circumstances of each case and the specific advice that was provided to the caller. Data analysis and incidence rates were calculated in Microsoft Excel. Graphs used 95% confidence intervals to calculate the significance in differences between groups.

RESULTS

Frequency and Incidence of Acute Fluoride Exposure

Based on the inclusion criteria, the acute fluoride exposures reported were from pure fluoride (which included professionally applied and/or prescribed supplements), toothpaste with fluoride, mouth rinse with fluoride and multivitamin with fluoride (with and/or without iron).

“Pure fluoride” included gel forms of acidulated phosphate fluoride (APF) which contained 1.23% (12,300 ppm) fluoride, gel or foam of sodium fluoride (NaF) at 0.9% (9,040 ppm) fluoride and applied gel of sodium fluoride (NaF) at 0.5% (5,000 ppm) fluoride or stannous fluoride (SnF₂) at 0.15% (1,000 ppm) fluoride. Overexposure/ingestion of NaF varnishes that were applied in-office by dental professionals were also included in the study, usually at 2.26% (22,600 ppm) fluoride preparation. Dietary fluoride supplements were in the form of tablets, lozenges or liquids. Most supplements contained sodium fluoride as the active ingredient with 1.0, 0.5 or 0.25 mg fluoride. The following highlights the conversion of fluoride to its ion/compound:

- APF=1.23% F=2.7% NaF-
- NaF=2% NaF=0.09% F-
- SnF₂=10% SnF₂=2.5% F-
- NaF Varnish=50 mg NaF-/ml=2.3% F-

Concentrations of fluoride in toothpaste ranged from 1,000 to 1,100 ppm. Fluoride in toothpaste came from 3 compounds (as permitted by the FDA): sodium monofluorophosphate (MFP), sodium fluoride (NaF) and stannous fluoride (SnF₂). Product labels for 1,000 and 1,100 ppm products read as follows (note: 1,000 ppm equals 1.0 mg F/ml and 1,100 pm equals 1.1 mg F/ml):²¹

- 0.76% w/v MFP, which equals 1,000 ppm F (or 30 mg F/oz)
- 0.243% w/v NaF, which equals 1,100 ppm F (or 33 mg F/oz)
- 0.0454% w/v SnF₂, which contains 1,100 ppm F (or 33 mg F/oz)

Figure 2: Classifications of Records, Based on Medical Outcome/Type

Category	Definition
Asymptomatic Cases	Individuals who were asymptomatic after acute exposure to fluoride, and deemed by New Jersey Poison Information and Education System to have no effect, or judged to be non-toxic and, therefore, not followed.
Symptomatic Cases	Individuals who were adversely symptomatic after acute exposure to fluoride, and deemed by New Jersey Poison Information and Education System to have at least a minor medical effect due to exposure. These cases were followed.
Informational Cases	Individuals who called in that were not exposed to fluoride but were seeking to gain more information about fluoride exposure.*

Toothpaste tube sizes varied; however, generally, a large tube of toothpaste was usually 6.4 oz and, therefore, contained 192 to 211 mg F. A small tube of toothpaste was usually 4.6 oz and contained 138 to 152 mg F. (6.4 oz tube (1,000 ppm F) x 30 mg F/oz=192 mg F).

Fluoride mouth rinse is a concentrated solution, and the most common fluoride compound used was sodium fluoride (0.05%, or 230 ppm fluoride). Multivitamins mostly contained sodium fluoride at 1.0, 0.5 or 0.25 mg fluoride.

As Table II depicts, there was a decreasing incidence of acute fluoride exposure over the years 2010 to 2012. Toothpaste with fluoride caused the highest incidence of calls related to acute fluoride exposure, each year and as a total.

Population Characteristics and Circumstances of Acute Fluoride Exposure Cases

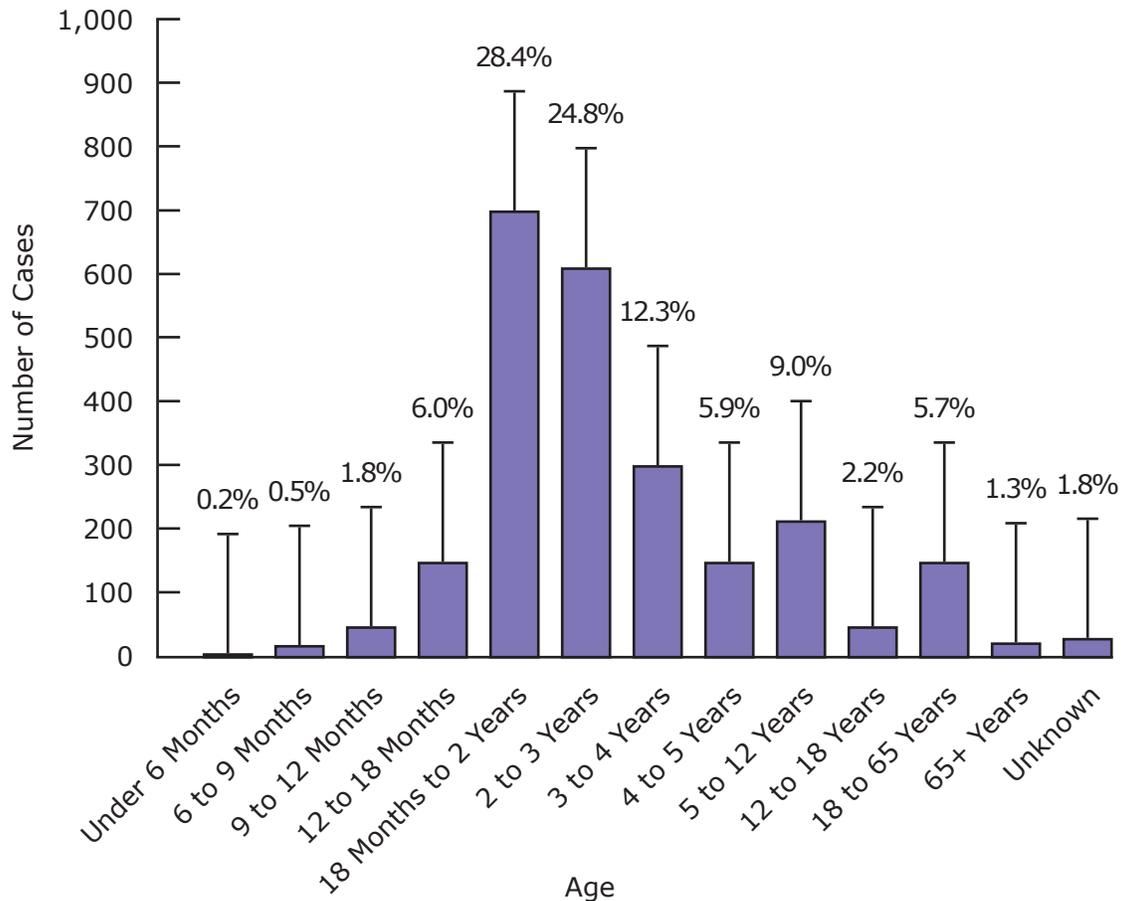
Age trends toward a unimodal distribution (Figure 3) among victims of acute fluoride exposure, with 53.2% of cases involving individuals between 18 months and 3 years of age. At a 95% confidence interval, the developmental age groups 18 months to 2 years and 2 to 3 years do not have overlapping bars (Figure 3), indicating a significant difference from other age groups. Of acute fluoride exposure victims, 79.9% were 5 years and under.

Males had a slightly higher incidence of reported acute fluoride exposures (Table III). Overlapping error bars at 95% confidence interval in Figure 4, how-

Table II: Incidence of Phone Call Records Related To Acute Fluoride Exposure in New Jersey, By Year and Fluoride-Containing Product

Substance	Toothpaste with fluoride	Mouth rinse with fluoride	Multivitamin with fluoride	Pure fluoride	
Year	n	n	n	n	Totals
2010	440	174	200	66	880
2011	398	176	181	56	811
2012	375	185	148	77	785
Totals	1214 (49.0%)	536 (21.6%)	530 (21.4%)	199 (0.08%)	2,476 (100%)

Figure 3: Age Distribution of Acute Fluoride Exposure Cases in New Jersey, 2010 to 2012*



*Age increments on vertical axis broken down by cognitive development stages

ever, show that this difference may not be significant (i.e. it may be due to chance). The majority of acute fluoride exposures occurred in one's own residence, while under the watch of the mother (Table III). Acute fluoride exposure was mainly unintentional.

Characteristics of Cases by Medical Outcome

As Table IV depicts, most cases would be considered asymptomatic. Of the symptomatic cases, there was mainly a minor medical effect and a small number had a moderate effect. There were no major medical effects or death, as deemed by the SPI

(Table V). As Table VI demonstrates, most symptomatic cases were caused by toothpaste with fluoride. People had the most questions (informational cases) about pure fluoride.

DISCUSSION

This study showed a decreasing trend of calls reporting acute fluoride exposure over the years 2010 to 2012 and follows the trend of decreasing calls since 2000 as per the 2011 AAPCC NPDS report. This decline may reflect the decreasing use of PCC's for acute exposures, possibly due to the increasing

Table III: Characteristic and Circumstances of Acute Fluoride Exposures in New Jersey, 2010 to 2012

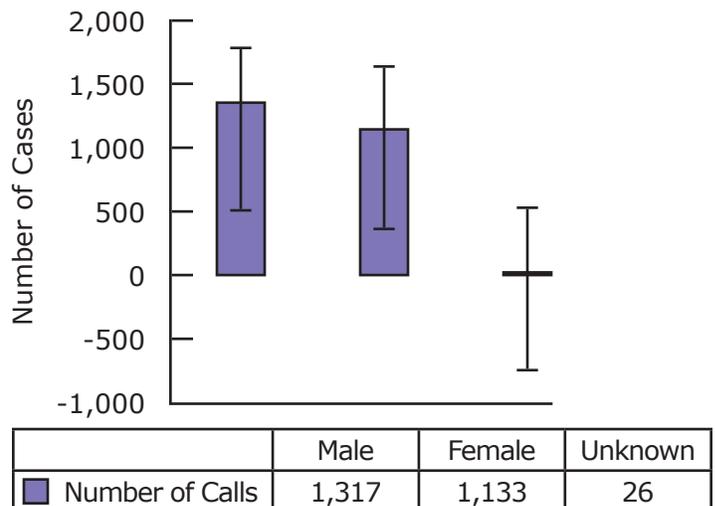
Characteristic	Percent	Characteristic	Percent
Gender		Reason for Acute Exposure	
Male	53.2	Unintentional	96.65
Female	45.8	Intentional	1.45
Unknown	1.45	Adverse Reaction	0.85
Location of Acute Exposure		Missing	1.05
Own Residence	93.1	Callers	
Other Residence	1.6	Mother	67.5
Workplace	0.1	Father	15.2
Health Care Facility	0.5	Self	5.2
School	0.7	Other Relative	3.1
Restaurant	0.0	Medical Doctor	2.1
Public Area	0.2	Nurse	1.6
Other	0.9	Occupational Therapist	0.5
Unknown	9.2	Grandparent	2.1
		Other	2.6

use of text over voice communication, and increased use and reliance on the internet.¹⁰ Additionally, the AAPCC report demonstrates that toothpaste comprised most of the fluoride-related calls. This is in accordance with this study's data, which demonstrated that toothpaste caused the highest incidence of acute fluoride exposure in New Jersey. Toothpaste is one of the most common at-home dental products containing fluoride and easily accessible. Children younger than 5 years tend to swallow toothpaste while brushing.¹⁹ Children 6 years and younger have a swallowing reflex that is not always well controlled.²²

The age groups most affected by acute fluoride exposure (for both symptomatic and asymptomatic patients), in 2010 to 2012, was 18 months to 3 years of age. This is a vulnerable population consisting of toddlers in an inquisitive and exploratory sensorimotor stage. Other studies also demonstrate that the incidence of poisoning peaks between 1 and 3 years of age.¹⁴ Males and females seemed to be equally affected, although Swierzewski's study shows that males tend to be more affected.¹⁴ The most common site of acute fluoride exposure occurred in the home while children were under the watch of parents/guardians.

The most common reason for excess exposure was found to be unintentional/accidental. Common reasons cited for reasons of excessive or inappropriate ingestion were related to taking older siblings prescription, playing with products and accidentally ingesting, and accidentally ingesting more than prescribed, either by fault of guardian or individually. However, as many dental products at home do not

Figure 4: Gender Distribution of Acute Fluoride Exposure Cases in New Jersey, 2010 to 2012



taste good to children, several phone records cite that the child stopped ingesting the product on their own. Other phone records, however, cite that the children wanted to ingest the products due to their "bubble gum" and "orange" flavors which are common among pediatric dental products.

Based on the results of this study, there were no life-threatening events or fatalities due to acute fluoride exposures, even when taken in doses higher than recommended or prescribed. Fluorides in available over-the-counter and prescription products are relatively safe and common acute doses have generally nontoxic and minor outcomes. It would require a very large amount of ingestion of fluoride-contain-

Table IV: Classification of Phone Call Records, Based on Medical Outcome

Classification of Call Type	Total number	Percent
Asymptomatic	2,346	94.75
Symptomatic	105	4.24
Informational	25	1.01

Table V: Symptomatic Cases, Categorized by Types of Symptoms

Symptomatic Medical Outcome	Total number	Percent
Minor	89	83.96
Moderate	17	16.04
Major	0	0
Death	0	0

ing product to even require medical intervention, let alone direct fatality. Recall that it would take 67 mg of ingestion of fluoride for an average 2 year old child at 30 lbs. To put it into perspective, it would take nearly an entire tube of an average sized children's toothpaste tube to reach the acute toxic dose and ingestion of 3 tubes of toothpaste to reach the acute lethal dose.

There was a small group (4.24% of total cases) of symptomatic cases, who exhibited minor and moderate effects of acute fluoride exposure. Most of these cases reported gastrointestinal symptoms (including nausea and vomiting and less frequently, diarrhea, abdominal pain and colored urine). The mechanism of toxicity is thought to occur by corrosive action, where fluoride reacts with hydrochloric acids in the stomach, resulting in gastrointestinal irritation.¹⁵ These symptoms were generally easily remedied with calcium as the antidote, in the form of milk, cheese, yogurt, etc., to bind the fluoride. Induced vomiting was not recommended by SPI's. The main concern was not poisoning, but rather aspiration or dehydration from the vomiting and the rare allergy. Based on this study, there were no hospitalizations necessary due to acute fluoride exposure.

New Jersey Poison Information and Education System, like other poison control centers across the nation, receives a large volume of fluoride-related calls largely concerning young children's excess exposure. While the warning labels are effective in alarming people to the dangers of excessive fluoride intake, this study found several cases of parents rushing their children to the hospitals due to the statement to "seek medical help right away." It was found that it was unnecessary to do so; all of the children were discharged and did not need further treatment (as

Table VI: Breakdown of Medical Outcome Classification by Product Type

Classification Type	Percent
Asymptomatic	
Toothpaste with Fluoride	49.0
Mouth Rinse with Fluoride	21.6
Multivitamin with Fluoride	21.4
Pure Fluoride	8.0
Product Not Defined	0.0
Symptomatic	
Toothpaste with Fluoride	57.0
Pure Fluoride	22.0
Mouth Rinse with Fluoride	14.0
Multivitamin with Fluoride	7.0
Product Not Defined	0.0
Informational	
Pure Fluoride	45.0
Toothpaste with Fluoride	24.0
Mouth Rinse with Fluoride	17.0
Multivitamin with Fluoride	0.0
Product Not Defined	14.0

confirmed by a follow-up call from New Jersey Poison Information and Education System). Visits to the emergency department can cost resources and it may be more cost-effective for the label to indicate making a phone call to a PCC first. The authors support ADA's statement that the FDA warning labels may be making parents and guardians overly frightened.

This study is important for the dental hygienist in light of clinical practice, patient education and the current controversies in the media regarding fluoride.

Clinical Practice

Guidelines for in-office ingestion of fluoride: If the child patient in the dental chair accidentally swallows fluoride during an in-office fluoride treatment, the child should be given water and any calcium-containing product (milk, cheese, yogurt, ice cream) as soon as possible. If vomiting occurs and does not stop, and/or severe abdominal pain, it may be necessary to take the child to the emergency department. The main concern with vomiting is dehydration. If the child is vomiting, make sure they are seating up right and not sleeping on their back to prevent aspiration.

When prescribing/recommending fluoride as a supplement: As dental professionals, it is important

to perform a caries risk assessment before making recommendations associated with preventing or controlling caries. As the American Academy of Pediatric Dentistry (AAPD) recommends, dental caries risk assessment should be based on a patient's age, biological factors, protective factors and clinical findings.²⁵ Biological factors include primary caregivers having active caries, low socioeconomic status, the number of meal sugar-containing snacks or beverages consumed per day, the patient having special health care needs, and/or the patient is a recent immigrant. Protective factors include whether the patient receives optimally-fluoridated drinking water, other fluoride supplements and the patient follows regular dental home care and in-office visits. Clinical findings include having more than 1 decayed/missing/filled surfaces, having active white spot lesions or enamel defects, elevated mutans streptococci levels, or plaque on teeth.²⁵

It is critical to assess a child's total fluoride exposure from all sources (food, drink, optimally treated water, toothpaste, supplements, topical applications in-office, etc.) when developing oral care recommendations and treatment plans.²³ The ADA, AAPD and the American Academy of Pediatrics (AAP) encourages practitioners to calculate appropriate dose based on a child's total fluoride exposure and caries risk status.^{17,21,25} Fluoride supplements are recommended only for children living in non-fluoridated areas and at high risk for tooth decay.²³ While studies demonstrate that fluoride can provide a tremendous benefit,²⁻⁵ and this study supports the relative safety of fluoride, a risk still remains with overexposure calling for its judicious application.^{4,6-8} Fluoride therapy can be customized, and it must be remembered that modifications to therapy are necessary based on a patient's changing risk assessment, disease status and fluoride exposure.

If fluoride levels in water are unknown, drinking water should be tested for fluoride content before supplements are prescribed. If the water comes from a public or community water supply, the local water supplier can help to determine the amount of fluoride. The Environmental Protection Agency (EPA) regulates fluoride in drinking water, although the decision to fluoridate a water supply at all is made by the state or local municipality.²⁴ The CDC and EPA's websites can be valuable resources to determine water fluoridation levels. If the water source is a private well, it will need to be tested and the results obtained from a certified laboratory.²⁴

If a fluoride prescription is deemed necessary, it should be written legibly and distinguish between mg F and mg NaF. No more than 120 mg of fluoride in a bottle should be prescribed to avoid possible lethal dose, although multiple refills are permitted.

Dental hygienists must remember to carefully evaluate new fluoride products in the market, and review laboratory and clinical evidence supporting the efficacy of these products before applying them in-office or recommending them to patients.

Education

Dental hygienists provide valuable information to their patients regarding home care and effective dental products. It is important that they remember to remind patients of proper dosage and safety measures when handling these products at every visit. The act of reminding helps to solidify knowledge and good habits. Toothpaste is the number one fluoride-containing dentifrice in acute fluoride exposures; therefore, dental hygienists should educate and remind parents to put away their toothpaste in a place at home that is far from reach from their toddlers.

A few days after birth and even before the teeth erupt, caregivers should clean their child's mouth and gums with a soft moistened washcloth or gauze pad at bath time. This helps ready the child for the toothbrush cleaning to come, and they become accustomed to having something in their mouth in such a manner.²⁶ Additionally, this routine will wash off bacteria that could otherwise damage the infant teeth as they come in.²⁷ For children younger than 3 years of age, caregivers should start brushing children's teeth as soon as they begin to come into the mouth with fluoridated toothpaste – no more than a smear or size of a grain of rice.¹⁷ For children 3 to 6 years of age, caregivers should dispense no more than a pea-sized amount of fluoridated toothpaste.¹⁷ Children should always be supervised to ensure that they use the appropriate amount of toothpaste and to minimize swallowing of toothpaste. It is important to provide counseling to these caregivers at every dental visit with the use of clear description, visual aids and demonstration to ensure that the appropriate amount of toothpaste is used. Studies show that caregivers apply up to twice the recommended amount of toothpaste – it is imperative that they are well-educated.^{18,20}

As part of oral health education, dental hygienists can also assure concerned parents that if too much fluoride intake is suspected, it is helpful to have their child ingest a calcium-containing product. It is not recommended to induce vomiting. If any uncertainties arise, patients should be educated on the role of the poison control center which is open 24 hours a day and 365 days a year.

This study revealed that many informational calls were made by concerned parents and guardians regarding the safety of fluoride, further illustrating the current controversies. Recently, many dental hygienists are faced with questions from patients and

parents of patients regarding the safety of fluoride. While too much of any substance can be harmful, patients can be assured that the benefits of fluoride in fighting tooth decay outweigh potential harms. If patients express doubts about fluoride use and evidence-based discussions do not placate concerns, dental professionals must respect the patient's position and emphasize the need for proper nutrition and meticulous oral hygiene. Dietary counseling and education on sugar, forms of sugar and unhealthy vs. healthy snacks is important.

When educating patients and/or caregivers, it is imperative that dental hygienists are conscious of their communication techniques to help drive motivation and compliance. The patient will be most motivated to learn when good rapport, speech, tone of voice, body language and facial expression have been established.²⁸ Basic principles of teaching have been shown to increase the effectiveness of compliance, including:²⁸

- Presenting small amounts of information at one time in simplified words
- Letting the patient set their own pace by making sure they have learned the technique before moving on to teach other things
- Supervising the patient and making sure they are practicing the correct technique
- Providing feedback during visits and teaching the patient self-evaluation tools
- Using positive reinforcement

Taking the time to perform the correct assessment and employing proper communicative techniques during education are the fundamentals of successful compliance.

There were some limitations to the study due to its retrospective nature. The data is limited in that it only deals with cases reported to New Jersey Poison Information and Education System. That is, the actual number of actual exposures that occur in the population is unknown, as they may go unreported. Additionally, the data is all based on history given, and some were estimates. There was some missing and unknown data in some subcategories, including age, gender, locational site, medical outcome and reason for exposure. It is possible that some of the adverse reactions to ingestion of the products were related to ingredients other than fluoride.

Future studies may want to test and verify accurate amounts of fluoride ingested, rather than accepting caregiver reports. In the future, it would be helpful to separate and evaluate dental products based on the type of fluoride present (whether sodium fluoride, stannous fluoride, etc.) instead of grouping all toothpaste, mouth rinse, pure fluoride and multivitamins with fluoride together. It was difficult to separate the types of fluoride in this study due to the second-hand nature of obtaining the data based on personal reports.

CONCLUSION

Based on the results in the study, there was no incidence of lethality or toxicity due to acute fluoride exposure in New Jersey from 2010 through 2012. Almost all cases had no medical outcomes; very few cases had mostly minor symptoms from acute fluoride exposure. The benefits of fluoride generally outweigh the risks.

Dental hygienists are advised to perform caries risk assessment and evaluate overall fluoride exposure for each patient before making recommendations associated with preventing or controlling caries. Dental hygienists should remind patients or caregivers to call the American Association of Poison Control Center (800-222-1222) immediately if fluoride toxicity is suspected.

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DISCLOSURE

Toxicall is a registered trademark of Computer Automatic Systems, Inc.

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Effect of a Simulation Exercise on Restorative Identification Skills of First Year Dental Hygiene Students

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Abstract

Purpose: This study explored the effectiveness of simulated mouth models to improve identification and recording of dental restorations when compared to using traditional didactic instruction combined with 2-dimensional images. Simulation has been adopted into medical and dental education curriculum to improve both student learning and patient safety outcomes.

Methods: A 2-sample, independent t-test analysis of data was conducted to compare graded dental recordings of dental hygiene students using simulated mouth models and dental hygiene students using 2-dimensional photographs. Evaluations from graded dental charts were analyzed and compared between groups of students using the simulated mouth models containing random placement of custom preventive and restorative materials and traditional 2-dimensional representations of didactically described conditions.

Results: Results demonstrated a statistically significant ($p \leq 0.0001$) difference: for experimental group, students using the simulated mouth models to identify and record dental conditions had a mean of 86.73 and variance of 33.84. The control group students using traditional 2-dimensional images mean graded dental chart scores were 74.43 and variance was 14.25.

Conclusion: Using modified simulation technology for dental charting identification may increase level of dental charting skill competency in first year dental hygiene students.

Keywords: simulation, pre-clinical, dental, dental hygiene, dental materials, identification, restorative, theoretical frameworks

This study supports the NDHRA priority area, **Professional Education and Development:** Validate measures that assess continued clinical competency.

INTRODUCTION

The use of simulation in medical and health science education has emerged as a seminal pedagogical tool in the past several decades.¹⁻³ The needs and application of simulation technology for training in dental and dental hygiene education have progressively paralleled the same utility of supporting and improving student learning.⁴⁻⁶ Incorporating simulation into pre-clinical curriculum acknowledges the Institute of Medicine's attempt at improving patient safety and enhances student ability and confidence prior to encountering live patients.^{7,8} Simulation can be incorporated into various pre-clinical phases of dental and dental hygiene education but must be financially feasible and supported by the faculty of each institution.

Prior to providing oral health care to patients, undergraduate dental hygiene students must demonstrate proficiency in all areas of patient oral health assessment, treatment and evaluation. Included in the oral health assessment are identification, and recording of specific dental restorative conditions. Historically, students struggle with demonstrating these skills despite didactic and laboratory instruc-

tion in dental materials and theory.⁹ Pre-clinical laboratory sessions typically include students partnering with one another to practice identification and assessment skills; however, traditional undergraduate dental hygiene students are often young adults and may have limited dental restorations, reducing practical experience beyond 2-dimensional textbook and didactic instruction. Advances in dental material shade-matching and contouring abilities have introduced clinical similarities between various materials and tooth structures with seemingly undetectable margins.^{10,11} Although, these attributes contribute to the success of esthetic dentistry, identification and charting of these materials have proved to be challenging for pre-clinical dental hygiene students.^{12,13} Although these concepts are reviewed didactically using photographs and written descriptions, students continue to have difficulty comprehending 2-dimensional models and have limited pre-clinical laboratory experiences. The ultimate goal of dental and dental hygiene education is to become proficient in skills set forth by the Commission on Dental Education. Deliberate practice is an educational approach to become proficient in these skills by using repetition,

assessment of performance and feedback resulting in improved skill performance by the student.

Other health science disciplines continue to demonstrate success in the use and effectiveness of simulation as an adjunct to clinical and didactic learning. Simulation closes the gap between pre-clinical knowledge building and actual hands-on patient care. In the 1960s, the cardiology patient simulator was developed. Still in use today, this simulator is able to reproduce 30 different cardiac conditions allowing medical students to successfully improve training in cardiac and pulmonary clinical skills.^{14,15} Many programs in emergency medicine use simulation scenarios for rapid response teams to practice critical skills such as intubation and resuscitation. These activities improve team member roles during real life traumas and hospital emergencies.¹⁶⁻¹⁸ Neurosurgery, vascular and orthopedic surgery students also benefit from simulation technology to build and improve surgical skills.^{19,20}

In the nursing education and practice setting, simulation programs have been developed to improve learning environments for nurses of varying levels of experience and expected scenarios, such as critical care, acute care, infant care, obstetrics and gynecology.²¹⁻²³ Hospitals are now incorporating simulation into their orientations. One hospital developed a simulation program concurrently with their cardiac surgery unit and developed scenarios that reflected typical care a cardiac patient may require.^{24,25} In obstetrics, simulation training is common. New and seasoned practicing nurses as well as other health professionals have opportunities to participate in common neonatal diagnoses such as sepsis and respiratory distress. The team approach to learning with simulation addresses the need to improve neonatal outcomes.²⁶

Simulation in anesthesia education has been used since the 1980s. Given the nature of the practice environment, teachable moments are often overshadowed by the necessity for seasoned anesthesiologists to respond to critical patient needs instead of allowing for student instruction. Simulation in anesthesiology offers learners the opportunity to experience critical decision making in a safe environment.²⁷ In addition, the American Board of Anesthesiology now requires some form of simulation training to fulfill certification requirements.²⁸

The 2 theoretical frameworks used in this study include Benner's stages of clinical competence²⁹ and Kirkpatrick's training outcomes model.^{30,31} Students interacting with the simulated dental conditions in this investigation were provided with both a visual and tactile sense of experiential learning.³² "Learning by doing, observing, and participating" provides experiential learning in the form of apprenticeship

rather than isolated didactic classroom instruction.³² Benner's theory reflects upon these vital experiences related to both philosophical behaviorism and constructivism, and is based on the Dreyfus model of skill acquisition.³²⁻³⁵ This theory also recommends cohesive adoption of experiential learning into a larger didactic training process including a well-designed curriculum and evaluation protocol.³³ Benner's theoretical framework is ubiquitous among educational research in nursing and has direction for interprofessional applications.³⁶⁻³⁸

The aim of this study was to investigate the use of customized simulated mouth models improved identification and recording of dental restorations in first-year dental hygiene students when compared to the use of traditional didactic instruction and 2-dimensional images.

METHODS AND MATERIALS

The School of Dental Hygiene at Old Dominion University enrolls 48 students into their entry-level Baccalaureate degree program each year. The program requires 2 years of pre-requisite and general education courses preceding 2 years of dental sciences, dental hygiene theory and practice, community oral health, research methodology, and teaching strategies. Participants of this study were dental hygiene students who had completed 2 years of pre-requisite courses and were recognized as first year dental hygiene students. Students completed 1 semester of a dental materials course and had knowledge of Blacks classification. The School of Dental Hygiene supported this research study by providing participants and the facility for conducting the clinical trial. Prior to the start of this investigation, the protocol was reviewed and approved by the institutional review board ensuring the protection of human subjects.

Using an A-Dec 42L Stationary Simulator, 11 stock interchangeable Frasco A-PZ DA periodontal simulated mouth models were customized to reflect restorative findings of a typical patient receiving care in the dental hygiene clinic. Each model was uniquely modified by a faculty dentist who "restored" them to randomly include 10 chartable items: 2 sealants, 3 posterior multi-surface amalgams, 3 posterior multi-surface composites and 2 anterior multi-surface composites. Two-dimensional images were obtained by photographing dentition of 3 patients from the clinic facility with 10 chartable items similar to the modified simulated mouth models.

A convenience sample of dental hygiene students from the first year, baccalaureate degree program were chosen for this study. At the time of the study, 48 students were enrolled in the program

as first year dental hygiene students and were eligible for participation in the investigation (Table I). Following recruitment, 34 students committed to enrollment in the study. The number of sample participants was based on the total available students starting their first-year dental hygiene cohort experience, having all been equally exposed to 1 semester of dental and dental hygiene science studies. It was important to study this sample population because all participants were identified as having the same formal pre-requisite education and only 1 cohort semester of education in the dental hygiene program. The sample was randomly divided into 2 groups: the Didactic Group (control) and the Simulator Group (experimental). Four students reported having 2 years or less of dental assisting experience prior to entering the program. Two of these students were randomly assigned to each group.

Random assignment rendered 17 students in the Simulator Group (experimental) and 15 students in the Didactic Group (control). Two students from the control group did not complete all sessions and were disqualified from the study. Students in the Simulator Group utilized a randomly selected custom simulated mouth model for 3 sessions of 15 minutes each to practice identification and documentation of dental conditions. Both groups had previous identical didactic and laboratory lessons on dental charting. Students in the Didactic Group viewed randomly selected 2-dimensional images for 3 sessions of 15 minutes each to also practice identification and documentation of dental conditions. Students from both groups recorded findings using standard dental charting criteria. Students in SC scheduled individual 15 minute timed sessions with a supervising faculty in a private room with 1 simulator. Students in the Didactic Group SC scheduled individual 15 minute timed sessions with a supervising faculty in a quiet room. Sessions were scheduled over a 3 week time frame. Students charted findings at every session. Students were not able to ask questions or collaborate with other students. Both groups received feedback immediately after the 15 minute time ended. One dental hygiene faculty member graded all dental charts anonymously and did not see the student's name or any identifying information to maintain intra-rater reliability. Since there were 10 chartable items in each scenario, each item was worth 10 points for a total of 100 possible points earned per session.

A 2-sample, independent t-test analysis of data was conducted to compare graded dental recordings of dental hygiene students using simulated mouth models and dental hygiene students using 2-dimensional photographs.

Table I: Cohort Demographics

	Experimental Group	Control Group
Age		
18 to 25	14	12
26 to 33	3	3
Race		
Caucasian	9	8
African American	4	4
Asian	4	2
Hispanic	0	1
Gender		
Male	1	0
Female	16	15

RESULTS

Using Microsoft Excel 2010, a t-test for independent samples assuming unequal variance was calculated. The variances were unequal based on the f-test, which resulted in a p-value of 0.055. The t-test gave a p-value of <0.0001. Figure 1 illustrates mean Simulator Group (Experimental) and Didactic Group (Control) Scores. Table II demonstrates a statistically significant difference in the graded dental chart scores for Simulator Group (mean=86.73, variance=33.84) and control (mean=74.43, variance=14.25). Considering this study was restricted to a small, unique population group, generalizability of the results may be limited to first-year dental hygiene students. Overall, students who identified restorations on the simulator yielded a mean 87% success rate while those students who identified restorations using 2-dimensional photographs yielded a mean 74% success rate.

DISCUSSION

Findings of this study reflect the collective evidence of beneficial outcomes published in current dental and health care simulation education literature.³⁹⁻⁴³ Comparatively, the beneficial outcomes in this and other current studies consistently demonstrate the effectiveness and major benefits of using simulation. These benefits include increasing skill acquisition before patient exposure and the ability to repeatedly practice identification skills in a safe environment. Specific diagnostic and assessment skills are especially important in dental hygiene education to ensure safe delivery of care as the evolving profession uses highly realistic restorative and prosthetic materials, conservative caries detection methods, and roles for dental hygienists continue to expand nationally.^{42,44} The results of this study showed diagnostic and assessment skills can be increased by using simula-

tion which should be adopted as proficient learning tools to help dental hygiene students increase their success rate of providing effective, safe care for preparedness in expanding roles such as nurses used to prepare students for midwifery roles.⁴⁴ Studies in nursing simulation also provide evidence similar to this study in demonstrating how low-cost, low-to-medium level fidelity simulation allows students an opportunity to increase success when learning new skills.^{39,44} Methods and outcomes in this study further mirrored nursing simulation studies which implemented best practices and standards for simulation use in education and research.^{43,45}

The use of modeling and simulation has shown to be an effective method to transfer knowledge from instructor to student when compared to traditional teaching methods in dentistry.⁴⁶⁻⁴⁸ Simulators provide integration of psychomotor skill training with problem-based learning, such as didactic instruction. In this study, dental hygiene students were able to identify and correctly chart each preventive and restorative dental material based on visual, tactile and auditory senses. This leads to improved performance when compared to isolated classroom delivered learning. In addition, this allowed for students to become confident and proficient in critical skills necessary for successful assessment of oral conditions when evaluating live patients and in-vivo scenarios.

Limitations of the study included a small sample size. Additionally, due to budget constraints, extensive restorations (such as cast porcelain and metal crowns) were not used in the simulation. Educators within the disciplines of both dental and dental hygiene curriculum may be able to use the findings of this study to improve assessment skills of students. The supporting data, which proves the effectiveness of the simulated technology, demonstrates the need for educators to consider and adopt realistic, safe, efficient, inexpensive and effective teaching methodologies. Simulation of the oral cavity enhanced the pedagogical transfer of didactic clinical assessment and evaluation skills into a realistic scenario. Each interchangeable modified simulated mouth model served as a tool to enhance dental hygiene students' ability to accurately identify specific dental materials and conditions. This modeling and simulation exercise will be implemented into the junior year dental hygiene pre-clinical laboratory course to assist students in accurately identifying dental restorations prior to actual patient care.

CONCLUSION

Using this type of simulation tool in conjunction with traditional teaching strategies of didactic education may allow students to physically assess, identify and chart certain restorations presented in the clinical setting. Although using simulated mouth models

Figure 1: Mean SG (Experimental) and DG (Control) Scores

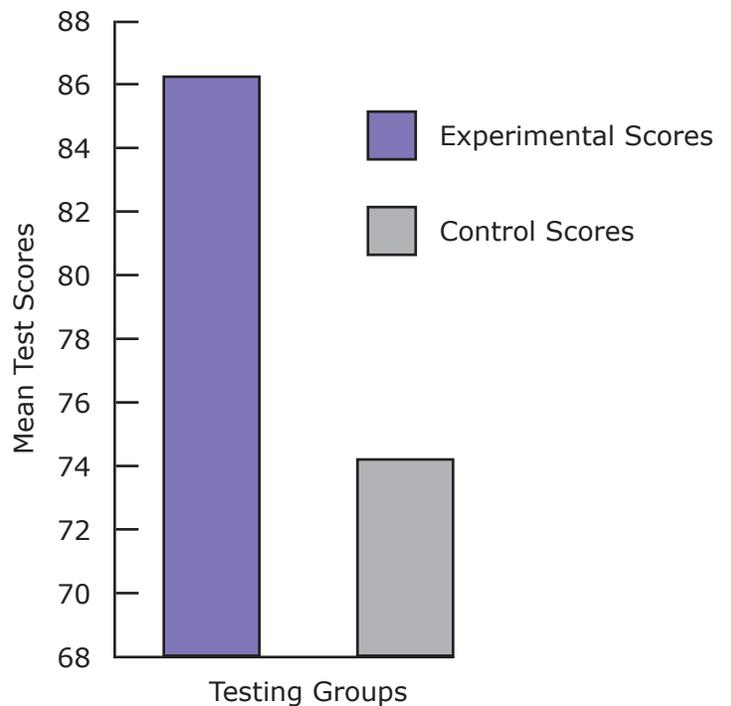


Table II: Statistical Analyses t-test Results

t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2
Mean	86.73529	74.43333
Variance	33.84743	14.25417
Observations	17	15
Hypothesized Mean Difference	0	-
df	28	-
t Stat	7.17306	-
P(T<=t) one-tail	4.16E-08	-
t Critical one-tail	1.701131	-
P(T<=t) two-tail	8.32E-08	-
t Critical two-tail	2.048407	-

is not a new concept in dental and dental hygiene education, this study reaffirms the importance and success of this type of educational tool. In this study, modified simulated mouth models improved identification and recording of dental conditions by dental hygiene students when compared to students who used 2-dimensional images. Future research should include larger sample sizes, more complex restorations and an evaluation of the effects of experiential learning with modeling and simulation using outcomes assessment in dental hygiene education.

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DISCLOSURE

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Assessing Faculty Development Needs among Florida's Allied Dental Faculty

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Abstract

Purpose: Professional schools rarely prepare prospective academic faculty for the responsibilities of college and university teaching. Without this training, faculty are often left to discover on their own and to varying degrees of success what is expected of them once they enter the academy. At the same time, universities and colleges recognize that retention of faculty depends on the successful transition of academics into the related roles and responsibilities of the professoriate. The purpose of this study was to assess the faculty development needs among allied dental faculty, specifically the state of Florida's dental hygiene and dental assisting faculty, by measuring the following: the relationship between their knowledge and priorities for further training, their level of satisfaction with current faculty development opportunities and mentoring, and their perceptions of what additional training and resources might advance their careers.

Methods: Two hundred and four full-time and part-time faculty were invited to participate in this survey research study. McNemar's test for paired binary data was used to analyze the level of agreement between knowledge and indicated priority. Responses to open ended questions were coded and categorized thematically.

Results: There were 115 responses (n=204, 74%). There were statistically significant differences between participants' ratings of knowledge and priorities for further training on many items related to teaching, scholarship and leadership skills. Participants also identified 5 categories of unmet needs.

Conclusion: The findings suggest that universities and colleges need to offer learning experiences aimed at strengthening the teaching, scholarship and leadership skill needs of their allied dental faculty. Additionally, professional schools might consider offering a program track that provides prospective allied dental faculty with the types of opportunities that develops teaching, scholarship and mentoring skills prior to graduation.

Keywords: allied dental faculty, continuing education, faculty development, quantitative analysis, survey research

This study supports the NDHRA priority area, **Professional Education and Development:** Identify the factors that affect recruitment and retention of faculty.

INTRODUCTION

Professional schools rarely prepare prospective academic faculty for the responsibilities of college and university teaching. Without this training, faculty are often left to discover job expectations on their own. At the same time, universities and colleges recognize that retention of faculty depends on the successful transition of academics into the related roles and responsibilities of the professoriate. This issue is further complicated by the observation that the landscape of teaching and learning has changed dramatically in the last 2 decades. Online learning, learning management systems and technology make it possible to teach and learn from any location, from a coffee shop to the comfort of one's home. Supplemented by technology, changes encompassing opportunities to teach from and learn in a variety of environments now require that university and college faculty assess the currency of their teaching skills. Taking time to assess what faculty know about teaching, educational research, and trying to discover what their teaching and learning needs are is crucial to

ensuring that faculty remain current in their pedagogical expertise. The purpose of this study was to assess the faculty development needs among allied dental faculty, specifically the dental hygiene and dental assisting faculty teaching in the state of Florida.

Previous research highlights the importance of addressing the needs of dental hygiene faculties regarding faculty development programs.¹ Such initiatives have been linked to faculty's decision to remain in academics. In a study of 167 baccalaureate dental hygiene faculty, 40% (n=35) of participants reported that they were somewhat or very dissatisfied with the amount of time allowed for keeping abreast of new and emergent knowledge in the field.² In the Collins et al study, the majority of the participants (96%, n=107) reported that advancement opportunities were somewhat or a very important factor in their decision to leave their current position and accept another position. A majority (85%, n=96) also indicated that having no pressure to publish

was somewhat or a very important factor in their decision to leave their current position and accept another position. Faculty reported that they had little time available for research/scholarship and professional growth activities, although these are often deciding factors in tenure decisions. When asked to rate the most important skills for future dental hygiene faculty, more than 90% of 592 participants in the Coplen et al study identified educational, technological and clinical skills.³

Faculty development programs have been reported to enhance participants' sense of belongingness. For example, a dental hygiene faculty development program enhanced faculty sense of community and satisfaction.⁴ Yet, the availability of faculty development opportunities for dental hygiene and dental assisting faculty or professional preparation in educational methodologies for these faculty are not readily discussed either in scholarship or reported in the literature.⁵

In a recent study, several authors sought to explore how the adoption of e-courses could be increased among dental and dental hygiene faculty members.⁶ Using focus group interviews, 27 dental and 23 dental hygiene faculty members from 6 institutions participated.⁶ This study identified 4 barriers to e-course adoption: low perceived relative advantage to faculty members, low compatibility with current curriculum, high perceived time commitment and complexity of e-course development. Compared to traditional courses, participants reported that e-courses increased accessibility and convenience for students, allowed faculty members to make additional materials such as websites, readings, and activities available, and offered a relatively easy way to assess student progress with the use of online quizzes.⁶

The purpose of this study was to assess the faculty development needs among allied dental faculty, specifically the state of Florida's dental hygiene and dental assisting faculty, by measuring the relationship between their knowledge and priorities for further training, their level of satisfaction with current faculty development opportunities and mentoring, and their perceptions of what additional training and resources might advance their careers.

METHODS AND MATERIALS

The university's institutional review board approved the study (IRB# U-989-2013). An Office of Educational Affairs' committee at the University of Florida's Jacksonville College of Medicine originally developed the survey in response to a request that they create a needs assessment to help plan a new faculty development curriculum. Since no database was available of all dental hygiene and dental assisting faculty in the state of Florida, the researchers compiled a list of all of the institutions that have a dental hygiene and dental assisting program in the state. Each of the identified 31 program direc-

tors were contacted via email and asked to provide a list of full-time and part-time faculty with their first and last name and corresponding email address. Two hundred and four full and part-time faculty teaching faculty were invited to participate in the faculty development needs assessment via a 37-item questionnaire. The questionnaire was developed to measure participants' knowledge of and priorities in teaching, scholarship and leadership skills. Participants were asked to indicate and rate of satisfaction with their institution's faculty development opportunities, the frequency of their participation and level of satisfaction with the mentoring they received. Next, they were asked to rate their knowledge of items related to teaching, scholarship and leadership using a Likert response scale where: 1=none, 2=very little, 3=some, 4=approaching mastery and 5=mastery/could teach others. They were also asked to indicate their priority for each item in their personal development using a Likert response scale where: 1=low, 2=medium and 3=high. Finally, they were asked to list 3 needs that they believed that, if fulfilled, would advance their career.

The survey was sent to participants using the professional and encrypted version of Survey Monkey. Reminder messages were sent to participants several times to enhance the response rate. The rate of return was 74%, or 115 of 204. The sample included almost an equal amount of full and part time faculty, 73 (48.3) and 78 (51.6), respectively, from dental hygiene and dental assisting schools across Florida. All data were de-identified prior to the analysis.

Statistical Analysis

Summary statistics were computed for all items in the survey. The authors dichotomized scores (lower: knowledge=1, 2, 3 versus high: knowledge=4, 5) and priority scores (lower: priority=1, 2 versus high: priority=3) for the knowledge and priority items. Using McNemar's test for paired binary data, the level of agreement between knowledge and indicated priority was tested. A significant p-value from McNemar's statistical test provided evidence that there was disconnect between knowledge and priority, either evidence that there was a lack of knowledge in an area and that it was not prioritized for future training or that there was not a lack of knowledge but it was given higher priority.

Hypothesis testing was set at a level of 0.05 to ascertain statistical significance. SAS version 9.3 (Cary, NC) was used for all data analysis. A reliability analysis was run to compute Cronbach's alphas for each of the 3 subscales for both knowledge and priority. The internal estimates of reliability

were strong for all subscales ranging from 0.78 to 0.89. Cronbach's alpha for knowledge and priority by subscale is shown in Table I. The respondents listed up to 3 current needs. Overall, 413 current needs were listed. The items were open coded and categorized by the authors independently. The most frequent categories coalesced into 5 themes (professional development and skills, need for a position/job, continuous education, completing a degree, and financial needs and other resources). Operational definitions were created from the free responses by paying special attention to the way that responses overlapped or conflicted and the overarching concept they illustrated. Data was extracted to exemplify each of the themes.

RESULTS

Faculty's Rating of and Level of Participation in Faculty Development Programs

With regard to program quality of faculty development opportunities, participants (34.71%) rated them as poor or fair 33.53% rated good and 31.76% indicated they were very good to excellent. Of those who frequently participated in a faculty development program (5 to 7 times per year), 11.86% indicated a poor/fair rating, 21% selected a good rating and 44.44%, a very good to excellent rating. Rates of participation across 3 levels (never to 1 or 2 per year, some, 3 to 4 per year, and often and frequently) were comparable at 32.94%, 30% and 37.05%, respectively (Table II). No statistical differences were found between ratings of and level of participation in faculty development opportunities.

Faculty's Perceptions of Mentoring

About one-third of the respondents rated the quality of the mentoring they received as poor (11.18%) or fair (23.53%). Of those who rated mentoring quality positively, 33.53% reported a good rating, 23.53% reported a very good rating and 8.24% reported a rating of excellent.

Faculty Priorities in Teaching, Scholarship and Leadership

There was a statistically significant difference in 4 of the 9 teaching items. As shown in Table III, 36.18% of the participating faculty rated their teaching knowledge as low on providing constructive feedback to learners. More than a third (35.57%) rated their knowledge as low on designing courses. Faculty who identified these activities as high priority needs ranged from 71.81 to 80.92%, respectively. The findings showed that faculty have a need for these skills. More than half

Table I: Internal Estimates of Reliability by Subscale

Subscale	Knowledge	Priority
Teaching	0.889	0.779
Scholarship	0.857	0.826
Leadership	0.866	0.851

Table II: Perceptions of Faculty Development by Level of Participation

Level of Participation	Current State of Faculty Development Program			
	Poor/Fair	Good	Very Good/Excellent	Overall Percent
Never to 1 or 2 per Year	40.68	38.60	18.52	32.94
Some (3 to 4 per year)	42.37	31.58	14.81	30.00
Often (5 to 7 per year)	11.86	21.05	44.44	25.29
Frequently (8 or more per year)	5.08	8.77	22.22	11.76
Overall Percent	34.71	33.53	31.76	—

(59.73%) reported having a low knowledge on the items of teaching effectively, and 73.97% reported low knowledge on developing an educational portfolio. More than a third (35.57%) reported a high priority for training on teaching effectively, and 25.34% indicated that they had a need for training in developing an educational portfolio. Of the remaining 5 items, no statistically significant differences were observed between their level of knowledge levels and priority for additional training.

With respect to scholarship there was a statistically significant difference ($p < 0.05$) between ratings of knowledge and priority on all 5 items. Almost two-thirds to nearly all of the faculty (63.16% to 97.37%) rated their knowledge as low on the following related items: grant proposal writing in discipline research, conducting literature searches, developing research designs, documenting education outcomes and writing an education manuscript. However, only 15.65% and 34.21% identified these activities as a high priority need. The discrepancy between the participant's identification of these items as areas of low knowledge and the low percentage that identified these behaviors as areas of high priority signify a lack of awareness among the participants in prioritizing these needs for personal development.

Table III: Relationship between Participants' Knowledge and Priority for Training

Item	Percent Lower Knowledge	Percent High Priority	p-value [#]
Teaching			
Teaching Effectively	59.73%	35.57%	0.0004*
Providing Constructive Feedback to Learners	36.18%	80.92%	<0.0001*
Using Effective Assessments	59.87%	53.95%	0.371
Enhancing Small Group Teaching	60.14%	55.41%	0.453
Using Emerging Technology in the Classroom	53.33%	55.33%	0.742
Selecting Appropriate Teaching Methods	50.67%	58.67%	0.190
Enhancing My Classroom Teaching	61.49%	49.32%	0.075
Designing Courses	35.57%	71.81%	<0.0001*
Developing an Educational Portfolio	73.97%	25.34%	<0.0001*
Scholarship			
Grant Proposal Writing in Discipline Research	63.16%	25.00%	<0.0001*
Conducting Literature Searches	74.34%	34.21%	<0.0001*
Developing Research Designs	97.37%	16.45%	<0.0001*
Documenting Education Outcomes	94.08%	15.13%	<0.0001*
Writing an Education Manuscript	93.20%	15.65%	<0.0001*
Leadership			
Balancing Work and Personal Responsibilities	69.33%	30.67%	<0.0001*
Managing Stress	33.33%	59.33%	<0.0001*
Managing Time	76.67%	32.00%	<0.0001*
Demonstrating Leadership Skills	41.33%	58.00%	0.0095*
Sustaining Passion for Teaching	53.33%	56.67%	0.574
Managing Conflict	42.67%	58.67%	0.005*
Utilizing Negotiation Skills	30.26%	64.47%	<0.0001*
Preparing for Promotion and/or Tenure Review	56.67%	39.33%	0.008*
Creating a Teaching Portfolio	70.39%	35.53%	<0.0001*
Mentoring Peers	77.48%	31.13%	<0.0001*
Peer Observation of Teaching with Feedback	28.08%	67.81%	<0.0001*

[#]p-value from McNemar's test

*Denotes statistically significant difference between level of knowledge and priority given

With respect to acquiring leadership skills that might fulfill career advancement there was a statistically significant difference ($p < 0.05$) between ratings of knowledge and priority on 8 of the 11 items. Of the participants, 73.8 to 91.8% rated their knowledge as low on items related to: balancing work and personal responsibilities, man-

aging stress, managing time, managing conflict, preparing for promotion and/or tenure review, creating a teaching portfolio, mentoring peers, and peer observation of teaching with feedback. However, 55.7% rated these activities as a high priority.

Relationships among Faculty's Level of Knowledge and Priorities for Additional Training on Teaching, Scholarship and Leadership Skills

Any item in the Knowledge and Priority columns with a percentage of more than 40% was rated as a high need and high priority (Table IV). Faculty identified 8 items that were both high needs and a high priority. Five teaching and 3 leadership skills items were identified, although this did not apply to scholarship items. The teaching items included: using effective assessments, enhancing small group teaching, using emerging technology in the classroom, selecting appropriate teaching methods and enhancing my classroom teaching. The leadership items included: demonstrating leadership skills, sustaining passion for teaching and managing conflict.

Unmet Faculty Needs

Participants were asked to list up to 3 items that they believed would advance their career. Four hundred and thirteen participants' responses were reported. Participants most frequently reported items pertaining to: professional development and skills, need for a position/job, continuous education, completing a degree, and financial needs and other resources. Overall, these accounted for 60.53% of the responses (Table V).

Responses in the professional development and skills category included classroom management training, training on large and small group interactions, course development, learning better student-teacher dialogue, teaching methodology and skills, and updating technology skills, outcomes assessment and assessment methods, teaching organization and design, peer presentations, educational theory, evaluating critical thinking, interdisciplinary teaching, current trends in education, cooperative learning, publishing, and enhancing student retention of information. Those in the position need/job opportunity category were described as a desire for full time job opening or an open position, the opportunity to attain full professorship or promotion, a desire to eventually teach full time, and participate in other didactic teaching opportunities. The continuing education category included acquiring education based continuing education units. Others cited the need to learn more about educational methodologies for accreditation, finish continuing education credits for an upcoming certified dental assistant renewal and access to continuing education units on education. Some participants identified completing a degree would advance their career including obtaining bachelor of science, master's, postgraduate or doctoral degree, or a higher level

Table IV: Summary of Items that Participants Indirectly Identify as High Need and Priority

Item	Percent Lower Knowledge	Percent High Priority	p-value
Teaching			
Using effective assessments	59.87%	53.95%	0.3705
Enhancing small group teaching	60.14%	55.41%	0.453
Using emerging technology in the classroom	53.33%	55.33%	0.7419
Selecting appropriate teaching methods	50.67%	58.67%	0.1904
Enhancing my classroom teaching	61.49%	49.32%	0.0747
Leadership			
Demonstrating leadership skills	41.33%	58.00%	0.0095*
Sustaining passion for teaching	53.33%	56.67%	0.5737
Managing conflict	42.67%	58.67%	0.0053*

Table V: Most Frequently Reported Unmet Faculty Needs (n=413)

Type of Need	Frequency
Professional Development and Skills	108
Need for a Position/Job	39
Continuous Education	36
Completing a Degree	34
Financial Needs and Other Resources	33

of education. Finally, financial or other resources were indicated by participants as needed for career advancement. This included paid time to plan courses and attend meetings, as well as additional resources such as books and office space, funding, increased pay, pay for time spent grading assignments, and corporate investments.

DISCUSSION

The need for effective faculty development in the health sciences in general and for dental hygiene and assisting faculty specifically is driven by significant changes in the health care environment in the U.S.⁷ Previous research indicates that dental faculty development programs are significantly important for faculties, students and community. The ways in which faculty development programs foster academic careers in the health science has been stud-

ied in medical, pharmacy, nursing, dentistry and dental hygiene.⁸⁻¹³

The findings of the current study showed that there were differences in the knowledge, needs, and priorities among Florida dental hygiene and dental assisting faculty who teach full-time and part-time. This study was aimed at the institutional offerings for faculty development provided at each participant's respective college/university. As might be expected, at times faculty judged their knowledge to be low and their priority of these items to be low. At other times, faculty judged their knowledge to be high and their priority for additional training among items to be high. Also when their knowledge and priority were both greater than 40% on an item, it was determined that particular item was a priority. Overall participants indicated low knowledge and high priority needs among 17 of 25 faculty development assessment items.

Compared to previous research on faculty development needs among dental faculty participants, these findings are similar in some aspects, although dissimilar in others. One study of faculty development needs among University of Tennessee (UT) Health Science Center faculty found that one teaching item, assistance with instructional design, was rated highest which is in agreement with the current study, "designing courses."⁷ The authors of the UT study suggested that improved teaching skills is particularly important because "much of the curriculum is mandated by the professional health care organizations that oversee and accredit professional schools," and because faculty do not often receive training in pedagogy in their professional programs of study.⁷

The findings in the current study are comparable to another study conducted of dental faculty.¹⁴ For example, participants in the current study participated more frequently in annual faculty development opportunities of 3 to more than 5 times per year (67.1%) compared to dental faculty (49.3%). An infrequent rate of participation among dental faculty (0 to 2 times per year) was considerably higher than a similar rate of participation reported by dental hygiene and dental assisting faculty suggesting that dental hygiene and dental assisting faculty tend to take greater advantage of faculty development opportunities.¹⁴

In the current study there were 5 teaching items (using effective assessments, enhancing small group teaching, using emerging technology in the classroom, selecting appropriate teaching methods and enhancing my classroom teaching) in which ratings of knowledge and priority were not statistically significant. However, these items were rated as statistically significant by dental school faculty.¹⁴

It may be that dental hygiene and dental assisting faculty feel more prepared for teaching than dental faculty. Dental hygiene and dental assisting faculty rated the knowledge and priority among several items (teaching effectively, conducting literature searches, managing stress and demonstrating leadership skills) as statistically significant. However, they were not rated as statistically significant by dental school faculty participants.¹⁴ This findings may be due to stricter requirements in colleges of dentistry at academic institutions compared to the requirements for promotion that dental hygiene and dental assisting faculty need to attain.

Although entry level programs are designed to prepare clinicians for professional careers in dentistry and not for preparing academicians, promotion requirements continue to increase at all levels of education including community colleges where many dental hygiene educational programs are located, as well at universities. As these requirements change, more faculty in post secondary institutions are being asked to show evidence of scholarly activities such as teaching portfolios, increased use of active teaching strategies, information supporting the use of learning activities that promote cultural competence, evidence-based assessment and critical thinking. With increasing opportunities for online programs that provide access to more individuals, many options to enroll in post-graduate programs are now available for allied dental health educators. There are degree completion and master's degree programs. Individuals who seek academic careers are typically the groups that take these programs of study but there is no requirement that they include courses in education.

Research has shown the benefits of faculty development opportunities using varied formats such as workshops, seminars and courses. Studies of medical school faculty development programs indicate the urgency of improving teaching skills, strengthening colleague relationships and improving the overall academic advancement of health care faculties.^{15,16} Wallace et al reported that faculty development focused on the reinforcement of clinical teaching practices and methods, leading to increased knowledge in competency-based teaching and positive changes to communication skills with students.¹ Clinical teachers demonstrated improved teaching skills following their participation in faculty development.¹⁷

One limitation of the study is that the researchers did not differentiate responses based on institutional type, full or part-time employment, position type (such as faculty or chair), and whether the participant was a dental hygienist or dental assistant. The reason was that the researchers were looking to obtain a "snapshot in time" view of participation and

satisfaction with faculty development opportunities, mentoring, and identification of the teaching, scholarship and administrative and leadership skills/career advancement needs among a population of faculty participants in allied health programs across the state of Florida.

Overall, the findings in this study showed that participants overwhelmingly reported the need for professional development opportunities. In response to that need, following the completion of a related study conducted with dental faculty that demonstrated similar outcomes, the authors have developed 3 online accredited courses in the university's continuing dental education program.⁸ Future research should include ways to provide professional opportunities to faculty at all levels of their career in formats which are easily accessible and cost effective for all faculty.

CONCLUSION

Findings from this study support previous research which reports that faculty development is particularly important in dental education for improving faculty skills, for ensuring the effectiveness of future academic dentists and for recruiting dental hygiene faculty.^{18,19} Taking time to assess faculty knowledge about teaching, educational research, and identifying their teaching and learning needs is crucial to ensuring that faculty remain current in their pedagogical expertise. Such initiatives may ultimately ensure that future faculty are prepared to enter the

academy, and for others such initiatives may ensure their retention.

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DISCLOSURE

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PRACTICE GUIDELINES

Clinical Practice Guidelines for Recall and Maintenance of Patients with Tooth-Borne and Implant-Borne Dental Restorations

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Abstract

Purpose: To provide guidelines for patient recall regimen, professional maintenance regimen, and at-home maintenance regimen for patients with tooth- and implant-borne removable and fixed restorations.

Methods: The American College of Prosthodontists (ACP) convened a scientific panel of experts appointed by the ACP, American Dental Association (ADA), Academy of General Dentistry (AGD), and American Dental Hygienists Association (ADHA) who critically evaluated and debated recently published findings from 2 systematic reviews on this topic. The major outcomes and consequences considered during formulation of the clinical practice guidelines (CPGs) were risk for failure of tooth- and implant-borne restorations. The panel conducted a round table discussion of the proposed guidelines, which were debated in detail. Feedback was used to supplement and refine the proposed guidelines, and consensus was attained.

Results: A set of CPGs was developed for tooth-borne restorations and implant-borne restorations. Each CPG comprised of 1) patient recall; 2) professional maintenance, and 3) at-home maintenance. For tooth-borne restorations, the professional maintenance and at-home maintenance CPGs were subdivided for removable and fixed restorations. For implant-borne restorations, the professional maintenance CPGs were subdivided for removable and fixed restorations and further divided into biological maintenance and mechanical maintenance for each type of restoration. The at-home maintenance CPGs were subdivided for removable and fixed restorations.

Conclusion: The clinical practice guidelines presented in this document were initially developed using the 2 systematic reviews. Additional guidelines were developed using expert opinion and consensus, which included discussion of the best clinical practices, clinical feasibility and risk-benefit ratio to the patient. To the authors' knowledge, these are the first CPGs addressing patient recall regimen, professional maintenance regimen, and at-home maintenance regimen for patients with tooth-borne and implant-borne restorations. This document serves as a baseline with the expectation of future modifications when additional evidence becomes available.

Keywords: clinical practice guidelines, tooth-borne, implant-borne, patient recall, maintenance

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INTRODUCTION

Clinical practice guidelines (CPG) are intended to provide clinicians with guidance in diagnosis, treatment planning, and clinical decision-making.¹ CPGs have been shown to improve patient care processes and clinical outcomes, and to better identify and limit treatment risks.¹⁻⁴ Although empirically developed CPGs have been used in medicine for hundreds of years, in the 1990s systematic approaches were advanced and advocated for CPGs. In an extensive systematic review of 59 published

CPGs in medicine, Grimshaw and Russell⁴ showed that explicit CPGs improved clinical practice when introduced in the context of rigorous evaluations. In dentistry, a few oft-cited CPGs include the use of antibiotic prophylaxis before dental procedures to prevent endocarditis in certain cardiac patients,⁵ the use of prophylactic antibiotics prior to dental procedures in patients with prosthetic joints,⁶ antibiotic prophylaxis for dental patients at risk for infection,⁷ oral health care for the pregnant ado-

lescent,⁸ guidelines for the care and maintenance of complete dentures,⁹ management of patients with medication-related osteonecrosis of the jaws (MRONJ)¹⁰ and many others.¹¹ The United States maintains a national registry in the National Guideline Clearinghouse for evidence-based clinical practice guidelines, which are submitted and endorsed by various medical and professional organizations.¹¹ It is important to note that unlike traditional CPGs based on empiricism or medical authority, modern CPGs involve a systematic and transparent process for scrutiny of scientific evidence, and recommendations are made with the intent that they will be updated and modified as scientific evidence becomes available.¹⁻⁴ Despite this, recommendations made in CPGs are not always supported by scientific evidence. This is because many empirical procedures and treatments that yield favorable outcomes do not necessarily have scientific evidence at the present time.¹²

Patients seeking prosthodontic care often present with significant previous dental treatment, a complex etiology of factors contributing to the loss of teeth, loss of tooth structure, and equally complex treatment needs to restore function and esthetics. Treatment plans to address patient needs using tooth- or implant-borne restorations require careful diagnosis, risk assessment, treatment planning, meticulous execution of care, and a long-term partnership with the patient and treatment team to maintain an enduring result. Given the resources required to treat patients with complex dental needs, an appropriate patient recall regimen, professional maintenance regimen, and at-home maintenance regimen are paramount for long-term success.^{13,14} Furthermore, it is likely that the professional and at-home maintenance protocols in healthy adult patients with tooth- and implant-borne restorations may be significantly different when compared to patients with no restorations, or patients with acute or chronic oral and systemic diseases. For tooth-borne restorations, guidelines on the options and relative merits of professional and at-home maintenance protocols to predictably achieve stable results are lacking.¹³ Current guidelines for the maintenance of implant restorations are poorly defined and often based on empiricism or traditional protocols for patients with natural dentition rather than what is most suitable for maintenance of implant restorations and supporting tissues.¹⁴ Therefore, professional and at-home maintenance guidelines are necessary for patients with tooth- and implant-borne removable and fixed restorations to improve the health of supporting tissues, limit disease processes such as caries, periodontitis, or peri-implant disease, and improve the expected longevity of restorations as well as the supporting teeth and implants themselves. Guidelines are needed to provide direction

for the dental health care provider with the goal of improved clinical outcomes for the patient.

Patients with complex tooth- and implant-borne restorations require a lifelong professional recall regimen to provide biological and mechanical maintenance customized for each patient. Therefore, the purpose of this CPG document is to provide: 1) guidelines for patient recall regimen, professional maintenance regimen, and at-home maintenance regimen for patients with tooth-borne restorations and 2) guidelines for patient recall regimen, professional maintenance regimen, and at-home maintenance regimen for patients with implant-borne restorations. The target populations of this CPG are patients with tooth- and implant-borne removable and fixed restorations. The intended users of the presented CPGs are: general dentists, dental hygienists, prosthodontists and other dental specialists, dental health care providers, allied health personnel, nurses, social workers, students, patients, medical and dental insurance carriers, and public health departments.

METHODS AND MATERIALS

To the authors' knowledge, this is the first CPG addressing patient recall regimen, professional maintenance regimen, and at-home maintenance regimen for patients with tooth- and implant-borne restorations and serves as a baseline for future modifications and versions based on future scientific evidence. Two separate systematic reviews of the literature were conducted to evaluate the recall and maintenance regimens for tooth- and implant-borne restorations.^{13,14} The systematic review on tooth-borne restorations included articles published from January 1, 1999 to December 31, 2014. The systematic review on implant-borne restorations included articles published from January 1, 2004 to December 31, 2014. The detailed methodology for the search processes are described in the respective systematic review articles.^{13,14} For tooth-borne restorations, 16 studies were identified in the systematic review that reported data on a combined 3569 patients. Of these, nine were randomized controlled clinical trials (RCT), and seven were observational studies. For implant-borne restorations, 20 studies were identified, reporting on 1088 patients. Of these, eleven were RCTs, and nine were observational studies. Results from all of these studies were scrutinized, tabulated, and analyzed to formulate conclusions and then create the CPGs.

A scientific panel comprised of experts appointed by the American College of Prosthodontists (ACP), American Dental Association (ADA), Academy of General Dentistry (AGD), and American Dental Hygienists Association (ADHA) critically evaluat-

ed and debated the published evidence from two systematic reviews on this topic. A rating scheme for strength of recommendation as described by Shekelle et al¹ was used as it was most applicable to this topic and is widely used and validated in the medical literature (Tables I, II). The major outcomes and consequences considered during formulation of these CPGs were: 1) risk for failure of tooth-borne restorations and 2) risk for failure of implant-borne restorations. Thereafter, the members of the task force conducted a roundtable peer review/evaluation discussion of the proposed guidelines, and the guidelines were debated in detail. These inputs were used to supplement and refine the proposed guidelines, and consensus was attained for the various guidelines presented.

RESULTS

Patients with tooth- and implant-borne restorations require a lifelong professional recall regimen to provide biological and mechanical maintenance, customized for each patient. Therefore, a set of CPGs was created for each type of restoration comprising: 1) patient recall; 2) professional maintenance, and 3) at-home maintenance. The CPGs are presented in Table III for tooth-borne restorations¹⁵⁻³⁰ and Table IV for implant-borne restorations.³¹⁻⁵⁰ For tooth-borne restorations, the professional maintenance and at-home maintenance CPGs were subdivided for removable and fixed restorations. For implant-borne restorations, the professional maintenance CPGs were sub-divided for removable and fixed restorations and further divided into biological maintenance and mechanical maintenance for each type of restoration. The at-home maintenance CPGs were subdivided for removable and fixed restorations. The strength of evidence and subsequent recommendation that is presently available was applied for each guideline. When a guideline comprised multiple aspects, then multiple strengths of available recommendations in descending order were applied. Additionally, when multiple strengths of recommendation were available for a specific guideline, they were all applied accordingly.

DISCUSSION

The scientific panel considered the potential benefits, harms, contraindications, and scope of these guidelines. The potential benefits for these guidelines include: 1) improved oral health and longevity of natural teeth, tooth-borne, and implant-borne restorations and 2) improved oral health related quality of life. The potential harms considered were 1) increased short-term cost to patients to adhere to recall regimen, professional maintenance regimen, and at-home maintenance regimen and 2) adverse effects related to any of

Table I: Levels and Category of Evidence as Described by Shekelle et al¹

Level	Category of Evidence
Ia	Evidence from systematic review of randomized controlled trials
Ib	Evidence from at least one randomized controlled trial
IIa	Evidence from at least one controlled study without randomization
IIb	Evidence from at least one other type of quasi-experimental study, such as time series analysis or studies in which the unit of analysis is not the individual
III	Evidence from non-experimental descriptive studies, such as comparative studies, correlation studies, cohort studies, and case-control studies
IV	Evidence from expert committee reports or opinions or clinical experience of respected authorities or both

Table II: Rating Scheme for the Strength of Recommendation as Described by Shekelle et al¹

Classification	Strength of recommendation
A	Directly based on category I evidence
B	Directly based on category II evidence or extrapolated from category I evidence
C	Directly based on category III evidence or extrapolated from category I or II evidence
D	Directly based on category IV evidence or extrapolated from category I, II, or III evidence

the professionally used oral topical agents or at-home oral topical agents and oral hygiene aids. The contraindications to these guidelines include allergies or adverse effects related to any of the professionally used oral topical agents or at-home oral topical agents.

A potential source of bias considered during development of the CPGs was that authors of the systematic reviews also served as panel members for the CPG.^{51,52} To minimize this potential bias, efforts were made during the scientific panel meetings to debate and justify each guideline in an open and transparent format. Financial and organizational conflicts of interests were not identified. Strength of evidence was debated for every guideline. Thus, the effect of "groupthink" may not be a source of

Table III: Clinical Practice Guidelines for Recall and Maintenance of Patients with Tooth-Borne Dental Restorations

Number	Topic	Guideline	Strength of Recommendation
1.	Patient recall	Patients with tooth-borne restorations (fixed or removable) should be advised to obtain a dental professional examination at least every 6 months as a lifelong regimen.	D
		Patients categorized by the dentist as higher risk based on age, ability to perform oral self care, biological or mechanical complications of natural teeth or tooth-borne restorations should be advised to obtain a dental professional examination more often than every 6 months, depending upon the clinical situation.	D
2A.	Professional maintenance: Tooth-borne removable restorations (partial removable dental prostheses)	Professional maintenance for patients with tooth-borne removable restorations should include an extraoral and intraoral health and dental examination, oral hygiene instructions for existing natural teeth and any restorations, oral hygiene intervention (cleaning of natural teeth and restorations), and use of oral topical agents as deemed clinically necessary.	A, C, D
		Professional maintenance of the partial removable dental prostheses should include hygiene instructions, detailed examination of the prosthesis, prosthetic components and patient education about any foreseeable problems that could impair optimal function with the restoration. The partial removable dental prosthesis should be professionally cleaned extraorally using professionally accepted mechanical and chemical methods.	D
		Professionals should recommend and/or prescribe appropriate oral topical agents and oral hygiene aids suitable for the patient's at-home maintenance needs.	D
2B.	Professional maintenance: Tooth-borne fixed restorations (intracoronar restorations, extracoronar restorations, veneers, single crowns, and partial fixed dental prostheses)	Professional maintenance for patients with tooth-borne fixed restorations should include an extraoral and intraoral health and dental examination, oral hygiene instructions for natural teeth and the fixed restorations, oral hygiene intervention (cleaning of natural teeth and restorations), and use of oral topical agents as deemed clinically necessary.	A, C, D
		Professionals should recommend and/or prescribe appropriate oral topical agents and oral hygiene aids suitable for the patient's at-home maintenance needs.	D
		When clinical signs indicate the need for an occlusal device, professionals should educate the patient and fabricate an occlusal device to protect the tooth-borne fixed restorations.	D
		Professional maintenance of the occlusal device should include hygiene instructions, detailed examination of the occlusal device, and patient education about any foreseeable problems that could impair optimal function with the occlusal device. The occlusal device should be professionally cleaned extraorally, using professionally accepted mechanical and chemical methods.	D

Note: Guidelines 2A, 2B, 3A and 3B are supported by references 15 through 30

bias in this baseline CPG document. Conversely, having the same author group to draft the CPGs may be viewed as a strength of this document, due to the profound insight obtained by the author group during the systematic review process.

Most of the guidelines in this document are graded as category D for strength of recommendation, but it is anticipated that the strength of recommendation would be higher in the future. Using Shekelle's method¹ for grading the strength of recommendation allowed incorporation and delineation of various types of evidence, including expert

opinion/consensus, into four categories, while formulating these guidelines. Additionally, it allowed extrapolation of higher categories of evidence to lower categories and provided more freedom in designation of an article to a specific category. The authors considered other widely popular alternatives such as Grading of Recommendations Assessment, Development and Evaluation (GRADE) method,⁵³ and the Strength of Recommendation Taxonomy (SORT) method.⁵⁴ However, these alternatives were less applicable to the topic of this baseline CPG. The GRADE method divides the expression of evidence into only two categories, weak

Table III: Clinical Practice Guidelines for Recall and Maintenance of Patients with Tooth-Borne Dental Restorations (continued)

Number	Topic	Guideline	Strength of Recommendation
3A.	At-home maintenance: Tooth-borne removable restorations (partial removable dental prostheses)	Patients with tooth-borne removable restorations should be educated about brushing existing natural teeth and restorations twice daily, and the use of oral hygiene aids such as dental floss, water flossers, air flossers, interdental cleaners, and electric toothbrushes.	C, D
		Patients with tooth-borne removable restorations should be educated about cleaning their prosthesis at least twice daily using a soft brush and the professional recommended denture-cleaning agent.	D
		Patients with multiple and complex restorations on existing teeth supporting or surrounding the removable restoration should be advised to use oral topical agents such as toothpaste containing 5000 ppm fluoride or toothpaste with 0.3% triclosan, and to add supplemental short-term use of chlorhexidine gluconate when indicated.	A, C, D
		Patients with tooth-borne removable restorations should be advised to remove the restoration out of the mouth during sleep. The removed prosthesis should be stored in a prescribed cleaning solution.	D
3B.	At-home maintenance: Tooth-borne fixed restorations (intracoronal restorations, extracoronal restorations, veneers, single crowns, and partial fixed dental prostheses)	Patients with tooth-borne fixed restorations should be educated about brushing twice daily, and the use of oral hygiene aids such as dental floss, water flossers, air flossers, interdental cleaners, and electric toothbrushes.	A, D
		Patients with multiple and complex restorations on existing teeth should be advised to use oral topical agents such as toothpaste containing 5000 ppm fluoride or toothpaste with 0.3% triclosan, and to add supplemental short-term use of chlorhexidine gluconate when indicated.	A, C, D
		Patients prescribed with occlusal devices should be advised to wear the occlusal device during sleep.	D
		Patients prescribed with occlusal devices should be educated about cleaning their occlusal device before and after use, with a soft brush and the prescribed cleaning agent. Patients should also be educated about proper methods for storage of the occlusal device when not in use.	D

Note: Guidelines 2A, 2B, 3A and 3B are supported by references 15 through 30

or strong, which was not appropriate for this baseline CPG.⁵³ The SORT method divides the strength of recommendation into three categories (A, B and C) but does not allow extrapolation of higher categories of evidence to lower categories.⁵⁴

This document is intended for healthy adult patients with tooth- or implant-borne restorations. Management of patients with mixed restorations (tooth- and implant-borne removable or fixed restorations) in one or both jaws should encompass both sets of proposed guidelines, appropriate to the clinical situation. Management of patients with conditions such as bruxism, xerostomia, periodontal disease, peri-implant disease, or other conditions are outside the scope of these CPGs; however, the recall and maintenance regimen guidelines made in this document would likely be helpful to these patients. This baseline document is intended

to improve patient care protocols, but is not intended as a standard of care. The outlined CPGs should be supplemented with professional judgment and consideration of the unique needs and preferences of each patient.

CONCLUSION

This document provides clinical practice guidelines for patient recall regimen, professional maintenance regimen, and at-home maintenance regimen for patients with tooth-borne and implant-borne restorations. The various guidelines were made using the best level of evidence whenever available. Guidelines made using expert opinion/consensus included the best possible analysis of best clinical practices, clinical feasibility, and risk-benefit ratio for patients. A scientific panel ap-

Table IV: Clinical Practice Guidelines for Recall and Maintenance of Patients with Implant-Borne Dental Restorations

Number	Topic	Guideline	Strength of Recommendation
1.	Patient recall	Patients with implant-borne restorations (fixed or removable) should be advised to obtain a dental professional examination visit at least every 6 months as a lifelong regimen.	D
		Patients categorized by the dentist as higher risk based on age, ability to perform oral self care, biological or mechanical complications of remaining natural teeth, tooth-borne restorations or implant-borne restorations should be advised to obtain a dental professional examination more often than every 6 months, depending upon the clinical situation.	D
2A.	Professional maintenance (Biological): Implant-borne removable restorations (implant-supported partial removable dental prostheses and implant-supported overdenture prostheses)	Professional biological maintenance for patients with implant-borne removable restorations should include an extraoral and intraoral health and dental examination, oral hygiene instructions, hygiene instructions for the prostheses and oral hygiene intervention (cleaning of any natural teeth, tooth-borne restorations, implant-borne restorations, or implant abutments).	A, C, D
		Professionals should use chlorhexidine gluconate as the oral topical agent of choice when antimicrobial effect is needed clinically.	A, C
		Professionals should use cleaning instruments compatible with the type and material of the implants, abutments and restorations, and powered instruments such as the glycine powder air polishing system.	A, C, D
		Implant-supported partial removable dental prostheses and implant-supported overdenture prostheses should be professionally cleaned extraorally using professionally accepted mechanical and chemical cleaning methods.	D
		Professionals should recommend and/or prescribe appropriate oral topical agents and oral hygiene aids suitable for the patient's at-home maintenance needs.	A, C, D
2B.	Professional maintenance (Mechanical): Implant-borne removable restorations (implant-supported partial removable dental prostheses and implant-supported overdenture prostheses)	Professional mechanical maintenance for patients with implant-borne removable restorations should include a detailed examination of the prosthesis, intra and extraoral prosthetic components, and patient education of foreseeable problems that could impair optimal function of the restoration.	C, D
		Professionals should recommend and perform adjustment, repair, replacement, or remake of any or all parts of the prosthesis and prosthetic components that could compromise function.	C, D
2C.	Professional maintenance (Biological): Implant-borne fixed restorations (implant-supported single crowns, partial fixed dental prostheses and implant-supported complete arch fixed prostheses)	Professional biological maintenance for patients with implant-borne fixed restorations should include an extraoral and intraoral health and dental examination, oral hygiene instructions, and oral hygiene intervention (cleaning of any natural teeth, tooth-borne restorations, implant-borne restorations, or implant abutments).	A, C, D
		Professionals should use chlorhexidine gluconate as the oral topical agent of choice when antimicrobial effect is needed clinically.	A, C
		Professionals should use cleaning instruments compatible with the type and material of the implants, abutments, and restorations, and powered instruments such as the glycine powder air polishing system.	A, C, D
		In patients with implant-supported fixed prostheses, the decision to remove the prosthesis for biological maintenance should be based on the patient's demonstrated inability to perform adequate oral hygiene. The prosthesis contours should be reassessed to facilitate at-home maintenance.	D
		Professionals should consider using new prosthetic screws when an implant-borne restoration is removed and replaced for professional biological maintenance.	D

Guidelines 2A, 2B, 2C, 2D, 3A and 3B are supported by references 31 through 50

Table IV: Clinical Practice Guidelines for Recall and Maintenance of Patients with Implant-Borne Dental Restorations (continued)

Number	Topic	Guideline	Strength of Recommendation
2D.	Professional maintenance (Mechanical): Implant-borne fixed restorations (implant-supported single crowns, partial fixed dental prostheses, and implant-supported complete arch fixed prostheses)	Professional mechanical maintenance for patients with implant-borne fixed restorations should include a detailed examination of the prosthesis, prosthetic components, and patient education about any foreseeable problems that could compromise function.	C, D
		Professionals should recommend and perform adjustment, repair, replacement, or remake of any or all parts of the prosthesis and prosthetic components that could impair patient's optimal function.	C, D
		Professionals should consider using new prosthetic screws when an implant-borne restoration is removed and replaced for professional mechanical maintenance.	D
		When clinical signs indicate the need for an occlusal device, professionals should educate the patient and fabricate an occlusal device to protect implant-borne fixed restorations.	D
		Professional maintenance of the occlusal device should include hygiene instructions, detailed examination of the occlusal device, and patient education about any foreseeable problems that could impair optimal function with the occlusal device. The occlusal device should be professionally cleaned extraorally using professionally accepted mechanical and chemical methods.	D
		Patients with multiple and complex restorations on existing teeth should be advised to use oral topical agents such as toothpaste containing 5000 ppm fluoride or toothpaste with 0.3% triclosan, and to add supplemental short-term use of chlorhexidine gluconate when indicated.	A, C, D
		Patients prescribed with occlusal devices should be educated to wear the occlusal device during sleep.	D
3A.	At-home maintenance: Implant-borne removable restorations (implant-supported partial removable dental prostheses, and implant-supported overdenture prostheses)	Patients with implant-supported partial removable dental prostheses should be educated about brushing existing natural teeth and restorations twice daily, and the use of oral hygiene aids such as dental floss, water flossers, air flossers, interdental cleaners, and electric toothbrushes.	C, D
		Patients with implant-borne removable restorations should be advised to clean their intraoral implant components at least twice daily, using a soft brush and the professionally recommended oral topical agent.	D
		Patients with implant-borne removable restorations should be advised to clean their prosthesis at least twice daily using a soft brush with a professional recommended denture-cleaning agent.	D
		Patients with implant-borne partial or complete removable restorations should be advised to remove the restoration while sleeping. The removed prosthesis should be stored in a prescribed cleaning solution.	D
3B.	At-home maintenance: Implant-borne fixed restorations (implant-supported single crowns, partial fixed dental prostheses and implant-supported complete arch fixed prostheses)	Patients with implant-borne fixed restorations should be educated about brushing twice daily, and the use of oral hygiene aids such as dental floss, water flossers, air flossers, interdental cleaners and electric toothbrushes.	C, D
		Patients with multiple and complex implant-borne fixed restorations, should be advised to use oral topical agents such as toothpaste containing 0.3% triclosan and to add supplemental short-term use of chlorhexidine gluconate when indicated.	A, C, D
		Patients prescribed with occlusal devices should be advised to wear the occlusal device during sleep.	D
		Patients prescribed with occlusal devices should be educated about cleaning their occlusal device before and after use, with a soft brush and the prescribed cleaning agent. Patients should also be educated about proper methods for storage of the occlusal device when not in use.	D

Guidelines 2A, 2B, 2C, 2D, 3A and 3B are supported by references 31 through 50

pointed by the American College of Prosthodontists (ACP), American Dental Association (ADA), Academy of General Dentistry (AGD), and American Dental Hygienists Association (ADHA) developed and approved the CPGs. This document serves as a baseline with the expectation of future modifications to reflect best clinical practices and when additional evidence becomes available.

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