Source: Journal of Dental Hygiene, Vol. 79, No. 2, Spring 2005

A Model for Effective Change

MA Gaston

Mary Alice Gaston is emeritus professor of dental hygiene at the University of Tennessee Health Science Center, a past president of the American Dental Hygienists' Association, and current editor of the Journal of Dental Hygiene.

Keywords: Dental hygienist, advanced dental hygiene practitioner, change, health care system

A Memphis, Tennessee landmark is coming down. Once reported to be the world's largest privately owned hospital, Baptist Memorial Health Care Corporation's flagship high-rise hospital is being torn down in stages. The hospital, along with some associated buildings in the Memphis medical center, will be replaced with several smaller buildings designed for other health-related uses, including research and biotechnology development. When the corporation's administrators announced in a press conference several years ago that the medical center hospital would be closing, it was hard to imagine the closing's ultimate effect on the medical center and the tri-state area of western Tennessee, eastern Arkansas, and northern Mississippi.

A Memphis medical center without the Baptist Hospital buildings was, at first, especially unimaginable to health care professionals who had lived out their careers there. In fact, many people even outside Memphis reported feeling melancholy about the hospital's destruction because they view it as an important landmark, as the place where Elvis Presley was pronounced dead in the emergency room.

Several years have now gone by since the hospital's plan to close was made public, and many of the hopes and expectations for using the vacated space have already been fulfilled, or will be very soon. The Memphis area health care community has adapted to the closing and, through collaboration, has achieved numerous positive outcomes. The resulting outcomes have not always been easy or painless to achieve, but the future now promises opportunities for numerous initiatives to meet the area's future health care needs and to stimulate growth in the overall health-related industry of the entire mid-South.

I'm sure that by now you're probably wondering what in the world all this has to do with dental hygiene and with you in particular. Well, I believe this true story provides an excellent example of how one dramatic change initiated by one powerful member of a community's health care industry can lead to even greater changes that, more often than not, provide benefits to individuals and groups within the community who were at first highly resistant to the change.

Not all changes in health care are as dramatic as the change in the Memphis Baptist Memorial Hospital System, thank goodness. However, the changes that many dental hygienists would like to see in the oral health care delivery system may be quite unsettling for others. One thing is certain - major changes to the oral health care system are coming, and the primary forces for change are originating outside the professions of dentistry and dental hygiene.

Emboldened by previously unavailable outside encouragement, dental hygienists across the country are now more visionary and supportive of changes being proposed to meet consumer needs through greater access to oral health care. Now when an opportunity arises, we are less likely to gasp in disbelief, or engage in useless rhetoric, or get bogged down in endless processes until the opportunity passes us by.

For months, American Dental Hygienists' Association (ADHA) committees and councils have been hard at work in developing the concept and articulating the curriculum and appropriate educational credential for the advanced dental hygiene practitioner. The ADHA House of Delegates will consider a report regarding the matter during the ADHA 2005 annual session. Shepherding the proposed advanced level of dental hygiene education and practice through the various stages to completion will require the utmost skill and diplomacy to achieve a positive outcome.

Because all dental hygienists are major stakeholders in the oral health care industry, we must each take a personal interest in making sure that the advanced dental hygiene practitioner becomes a reality. Equally as important, we must each be concerned and actively involved in new programs and activities to increase the public's access to oral health care. We must develop plans for change and then follow them to completion.

Dental hygiene's plans simply must include a research component. While I'm confident that ADHA planners have discussed this issue, the extent to which dental hygienists embrace the research aspect of professional development remains unclear to me.

Yes, I know that the ADHA strategic plan includes research goals and objectives, and I believe they represent a good effort. However, I know we are capable of doing much more with just a little more effort. I would still like to receive more research manuscripts that contribute significantly to the dental hygiene body of knowledge. This is one of those uncomfortable areas that I challenge you to think about. Perhaps there are changes you could make for the benefit of dental hygiene even though you know they will be uncomfortable at first.

I'm quite certain that long before the Memphis-based Baptist Memorial Health Care Corporation announced the closing of its flagship hospital, the leaders and decision-makers had agreed on a growth plan that enabled them to visualize their corporation well into the future. That plan no doubt included the specific actions they would take, systematically and step-by-step, to achieve their goals. I'd be willing to bet that they left nothing to chance. Seems like a good model for dental hygiene to follow.

Source: Journal of Dental Hygiene, Vol. 79, No. 2, Spring 2005

Upfront

Kristen Romanowski

Kristen M. Romanowski is staff editor of the Journal of Dental Hygiene and staff writer for Access

Federal government gets an "F" for tobacco control

When it comes to protecting public health through tobacco control, the U.S. federal government is failing miserably, according to the American Lung Association (ALA). In its *State of Tobacco Control 2004* report, the ALA gave the White House and Congress three F's and a D in four key areas.

For blocking legislation that would grant the Food and Drug Administration (FDA) the authority to regulate tobacco products, the U.S. House of Representatives earned an F. If given such control, the FDA would have the power to regulate tobacco as a drug.

"The failure to enact FDA authority gives the tobacco industry a pass to continue to market a new wave of products, including candy-flavored cigarettes-Camel Kuaui Kolada, Camel Warm Mocha Mint, Kool Mixx Midnight Berry-that are clearly being marketed to children and teens," ALA president and CEO John L. Kirkwood said in a January press release.

For its failure to implement and fund the National Action Plan for Tobacco Cessation, Congress earned an F. The plan advocates a national tobacco quitline, nationwide media campaign, federal funding of cessation benefits, and a smokers' fund to help people who are trying to quit. Congress also received an F for failing to raise the federal excise tax on cigarettes to $2, as recommended by the National Action Plan for Tobacco Cessation.

And finally, the federal government received a D for failing to ratify the Framework Convention on Tobacco Control, an international treaty that has been ratified by 40 countries to date. The president has signed the treaty, but has not sent it to the Senate for ratification.

The ALA also rated individual states on their efforts to discourage tobacco use. States were judged on their funding for tobacco prevention and control programs, smokefree air ordinances, cigarette taxes, and youth access to tobacco products. The marks were mixed, but trends show that smokefree air laws are on the rise, as is the average state cigarette tax. Although a handful of states received high marks for limiting youth access and funding tobacco prevention programs, the majority did not.

The ALA report card comes on the heels of a report by the Campaign for Tobacco-Free Kids, which found that for every dollar states spend on tobacco prevention programs, the tobacco industry churns out more than $23 worth of marketing. The yearly report evaluates how well states are using the proceeds from a 1998 settlement with the tobacco industry. *A Broken Promise to Our Children: The 1998 State Tobacco Settlement Six Years Later* noted that almost every state is failing to adequately support tobacco control programs.

-KR

Secondhand smoke linked to cervical cancer

Secondhand smoke has been shown to increase the risk for heart disease and lung cancer, but new research suggests that women who live with smokers also may have increased risk of developing cervical tumors.

"An association between active cigarette smoking and cervical cancer has been noted in numerous studies, but less is known about the potential link between passive smoking and the development of cervical neoplasia," study author Anthony J. Alberg, PhD, MPH, said in a press release. "When these new data for cervical cancer are considered in light of similar results from previously published studies, our findings suggest that passive smoking may be firmly linked with cervical cancer."

Researchers at Johns Hopkins Bloomberg School of Public Health studied questionnaires about the household and personal smoking habits of two Maryland groups from 1963 and 1975. When they compared questionnaires from 51,173 women to the county's cancer registry, the researchers found a link between secondhand smoke and cervical tumor growth, or neoplasia. The association was stronger for the earlier cohort, with a 2.1-fold increased risk of cervical neoplasia for those women who participated in 1963, and a 1.4-fold increased risk for those who participated in 1975.

The study, published in the January 2005 issue of *Obstetrics and Gynecology*, also corroborated previous studies that had found a link between active cigarette smoking and cervical tumors. "Our study results are one more piece of evidence that should encourage smokers to quit and warn non-smokers who live with smokers to decrease their secondhand smoke exposure," Alberg said.

Cervical cancer, which afflicts 10,520 women in the United States each year, is one of the most preventable cancers with advanced screening technologies. But according to a report titled *A Call to Action: The "State" of Cervical Cancer in America*, many American women, especially those in public insurance programs, remain unscreened or under-screened for cervical cancer.

Women In Government, a bipartisan educational association for women in state government, released the report in January. "We urge state legislators, public health officials, advocates, and others to renew their efforts to prevent cervical cancer by ensuring that all women have access to the most advanced screening technologies-including both the Pap and the HPV (human papillomavirus) tests-regardless of their socioeconomic status," Women In Government chair and Michigan Senator Beverly Hammerstrom said in a press release. "We will continue to monitor state successes and highlight their progress in future reports as part of our 10-year plan to eliminate this disease."

-KR

Zinc may help prevent oral cancers

Zinc supplements may help prevent esophageal and oral cancers in high-risk individuals, a study published in the January 5, 2005 issue of the *Journal of the National Cancer Institute* suggests.

Oral and esophageal cancers are associated with nutritional zinc deficiency, which increases cell proliferation in those areas and makes them more susceptible to carcinogens. Dietary zinc comes mostly from red meat and seafood, and up to 2 billion people in developing countries don't get enough zinc in their diets. About 10% of Americans have zinc-deficient diets. Meanwhile, the incidence of these cancers has been rising in recent years.

Oral and esophageal cancers are also associated with a rise in the expression of COX-2, an enzyme that is best known for its role in arthritis pain and inflammation. The enzyme has also been shown to stimulate the proliferation of cancerous cells. COX-2 overproduction helps destroy the tissue that anchors normal cells, which increases the risk for cancerous cells to develop. COX-2 overproduction has also been linked to colon, ovarian, prostate, and breast cancers.

Researchers from Thomas Jefferson University found that zinc given orally to zinc-deficient rats reversed the high expression of COX-2 in the esophagus and tongue, and reversed the development of precancerous conditions as well. These findings suggest that zinc supplements may help prevent oral or esophageal cancers, particularly in people who live in developing countries where zinc deficiency is a problem.

-KR

A drink a day keeps mental decline away?

The negative effects of regularly drinking too much alcohol are well documented, but a study published in the January 20, 2005 issue of *The New England Journal of Medicine* suggests that women who drink moderately may actually lower their risk of cognitive decline.

Several studies have demonstrated alcohol's protective effects on the heart, and the study authors suggest that moderate alcohol intake might protect the brain in a similar way by increasing blood flow. Previous studies have also shown that moderate drinkers do better on cognitive tests than do non-drinkers. Many such studies have been limited, however, by inadequate sample size and control for confounding variables.

To address these shortcomings, researchers used data from the Nurses' Health Study, which began in 1976 as a long-term prospective investigation into the risk factors for major chronic diseases in women. The study enrolled 121,700 female registered nurses, then aged 30 to 55, and collected their self-reported information regarding diseases and health topics like smoking, hormone use, and menopausal status. Every two years, follow-up questionnaires were mailed to participants, with questions about diet and alcohol use added in 1980. The participating women were asked how often they had consumed certain types of alcohol, and if their alcohol intake had changed greatly in the previous decade.

In 1995, the researchers began a study of cognitive function. Researchers evaluated 12,480 participants from the Nurses' Health Study who were 70 to 81 years old, did not live in a nursing facility, and had not experienced a stroke. To avoid bias, the cognitive analyses were limited to women with stable drinking patterns.

Women in the study who consumed up to one drink per day showed less cognitive impairment and better functioning than nondrinkers. Memory and concentration tests showed that up to 15 grams per day of beer, wine, or liquor was beneficial to women's brain functioning. However, researchers were unable to draw conclusions about possible beneficial effects of more than one drink per day. Due to the low number of heavy drinkers involved, they also could not evaluate the cognitive effects of heavy alcohol intake.

-KR

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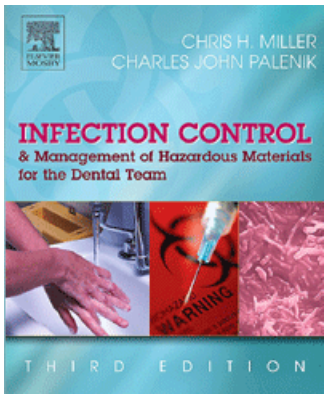
Review of: Infection Control and Management of Hazardous Materials for the Dental Team

Helene Bednarsh

Reviewed by Helene Bednarsh, RDH, BS, MPH, director of the Boston Public Health Commission HIV Dental Ombudsman Program, a faculty member at the Boston University Goldman School of Dental Medicine, and a lifetime member of the Organization for Safety and Asepsis Procedures (OSAP).

Infection Control and Management of Hazardous Materials for the Dental Team



3rd Edition

Miller CH, Palenik CJ

Elsevier Mosby, 2005

St. Louis, Missouri

515 pages, illustrated, indexed, glossary, selected readings, review questions, appendices, soft cover

ISBN: 0-323-02595-1

$39.95

The third edition of this previously well-received text on infection control and office safety management presents the reader with the equivalent of a full course on office asepsis and safety procedures. The text has been updated with timely regard to include the 2003 Centers for Disease Control and Prevention (CDC) guidelines for infection control in dentistry. In addition to the relevant updates, which also include references to other CDC guidelines such as those for hand hygiene (2002) and environmental infection control (2003), there are other noteworthy changes to this edition.

These additions include new devices such as tabletop instrument washers, new products for environmental infection control and hand hygiene, and other new features to enhance the text. New features include rationale for the step-by-step procedures associated with infection control, learning objectives for each chapter, new chapters, key terms, and relevant review questions at the end of each chapter. The authors also include the information on the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens Standard of 1991 and the Needlestick Prevention Act of 2001.

The text is in three parts, each building upon the previous to establish a comprehensive guide to infection control. Parts I and II present a review of microbiology and how, in understanding and managing microbial challenges, one has the basis for applying sound infection control practices in the oral health care environment. Part III is related to office safety, with respect to regulatory standards, chemical concerns, fire prevention, and emergency action plans. A new addition to this section is a chapter on infection control concerns during remodeling or construction. This chapter is a unique contribution and definite must-read for any facility considering renovations. Each chapter presents an outline, learning objectives, key terms, rationale, and review questions. This format is particularly useful for training new employees and for annual training of employees.

The text is designed for the oral health care team, although it closely resembles the curriculum one would hope is used for dental, dental hygiene, and dental assisting students. There is no presumption as to the knowledge base of the reader and, therefore, the information in each chapter is driven by that of previous chapters so that, in the end, one learns the fundamental aspects of infection control, the challenges from the microbial world, the means to interfere with the basic steps in the development and spread of infectious disease and, thereby, to prevent harm.

In Part II the authors review bloodborne pathogens and oral, respiratory, and waterborne disease agents before discussing infection control rationale, regulations, and recommendations. The building blocks from Part I facilitate the understanding of the disease agents discussed in Part II and the recommendations presented in chapter eight, which is the crux of infection control and includes a summary of the 2003 CDC dental infection control recommendations. The remaining chapters in Part II present strategies to minimize the risk of cross-contamination, exposure, and/or disease transmission. The final chapter is a clinical asepsis protocol, a fitting finale to this section and a useful tool for any oral health care facility.

Part III, all about office safety, begins with a review of OSHA, a new chapter to this edition. Subsequent chapters discuss management of the office safety program, including chemical concerns and industry standards for fire and emergencies. The final chapter in Part III is new to this edition and discusses the role of infection control during renovations.

There are nine appendices, including a resource list, recommendations from CDC guidelines, information from the OSHA Bloodborne Pathogens Standard, and other relevant infection control information from OSAP and the American Dental Association. The glossary that follows is quite comprehensive and serves as a useful dictionary tool.

In summary, this text is an essential companion to an office library, both for educational and practice settings. The structure of the chapters, with review questions included, will assist training programs within the oral health care setting and serve as an excellent review for those previously trained. The information is, above all else, accurate and timely and is presented by authors who are content experts.

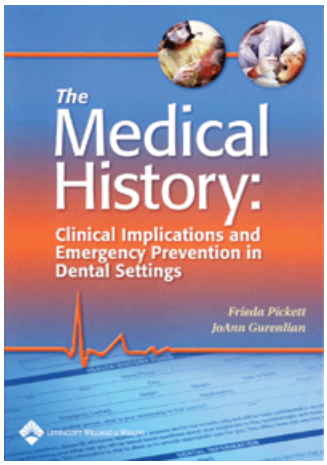
Source: Journal of Dental Hygiene, Vol. 79, No. 2, Spring 2005

Review of: The Medical History: Clinical Implications and Emergency Prevention in Dental Settings

Patricia A Frese

Reviewed by Patricia A. Frese, RDH, MEd, associate professor of dental hygiene at Raymond Walters College, University of Cincinnati, in Ohio.

The Medical History: Clinical Implications and Emergency Prevention in Dental Settings



1st edition

Pickett F and Gurenlian J

Lippincott, Williams, and Wilkins, 2004

Baltimore, Maryland

216 pages, illustrated, indexed, soft cover

ISBN 0-7817-4095-9

$44.95

The authors accomplish their goal of writing a text that teaches students to obtain complete medical histories to understand patients' health status, to identify the clinical implications of patients' health, to prevent potential medical emergencies, and to manage emergencies, should they occur.

Divided into 14 chapters to coincide with weekly chapter assignments in a semester course, this text is presented in a self-study format to prepare students, so the medical history review can be more focused. The text uses the American

Dental Association (ADA) health history form and incorporates critical thinking pathways. While the text is written primarily for dental hygiene students, it is valuable to anyone in the oral health care setting. Additionally, it is a valuable resource for faculty calibration.

Each chapter topic is covered by discussing the pathophysiology of the condition, application to practice, potential emergencies presented by the condition, techniques for prevention of emergencies, and management of emergencies, should they occur. The chapters follow the major sections of the ADA health history, with some questions from the medical history placed in the logical sections. The final chapter presents legal ramifications and HIPAA requirements of a medical history. It includes two cases with completed medical histories and analysis and application of the information.

The organization and unique features of the text make it easily readable and immediately applicable to practice. Each chapter begins with key terms, definitions, and objectives. Alert boxes highlight follow-up questions that should be asked after patients' initial responses to questions about their medical histories. The follow-up questions are further explained in the body of the chapter. Tables that provide additional information, scales, and test values are included and contribute to a clearer understanding of a patient's medical status. Self-study review boxes at appropriate points in each chapter contain two to four multiple choice questions about previous material.

At the end of each chapter, the multiple choice question answers are provided, and page numbers are included to review the material. This is an excellent feature for readers to monitor their understanding of the material and review as needed. The chapters end with a summary, a list of short answer review questions, a case study section, and references. Answers are provided for the review questions and case studies. The references provided are current and appropriate for the topic of the chapter. The authors acknowledge the assistance of an impressive list of dental practitioners and students in the preparation of the text.

Overall, the text provides adequate information that represents current thinking and practice in a clear format. The authors are confident that this text will meet the needs of both dental hygiene students and practitioners. Realizing that medical information can change, the authors request that any issues that arise and are not discussed in the text be forwarded to them for inclusion in subsequent editions.

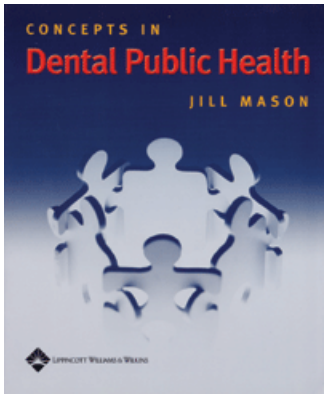
Source: Journal of Dental Hygiene, Vol. 79, No. 2, Spring 2005

Review of: Concepts in Dental Public Health

Cathryn L Frere

Reviewed by Cathryn L. Frere, BSDH, MSEd, associate professor in the Division of Dental Hygiene at West Virginia University School of Dentistry, in Morgantown, West Virginia.

Concepts in Dental Public Health



1st edition

Mason J

Lippincott, Williams, and Wilkins, 2005

Philadelphia, Pennsylvania

375 pages, illustrated, indexed, soft cover

ISBN: 0-7817-4488-1

$44.95

The role of dental hygienists in providing care for the public can be a difficult concept for dental hygiene students to grasp. *Concepts in Dental Public Health* presents a comprehensive overview of dental public health principles for the dental hygiene student, as well as for other health care workers interested in the field.

The text is divided into six modules, five of which are divided into multiple chapters. Each chapter begins with a topic outline, learning objectives, key public health terms used in the chapter, and the American Dental Education Association competencies addressed in the chapter. The chapters conclude with a short summary, a list of resources with credible Web sites and search terms, suggested learning activities, and review questions.

The first module, "Introduction to Dental Public Health," sets the stage by briefly describing the historic events that founded our public health principles, including the passage of the Social Security Act, the establishment of the National Institute for Dental and Craniofacial Research, and the role of the National Center for Health Statistics. This module stresses the need for multidisciplinary collaboration among private health care workers, all levels of government, and professional organizations to overcome health disparities and the access to care issue. The module also describes the development of the dental health care auxiliary to aid meeting public dental care demands in various countries, and it closes with a presentation of career opportunities for American dental hygienists in public health.

The second module encompasses the principles of public health program planning, using individual patient care treatment planning as a parallel. The third module addresses oral health promotion and includes discussion of the determining factors for oral health care demand, an overview of educational principles, and the factors to consider in the development of various educational materials. The fourth module is a comprehensive primer of epidemiology and biostatistics. Included is a chapter relating oral disease patterns in the United States, and another addressing communication methods, formats of common scientific documents, and literature evaluation guidelines.

The text comes full circle in the fifth module with the principles of ethics, including the responsibility of the profession and individual to contribute to the common good. A review of the legal system and an explanation of how laws are passed are included. The sixth module offers strategies to use in preparation for the National Board Dental Hygiene Examination along with five sample public health test cases.

The contributing authors have advanced degrees and are well known in the public health community for their expertise in their topic. The material is well referenced and written in a clear, concise, easy-to-read manner. Summary charts and tables accompany the text.

The chapter on biostatistics is especially well presented. The given biostatistical concepts are applied to oral health care examples, making for greater understanding. Simple statistical concepts are presented first and logically build to the more complex statistical tests.

One dental public health topic that may need to be supplemented in the classroom is the use and effects of various fluoride products. Discussion about fluoride compounds and fluoridation programs appears throughout the text as examples of public health principles; however, a more comprehensive section dedicated solely to the topic would be helpful. Also, although cultural considerations are not ignored, a chapter devoted to the impact of cultural determinants of health and cultural competency development guidelines for the practitioner would be a beneficial addition.

This is a comprehensive, up-to-date, easily read resource book that facilitates an understanding of dental public health principles for both the non-dental health care providers and dental hygiene students. The excellent reinforcing supplemental activities and review questions, however, make this book especially appropriate for use in professional entry-level educational programs.

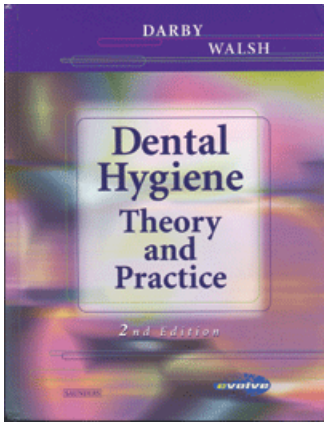
Source: Journal of Dental Hygiene, Vol. 79, No. 2, Spring 2005

Review of: Dental Hygiene Theory and Practice

Jacqueline Brian

Reviewed by Jacqueline Brian, LDH, MSEd, professor at Indiana University-Purdue University, in Fort Wayne, Indiana.

Dental Hygiene Theory and Practice



2nd edition

Darby ML, Walsh MM

Saunders, 2003

St. Louis, Missouri

1,248 pages, illustrated, indexed, hardcover

ISBN: 0-7216-9162-5

$71.95

The well-known authors have excelled by combining the expertise of 55 authors in their second edition of *Dental Hygiene Theory and Practice*. The emphasis of this text, which is demonstrated throughout, is on evidenced-based practice that is bounded in the human needs theory. This unique combination demonstrates the foundation of theory and clinical experience. The authors have wisely included the most current terminology, including the AAP classifications and insurance codes. Adding to their first edition, they have accomplished more in-depth coverage of periodontal disease technology and ultrasonics. The use of the term "client" instead of "patient" demonstrates the appropriate placement of responsibility for an individual's oral health.

The 54 chapters are arranged into eight sections that are in logical sequence for clinical care. These sections provide comprehensive coverage of dental hygiene care, beginning with the foundation of dental hygiene, preparation for the

appointment, assessments for the dental hygiene diagnosis and evaluation, implementation, pain and anxiety control, special needs, and, finally, practice management. Each chapter includes learning outcomes, key terms and concepts, evidence-based explanations, procedures to help the student determine if their expected clinical competencies are being achieved, client education, and legal, ethical, and safety issues. The critical thinking exercises at the end of each chapter create a wonderful venue to develop problem solving skills and stimulate class discussion. The use of color to highlight chapters, headings, and key concepts and issues complements the material and enhances visual learning. The numerous illustrations are strategically placed and enhance the reader's understanding of the material. The comprehensive glossary and index provides the reader a quick way to find information in the text.

One of the many exciting features is the textbook Web site for online access to activities and resources that enhance the comprehension and evaluation of competencies. The Web site gives links to additional resources and topics. Updates on content will be provided to keep one abreast of the latest research. In addition, competency based evaluation forms can be downloaded to use as self, peer, or instructor evaluations. In addition, the Web site provides easy access to references and suggested readings, and it has an image collection that can be downloaded to use in Power Point presentations. There is also a bank of 800 test questions that can be used by educators to create an annual exam in preparation for the National Board Examination.

This text is, by far, the most current and comprehensive coverage of dental hygiene care. By adopting this impressive textbook for classroom use, educators and students would be using the most current information and technology. You will not want to miss this text as part of your required reading and an essential addition for your library.

Source: Journal of Dental Hygiene, Vol. 79, No. 2, Spring 2005

Prevalence of Type I Natural Rubber Latex Allergy Among Dental Hygienists

Curtis P Hamann, Pamela A Rodgers and Kim M Sullivan

Curtis P. Hamann, MD, is CEO and medical director; Pamela A. Rodgers, PhD, is clinical research scientist; and Kim M. Sullivan, BA, is vice president of clinical research and regulatory affairs; all are at SmartHealth in Phoenix, Arizona.

Purpose. Oral health care professionals have been shown to be at risk for developing a type I allergy to natural rubber latex (NRL). The objective of this study was to assess the prevalence of this allergy in dental hygienists.

Methods. Participants attending the 2000-2002 American Dental Hygienists' Association (ADHA) national meetings were screened for type I allergies to NRL using skin prick testing, symptom assessment, and health history. Participants were classified as positive for a type I NRL allergy based on their positive skin prick reactions to standardized NRL solutions. Risk factors and symptom assessments were based on a self-reported health history.

Results. Of the 582 ADHA participants who completed the screening and health history questionnaire, 4.8% (n=28) screened positive for a type I allergy to NRL (SPT-positive). These SPT-positive participants were significantly more likely to report an allergy to cross-reacting foods, plants, molds, and pollens, and to report reactions to rubber products. Participants screened SPT-positive were also significantly more likely to report a history of hives and respiratory symptoms after contact with natural rubber.

Conclusion. Based on skin prick testing, the prevalence of a type I allergy to NRL in dental hygienists appears similar to that reported for other oral health care professionals and is greater than the general population. Educating dental hygienists about type I NRL allergy may help reduce prevalence and improve its management.

Keywords: Latex, allergy, rubber, dentistry, dental hygiene, occupational allergy, gloves, hypersensitivity

Introduction

The natural rubber latex (NRL) used in health care gloves is obtained from Hevea brasilensis trees.[1] This botanical product contains at least 13 known plant proteins that can elicit allergic reactions in susceptible individuals, in much the same way that pollen induces seasonal allergies. Allergenic plant proteins are found in latex health care gloves and latex products such as catheters, dental dams, and balloons.

While contact allergies to the chemicals in rubber have been recorded since 1927, systemic reactions to NRL were not documented until 1979.[2] This pivotal case report described symptoms consistent with a type I allergy, which is a systemic immune system response that can become life-threatening. Within the following decade, type I allergic reactions to NRL in both dental patients and workers had been reported.[3,4]

The diagnosis of a type I allergy to NRL should be based on both clinical test results and a detailed health history. Commonly accepted clinical test methods for type I NRL allergy include skin prick tests with standardized NRL solutions, or blood tests for the presence of circulating anti-NRL antibodies.[5] Of these, skin prick testing is generally considered the more accurate method.[6]

A medical and occupational history should also be obtained to determine the presence of symptoms associated with a type I NRL allergy, such as urticaria (hives) and rhinoconjunctivitis (runny nose and itchy eyes).[5,6] Potential risk factors should also be assessed, including recurring NRL exposure, previous reactions to rubber, multiple childhood surgeries, or treatment for myelodysplasia (e.g. spina bifida). An additional risk factor is a history of allergies to certain fruits and plants, such as avocados and kiwi, that contain proteins (panallergens) that are similar to those found in *Hevea brasiliensis*.[5]

Based on skin prick test results, studies estimate that between 6% and 38% of oral health care professionals may have a type I allergy to NRL proteins.[7,8,9] Although most research has focused on dentists, one study conducted in 1994 and 1995 noted that 9% of dental hygienists tested positive for a type I allergy to NRL.[9]

Our objective in the current study was to obtain a more current assessment of the prevalence of type I NRL allergy in dental hygienists, and to examine the frequency of common risk factors for type I NRL allergy in this population. Therefore, participants attending the American Dental Hygienists' Association (ADHA) annual sessions over a three-year period were screened for a type I NRL allergy using skin prick testing and a detailed health history questionnaire.

Materials and Methods

Dental hygienists attending the 2000, 2001, and 2002 ADHA national meetings in Washington, D.C., Nashville, Tennessee, and Los Angeles, California, respectively, were screened for a type I NRL allergy. Voluntary participation included a self-administered four-page questionnaire and skin prick testing for a type I allergy to NRL. All participants provided written consent according to guidelines established by the Department of Health and Human Services Office for Human Research Protections.[10]

Questionnaire

Participants received uniquely numbered questionnaires that asked questions about their occupational history, health, personal identifying data, and anthropometric data (e.g. height and weight). Participants were also asked to recall allergy symptoms and history, surgical history, known reactions to foods, medical, or household products, and any previous testing or treatment for an allergy to rubber products.

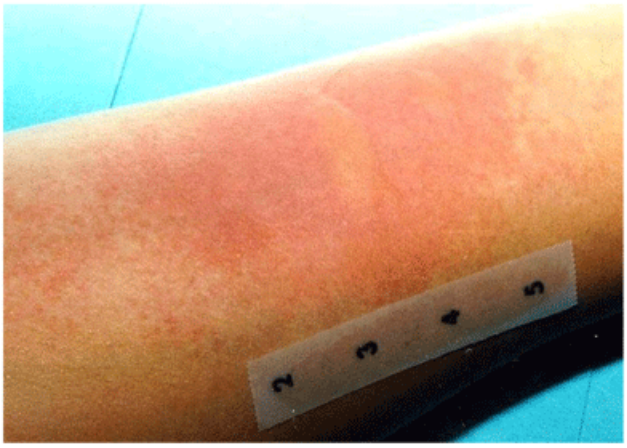
Skin prick testing (SPT) for type I latex allergy: Testing was performed using either a commercial NRL test solution (Stallergenes SA, France) alone (2002) or in combination with NRL glove-based solutions (2000 and 2001) prepared by the University Hospital of Tampere Dermatology Department in Finland, as described previously by Hamann et al. and Turjanmaa et al.[9,11] In two years of comparative studies conducted at various conferences, no differences were observed in skin prick test results between the Stallergenes commercial NRL test solution and the NRL glove solutions prepared in Tampere, Finland.

Drops of test solutions were placed on the inner forearm of each participant in the following order: 1) histamine positive control; 2) NRL test solution(s); and 3) saline negative control. The skin was pricked through each drop using separate sterile lancets (Prick Lancetter, Bayer), and the sites blotted dry with gauze. Skin prick sites were examined 15 minutes later for the presence of wheals, and their diameters were measured in millimeters. Other than localized itching, there were no adverse reactions to SPT.

Participants were considered "SPT-positive" if their type I NRL allergy test results included: 1) histamine-positive control wheal of at least three millimeters; 2) NRL test solution wheal(s) measuring at least half that of the histamine positive control; and 3) no measurable wheal for the saline negative control. Participants testing positive for a type I NRL allergy

(Figure 1) were given educational literature and management guidance and were instructed to consult their health care providers.

Figure 1. A positive skin prick test for type I allergy to natural rubber latex (NRL). The large central wheal is a response to a standardized NRL solution; the upper wheal is a response to the histamine positive control.



Participants were considered "SPT-negative" if their type I NRL allergy test results included: 1) histamine-positive control wheal of at least three millimeters; 2) no measurable wheal(s) for the NRL test solution; and 3) no measurable wheal for the saline negative control.

Participant SPT results were considered dermatographic and indeterminate if measurable wheals were present at all prick sites. Participant SPT results were considered equivocal if the histamine-positive control wheal was less than three millimeters. Equivocal reactions usually occurred in participants who exceeded the 15-minute test period time or had taken antihistamines in the last 24 to 48 hours. Participants with dermatographic or equivocal reactions were instructed to contact their allergist or dermatologist for additional testing.

Statistics

Data was entered and sorted with Access (Microsoft, Redmond, WA). Data tables were imported into the Statistical Package for Social Scientists (SPSS, Inc.; Chicago, IL), which was used for determination of means, standard deviations, frequencies, t-tests, and Pearson chi-square analysis.

Results

A total of 631 ADHA conference attendees participated in this type I NRL allergy screening during the three-year study. Of these, 582 participants completed the questionnaire and reported practicing, studying, or teaching dental hygiene; 49 did not identify themselves as associated with the dental hygiene field and were therefore excluded from the data set. Participants were generally female (98%) around 40 years of age (Table I) and identified themselves as one of the following categories of dental hygiene professionals: dental hygienists (86%), dental hygiene students (10%), dental hygiene program instructors (2.7%), and dental hygiene program administrators (0.7%). Most reported working in general dentistry practices full-time (approximately 30 hours per week and at least 44 weeks per year).

Table I. Self-reported demographics of participants (total n= 582) in type I NRL allergy screenings conducted at ADHA conferences.[1]

	2000	2001	2002
Total screened participants working in dental hygiene[2]	240	224	118
Female gender	99% (n=237)	98% (n=219)	100% (n=118)
Average age (years)	44.4 ± 10.8 (n=227)	39.4 ± 11.2 (n=201)	44.3 ± 11.0 (n=110)
Total years in practice	18.7 ± 11.5 (n=235)	15.3 ± 11.4 (n=204)	20.6 ± 11.3 (n=105)
Hours worked per week	31.4 ± 10.4 (n=235)	30.4 ± 11.4 (n=204)	29.0 ± 10.7 (n=105)
Weeks worked per year	44.3 ± 10.8 (n=235)	44.3 ± 12.3 (n=204)	47.6 ± 29.3 (n=105)

[1] Note that the n-value shown in parentheses is the number of individuals responding to each question and may be less than the total number of screening participants.

[2] Participants identified themselves as working in the field of dental hygiene and included dental hygienists, dental hygiene students, instructors, and school administrators.

Of the 582 ADHA participants that identified themselves as belonging to one of the above dental hygiene professional categories, 28 (4.8%) tested positive for a type I NRL allergy (SPT-positive). The prevalence of type I NRL allergy appeared to decrease over time, and was less in 2002 (3.4%) than in 2000 (5.4%), as shown in Table II.

Table II. Annual skin prick test results[1] for participants screened for a type I NRL allergy at ADHA conferences.

	2000	2001	2002
SPT-positive participants (total n=28)	5.4% (n=13)	4.8% (n=11)	3.4% (n=4)
Participants with an equivocal or dermatographic test result[2] (total n=5)	0.8% (n=2)	0.9% (n=2)	0.8% (n=1)
Number of participants screened (total n=582)	240	227	118

[1] Skin prick test results were classified according to wheal size per standardized testing as described in the Materials and Methods section.

[2] Participant skin prick test results were not interpretable due to dermatographism, late reading, insufficient response, or interference from drugs such as antihistamines.

Incidence could not be assessed due to the small number of participants (identified by name, date of birth, and height) screened at multiple conferences. Only four individuals were screened at all three conferences, while nine individuals were screened at both the 2001 and 2002 conferences; all tested negative. Nineteen participants were screened at both the 2000 and 2001 conferences; only one participant tested SPT-positive, and only in 2000.

Participants were generally healthy. Only 17% (97 of 571 respondents) reported having one of the following health conditions: diabetes, stroke, kidney disease, liver disease, rheumatoid arthritis, multiple sclerosis, alcoholism, and high blood pressure. However, a history of allergies or allergic reactions was more common. Hay fever, asthma, eczema, or contact dermatitis was reported in 46% (n=262) of participants. Reactions to foods, medications, plants, insects, chemicals, and dental materials were noted by 74% (n=435 of 582) of participants.

Participants that screened SPT-positive were more likely to report some history of allergies or allergic reactions (Table III). Significantly more SPT-positive participants reported a history of asthma as compared to those who screened SPT-negative. In contrast, SPT-positive participants reported symptoms of hay fever, eczema, or contact dermatitis slightly more frequently than SPT-negative participants, and this difference was not significant. Overall, 28% of study participants

noted some reaction to consumer, medical, or dental rubber products. These reactions were reported significantly more often in SPT-positive participants (Table III).

Table III. Self-reported allergies and allergic reactions in ADHA conference participants who screened positive or negative for a type I NRL allergy.

Participants reporting [1]:	SPT-Positive (n=28)	SPT-Negative (n=549)
History of asthma	29% [2] (n=8)	12% (n=66)
History of hay fever, eczema, or contact dermatitis (i.e. other allergies)	50% (n=14)	42% (n=231)
Reactions to cross-reacting molds, ragweed, trees, or grasses	46% [2] (n=13)	27% (n=149)
Reactions to cross-reacting fruits and plants (kiwis, bananas, peaches, passion fruit, chestnuts, avocados, potatoes, or ficus plants)	11% [2] (n=3)	3% (n=18)
Reactions to dental, medical, or consumer rubber products	46% [2] (n=13)	28% (n=153)

[1] Note that the n-value shown in parentheses is the number of individuals responding affirmatively and screening either positive or negative.

[2] Significant (p [.05) association between SPT-positive screening result and self-reported allergic reactions based on Pearson's chi-square statistics.

Positive reactions to NRL panallergens were reported more frequently by SPT-positive participants (Table III). Significantly more SPT-positive participants reported allergic reactions to cross-reacting botanicals such as molds, ragweed, trees, and grasses when compared to SPT-negative participants. Similarly, reactions to kiwis, bananas, chestnuts, avocados, potatoes, or ficus houseplants were reported significantly more often in SPT-positive participants as compared to SPT-negative participants.

Of the SPT-positive participants, 46% (n=13 of 28) reported having some type of symptom after contact with NRL, as compared to 32% of SPT-negative (n=176 of 549) participants. Of the symptoms listed, respiratory problems and hives were reported significantly more often in SPT-positive participants than in SPT-negative participants (Table IV). While both SPT-positive and SPT-negative participants reported skin symptoms ranging from itching to contact dermatitis after contact with NRL, differences between these groups were not significant.

Table IV. Symptoms experienced after contact with natural rubber as reported by participants screened for a type I NRL allergy at annual ADHA conferences.

Participants reporting [1]:	SPT-Positive (n=28)	SPT-Negative (n=549)
Respiratory symptoms: rhinoconjunctivitis, bronchospasm, runny nose, or red itchy eyes	18% [2] (n=5)	4% (n=21)
Hives	25% [2] (n=7)	4% (n=22)
Skin itching, cracking, or burning	39% (n=11)	26% (n=142)
Skin rash or contact dermatitis	36% (n=10)	22% (n=122)

[1] Note that the n-value shown in parentheses is the number of individuals responding affirmatively and screening either positive or negative.

[2] Significant (p [.05) association between SPT-positive screening result and self-reported allergic reactions based on Pearson's chi-square statistics.

SPT-positive participants reported experiencing symptoms for a significantly longer period than SPT-negative participants (11 +/- 5 years vs. 7 +/- 5 years; $p < .05$). Of these symptomatic SPT-positive participants, 54% (n=7 of 13) indicated that they had reported their symptoms to a physician. By comparison, 44% (n=77 of 176) of symptomatic SPT-negative participants noted that they had reported their symptoms to a physician.

Discussion

The first accounts of type I NRL allergy in dentistry appeared in the 1980s and involved both an oral health care professional and a patient's reaction to a rubber dam.[2,3,12] In the mid-1990s, the prevalence of type I NRL allergy averaged 9% in 329 dental hygienists and assistants, based on skin prick test methods similar to those used in the current study.[9] More recent studies suggest that the overall prevalence of type I NRL hypersensitivity in medical and dental workers is decreasing.[13,14,15,16] Results from the current study are consistent with this trend and suggest a 5% prevalence of type I allergy to NRL in dental hygienists.

Screening for a type I allergy to NRL was conducted by skin prick testing with non-ammoniated NRL commercial test solution (Stallergenes, Antony, France) alone or in combination with specially prepared extracts from high-antigen level latex gloves (K. Turjanmaa; Tampere, Finland). During the two years in which glove extracts and ammoniated NRL standard were used simultaneously on participants, no difference in test results were observed. Both skin prick reagents have a specificity reportedly near 100%, and sensitivity ranging from 90% to 98%.[5,11] Therefore, the probability of a false positive result would be nearly zero, and that of a false negative result would be less than 10%.

This study's cross-sectional design is limited in that it describes the prevalence of a type I NRL allergy in a specific (and self-selected) test population. Because a broader population of dental hygienists was not randomly sampled or screened, it is unknown whether the test population accurately represents dental hygienists overall. The effect of potential selection bias cannot be excluded. In other words, it is possible that participants with symptoms were more likely to be screened, which could have over-estimated prevalence. However, because another test (carpal tunnel syndrome screening) was also offered in conjunction with allergy testing, this may have mitigated a participant selection bias. Conversely, potential participants may have avoided the allergy screening because they were already diagnosed with a latex allergy or were symptomatic and fearful about the occupational ramifications of a positive screening. This latter rationale is supported by the observation that SPT-positive participants waited a significantly longer time to report their symptoms to their health care providers. If symptomatic participants avoided the allergy screening, this would underestimate prevalence.

Participants who screened positive for type I allergy to NRL were more likely to self-report known risk factors, such as a history of asthma and allergic reactions to rubber products, certain plants, and foods. This is likely related to the presence of similar allergenic proteins (panallergens) in NRL and certain fruits, grasses, weeds, trees, and house plants.[17] These findings are consistent with other studies of concomitant allergies and risk factors in type I NRL allergic health care workers.[17]

Four times as many ADHA participants thought they had a "latex allergy" than were actually SPT-positive (19% versus 4.8%). This belief was frequently based on non-specific itching or burning after contact with latex. However, skin reactions are not indicative of a type I NRL allergy. As shown in Table IV, hives and respiratory symptoms were more significantly associated with a type I NRL allergy than itching and burning. Obtaining an accurate diagnosis is essential to prevent oral health care professionals (and their health care providers) from mismanaging their occupational skin disease.[18]

Although participants reported experiencing symptoms after contact with natural rubber for an average of seven years, many had not obtained medical evaluation and treatment. This observation is consistent with other occupational health studies indicating that a health care worker's skin disease can remain undiagnosed and poorly managed for an average of three years.[16,19] The resulting chronically broken skin can permit pathogen and allergen penetration, as well as proliferation of resident and non-resident microflora.[20,21] Unmanaged skin disease has resulted in transmission of hepatitis and HIV in a health care worker.[20]

Participants that screened SPT-positive were instructed to be aware of potential NRL allergen sources and to take steps to avoid exposure. Successful management is based on avoiding NRL allergen sources because there is no "cure" or immunotherapy treatment for type I NRL allergy.[6] To reduce their personal exposure, SPT-positive dental hygienists should wear only gloves made of synthetic non-latex materials such as nitrile, neoprene, polyvinyl chloride (PVC or vinyl), or polyurethane. These synthetic non-latex gloves do not contain NRL proteins. Therefore, they can be powdered or

powder-free because the source of a type I allergy is the NRL protein, not the bioabsorbable cornstarch used as a donning agent.

Oral health care professionals are also exposed to NRL protein aerosolized from powdered latex gloves worn by their coworkers. When powdered latex gloves are donned or removed, the NRL-laden cornstarch powder released becomes an airborne carrier of NRL proteins. Particles contaminated with NRL proteins have been identified in dental office carpet, furniture, cabinetry, and air handling systems.[22] To reduce NRL protein contamination of dental office environments, coworkers of SPT-positive dental hygienists should wear latex gloves with a low NRL protein content that are also powder free.[6] Alternatively, coworkers can wear synthetic non-latex gloves (with or without powder). The overall goal in any environment with NRL-allergic workers is to lower airborne NRL protein levels to less than 10 ng/m3, per the recommendations of several investigators.[17,22]

In addition, dental practices should develop NRL allergy management protocols, as recommended by the Centers for Disease Control and Prevention, American Dental Association, and National Institute for Occupational Safety and Health.[23,24,25] These allergy management protocols should include: 1) steps to evaluate both staff and patients for their risk of a type I NRL allergy, 2) measures for identifying, substituting, and isolating products that contain NRL, 3) special NRL-allergic patient management regimens, 4) education about type I NRL allergy, and 5) emergency preparedness for adverse patient or dental worker reactions, should they occur.[26]

Conclusion

Based on this cross-sectional study, approximately 5% of dental hygiene professionals may have a type I NRL allergy. This prevalence may be greater than that observed in the general population, but it appears to be decreasing. Further research is required to determine if the downward trend observed during the three-year study period continues. Type I NRL allergic dental hygienists were also likely to report a history of reactions to foods, plants, and rubber products known to contain natural rubber. These individuals were also more likely to report a history of hives and respiratory symptoms. Type I NRL allergic individuals may delay effective diagnosis and management due to misinformation, fear, or preconceptions. Therefore, oral health care professionals should be educated about proper skin care, NRL allergens and allergy management, and should be encouraged to obtain an accurate diagnosis for any recurring symptoms of occupational skin disease.

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Notes

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A National Survey of Dental Hygienists' Infection Control Attitudes and Practices

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Purpose. The objectives of this study were to: 1) investigate the infection control practices of practicing dental hygienists, 2) document the attitudes and practices of dental hygienists toward patients with infectious diseases, and 3) determine if professional affiliation affected the attitudes and/or practices of the respondents.

Methods. A 49-item survey consisting of eight demographic, nine attitudinal, and 32 practice questions was used for this study. A stratified sampling method was used, in which the United States was divided into four regions. Three states were selected from each region according to geographic location and population. Five percent of registered dental hygienists within each selected state were randomly selected for inclusion in the study. All analyses were conducted using the Statistical Package for Social Scientists (SPSS v.10, Chicago, IL).

Results. Of the 2,009 surveys mailed, 104 were undeliverable. A total of 856 completed surveys were returned from practicing dental hygienists for a response rate of 44.9%. Overall, this study found an increased use of barriers and personal protective equipment in comparison to previous studies. A majority of respondents (53.9%) felt that treating patients with HIV or AIDS increased their personal risk for contracting the disease. The majority of respondents also reported always using extra precautions with HIV/AIDS patients (63.5%) and hepatitis patients (60.1%). In addition, most respondents reported they would not use an ultrasonic scaler when treating HIV/AIDS (65.8%) or hepatitis (58.9%) patients, indicating an alteration in clinical practice habits.

Conclusion. The majority of dental hygienists surveyed reported altering infection control practices and treatment techniques when treating HIV/AIDS or hepatitis patients. While there has been an improvement in compliance with recommended infection control guidelines, practitioners still have misconceptions, and possibly fear, regarding infectious diseases and disease transmission.

Keywords: Infection control, disease transmission, universal precautions, aerosols, personal protective equipment, attitude of health professional, practices, dental hygienist

Introduction

Over the last two decades, attitudes of health care providers towards infection control and treatment of patients with infectious diseases have changed dramatically.[1-20] Most oral health care professionals have realized the importance of

infection control and have incorporated Occupational Safety and Health Administration (OSHA) guidelines into their practices to prevent disease transmission.[1] Due to the media, public awareness of the possibility of disease transmission within the dental office has forced even more compliance with OSHA standards in order to assure apprehensive patients.

A key element of infection control is the concept of universal precautions. This concept was introduced by the Centers for Disease Control and Prevention (CDC) as a means to reduce the risk of transmission of blood-borne pathogens in health care settings. The primary principle behind this concept is based upon the premise that clinicians cannot rely definitively on the medical history and examination of a patient to determine the absence or presence of infectious diseases. Therefore, the same infection control procedures should be used for all patients.[21-23] In 1996, the CDC expanded this concept and changed the term to standard precautions. The 2003 guidelines state: "Standard precautions integrate and expand the elements of universal precautions into a standard of care designed to protect health care personnel and patients from pathogens that can be spread by blood or any other body fluid."[21]

The emergence of the Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS) has also been correlated with compliance with infection control guidelines. However, oral health care workers continue to indicate a reluctance to treat patients with HIV/AIDS or those in high-risk groups.[1-17] Although dentistry has come a long way in infection control practices, patients with infectious diseases continue to be treated with different infection control methods.[1]

Review of the Literature

Previous studies have investigated the knowledge, attitudes, and practices associated with infection control and the treatment of patients with infectious diseases. These studies, which date as far back as the early 1980s, have been conducted with a variety of oral health care workers, including dental assistants, dental hygienists, and dentists.

Several studies have been conducted to investigate the infection control knowledge, practices, and attitudes of dentists.[2-9] In 1998, Gershon et al. reported that 98% of Maryland dentists surveyed believed that following recommended infection control procedures (ICP) would protect them from exposure to HIV.[2] Although 69% of the respondents indicated a tolerance for and acceptance of treating patients with AIDS, 43% reported that they would rather refer HIV patients elsewhere, and 56% felt that they should have the right to refuse to treat HIV patients. HIV was believed to be transmitted through saliva by 44% of the respondents, and 67% felt that it could be transmitted by a splash to the eyes or mouth.[2]

A national survey of endodontists regarding infectious diseases and attitudes toward infection control was conducted by Cohen et al.[3] Ninety-five percent of endodontists reported receiving a hepatitis B vaccine during the period from 1982 to 1995, and 99% reported wearing gloves during every patient contact. In general, most respondents felt that infection control measures protected them from transmissible diseases. The majority of respondents also reported that they were willing to treat patients with transmissible diseases.[3]

Verrusio et al. compared the results of two national surveys of infection control practices conducted by the American Dental Association (ADA) during 1986 and 1988.[4] Results from these surveys indicated an increase in hepatitis B vaccination and in following ICP. Verrusio et al. attributed education, the media, and the AIDS epidemic to the increase in knowledge of infectious diseases. However, results from these surveys suggest that education and understanding of HIV infection have not eradicated irrational fears about this disease.[4]

Other studies also report a reluctance of dentists to treat patients with HIV.[5-7] Moretti and colleagues found that 30% of respondents would not treat patients suspected of having HIV, even if the patients had no clinical signs or symptoms of AIDS or AIDS Related Complex (ARC).[5] Survey results from Gerbert's study revealed that while California dentists were reluctant to treat patients with AIDS, 70% felt the responsibility to do so.[6] Forty-seven percent of the respondents also believed that AIDS was transmitted through saliva.[6]

Differences in infection control practices and attitudes of dentists, dental hygienists, and dental assistants were reported in two different studies.[10,11] Both studies reported that dental hygienists were more likely to use recommended ICP than dentists or dental assistants. Results also revealed a reluctance to treat AIDS patients in all three groups; however, those that reported thorough ICP were more willing to treat patients with AIDS. Although dental hygienists scored higher on ICP, all three groups (dentists, dental hygienists, dental assistants) fell short of following standard ICP.[10,11]

Several studies of dental hygienists' infection control attitudes and practices have been conducted.[12-20] A 1990 survey of ethical issues in dental hygiene was conducted by Gaston et al.[12] The most common ethical dilemma reported was observation of clinical practice behavior in conflict with standard ICP. The authors suggested that many of the ethical dilemmas reported occurred because dental hygienists often have limited control over the manner in which they practice.[12]

In 1991, a survey of Pennsylvania dental hygienists was conducted to study the knowledge, attitudes, and infection control practices in relation to AIDS and AIDS patients.[13] The majority of dental hygienists surveyed had comprehensive knowledge about AIDS (94.2%) and CDC- recommended ICP (92%). Most respondents reported routine use of basic infection control practices including safety glasses, masks, gloves, disposable items, surface disinfection of light handles, instrument bracket tray, and patient chair switches. Seventy-one percent of respondents indicated that infection control measures used for hepatitis B provided sufficient protection against HIV transmission. However, the majority of respondents (85%) expressed a moderate or high amount of "worry" in treating AIDS patients, with only 15% indicating slight or no worry. Fifty-three percent agreed that dental hygienists should be required to treat AIDS patients. Some areas of infection control procedures in which respondents reported low rates were: 1) taking or wearing soiled work clothing home (94%), 2) wearing jewelry during clinical duties (88%), 3) not changing soiled, contaminated clothing between patients (82%), and 4) blood and saliva contamination on their face during treatment in the past year (84%). In addition, only 69.5% of the respondents had received the hepatitis B vaccine. Snyder concluded that Pennsylvania dental hygienists were not following CDC guidelines on proper operatory aseptic techniques and in differentiating ICP based on perceived patient HIV status.[13]

A 1993 survey of Rhode Island dental hygienists and certified dental assistants suggested that lack of compliance with infection control guidelines is multifactorial.[14] Although the majority of respondents (75% dental hygienists, 74% dental assistants) had attended an infection control course within the previous year and were satisfied with their implementation of infection control, many recommended ICP were not practiced routinely. Wood suggested that since recent infection control education did not impact the respondents' compliance with infection control guidelines, future studies should investigate other possible reasons for non-compliance.[14]

Daniel et al. conducted a survey of Mississippi dental hygienists, investigating their knowledge and use of infection control techniques, attitudes pertaining to universal precautions and the risk of clinician/patient cross-infection, and attitudes toward treatment of patients with infectious diseases.[15] Results indicated that while 98% of respondents believed that barrier techniques were effective, some believed patients infected with HIV/AIDS (43%), hepatitis B (31%), or tuberculosis (40%) are best treated in "public clinics" rather than in private practice settings. Respondents also felt that patients with infectious diseases pose a health threat to dental hygienists. Furthermore, 65% of the respondents felt that all oral health care workers and patients should be tested for HIV/AIDS. An increase in the use of infection control procedures, as compared to other studies conducted during the same time frame, was also reported. Increased use of infection control techniques was found among the more recent and younger graduates. However, the use of gloves appeared to be approaching 100%, and use of other personal protective equipment continued to increase compared to previous studies.[15]

Although there is scientific support for the increase in infection control practices by oral health care professionals, data about current infection control practices and attitudes of dental hygienists is limited and, to date, no national study of dental hygienists has been conducted. The purpose of this study was to summarize the attitudes and practices of practicing dental hygienists in regards to infection control, infectious disease, and disease transmission and to determine if professional affiliation affected the attitudes and/or practices of the respondents.

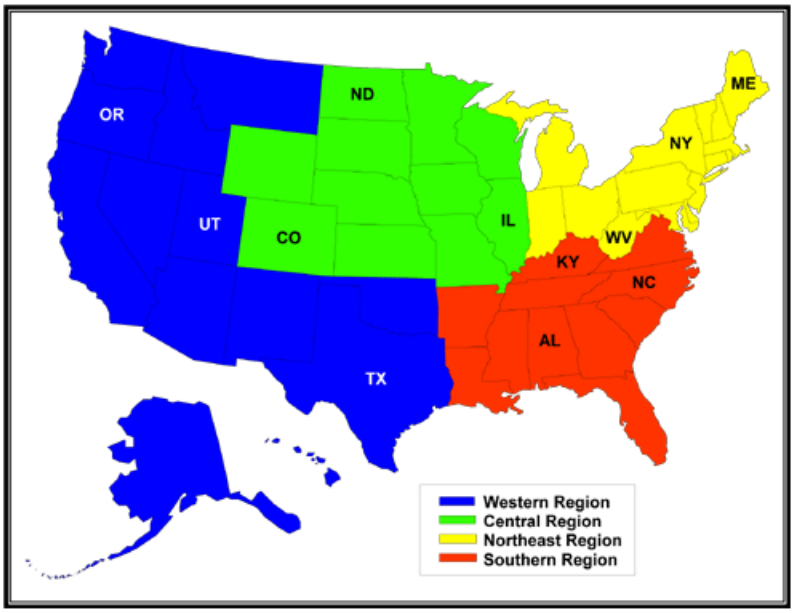
Methods

A 49-item questionnaire was used to survey a stratified random sample of practicing dental hygienists within the United States. The questionnaire was developed by the investigator and consisted of eight demographic, nine attitudinal, and 32 practice questions. The questionnaire included questions with a Likert rating scale, as well as multiple-choice and yes/no questions. Infection control and infectious disease questions were developed to measure practices and attitudes reported in the literature in order to compare results to previous studies.[1-17] The survey instrument and study proposal was approved by the Baylor College of Dentistry Institutional Review Board at Texas A&M University Health Science Center.

Sampling Method

A stratified random sample was conducted in which the United States was divided into four regions according to geographic boundaries. Three states were assigned from each region according to rural and urban population distributions. Approximately 5% of each assigned state's registered dental hygienists were randomly selected for inclusion in the study and assigned a tracking code in order to follow up with non-responders. A stratified random sampling method was used in order to sample a large population that is disbursed over a wide geographical region (Figure 1). This method was also chosen to achieve a sample similar to that of the general population of dental hygienists within the United States. Previous studies in this area of research have used convenience samples or random samples based on a single state's dental hygiene population.

Figure 1. United States Regional Map



A pilot study was conducted among a national sample of dental hygienists. Two dental hygienists from each of the assigned 12 states were randomly selected for inclusion in the pilot study (n=24). Two identical surveys were mailed to the same subject at two different time intervals in order to determine test/re-test reliability. Of the 24 subjects chosen, only six returned both surveys. Due to the number of subjects who returned both surveys, test/re-test reliability could not be determined. However, results from the pilot study revealed four questions in which several subjects answered differently on the second survey than their original survey. Four subjects changed their response to one attitudinal question when asked if they feel that their profession places them at a high risk for contracting infectious diseases. The other three questions, to which these subjects changed their responses, were practice questions pertaining to: taking contaminated clothing home, stating "too much trouble" as a reason for not wearing personal protective equipment (PPE), and use of a pre-procedural mouth-rinse. These four questions were not modified; however, other changes were made to the survey in order to improve clarity.

Data Collection

In October 2001, the revised 49-item survey was mailed with a cover letter and self-addressed, stamped return envelope to the 2,009 randomly selected subjects. A second mailing with survey, cover letter, and self-addressed, stamped envelope was sent to non-responders four weeks after the initial mailing.

Data were collected and entered into the Statistical Package for Social Scientists (SPSS, v. 10, Chicago, IL). SPSS was used for descriptive data analysis, frequency distributions, and cross- tabulations. Chi-square statistics were used to identify associations between descriptive variables and practice and attitude variables. The level of significance was set at alpha < 0.05.

Results

Of the 2,009 surveys mailed, 104 were undeliverable. A total of 930 surveys were returned. Non-practicing dental hygienists (n=69) and incomplete surveys (n=5) were excluded from the study. Eight hundred fifty-six surveys were analyzed for a response rate of 44.9%. Response rates according to state are reported in Table I. Because not all participants answered every question, the number of responses to each question vary. Demographic characteristics can be found in Table II. A majority of the respondents were female (n=846, 99.3%) with 16 to 21 or more years of clinical practice experience (n=402, 47.0%), had an associate degree in dental hygiene (n=567, 66.7%), and practiced in general dentistry (n=751, 89.0%) 31 to 40 hours a week (n=419, 49.1%). Approximately 71% (n=603) reported that they were not members of the American Dental Hygienists' Association (ADHA).

Table I. Response Rate by State

STATE	N	Frequency (n)	Percent (%)
Alabama	160	28	17.5%
Colorado	155	56	36.1%
Illinois	285	125	43.8%
Kentucky	76	37	48.6%
Maine	150	59	39.3%
New York	424	166	39.1%
North Carolina	188	84	44.7%
North Dakota	21	13	61.9%
Oregon	115	66	57.4%
Texas	362	177	48.9%
Utah	36	24	66.7%
West Virginia	37	21	56.7%

Table II. Demographic Characteristics of Respondents

CHARACTERISTIC	n	%
Gender		
Female	846	99.3%
Male	6	0.7%
Years in Clinical Practice		
1 to 5	190	22.2%
6 to 10	152	17.8%
11 to 15	112	13.1%
16 to 21+	402	47.0%
Dental Hygiene Education		
Certificate	58	6.8%
Associate	567	66.7%
Bachelor	211	24.8%
Master	14	1.6%
Practice Setting		
General	751	89.0%
Periodontic	29	3.4%
Pediatric	19	2.3%
Education	16	1.9%
Public Health	8	0.9%
Other	21	2.5%
Hours per Work Week		
Under 10	62	7.3%
10 to 20	117	13.7%
21 to 30	210	24.6%
31 to 40	419	49.1%
41+	45	5.3%
ADHA Membership		
Member	251	29.4%
Non-member	603	70.6%

Attitudes

Results from attitudinal questions related to treating patients with infectious disease are reported in Table III. A majority (n=441, 52.4%) of respondents felt that working in an oral health care profession placed them at a high risk for contracting infectious disease, and approximately 54% (n=455) believed treating patients with HIV/AIDS increased their personal risk for contracting HIV. Thirty-eight percent (n=321) felt that double-gloving was appropriate when treating this population, while 25.4% (n=214) reported that different sterilization and disinfection methods were necessary. Others reported that infectious disease patients should be treated in an isolated operatory (n=97, 11.5%) and referred to a public health clinic for dental treatment (n=60, 7.1%).

Table III. Attitudes Related to Treating Infectious Disease Patients

ATTITUDINAL QUESTIONS	YES	NO
High risk profession	52.4%(441)	47.6% (401)
Patients with HIV increase risk	53.9% (455)	46.1% (389)
HIV/hepatitis patients: treated same as non-infectious patients	67.3% (568)	32.7% (276)
HIV/hepatitis patients: treated by other specified means	13.4% (113)	86.6% (731)
HIV/hepatitis patients: double glove	38.0% (321)	62.0% (523)
HIV/hepatitis patients: different sterilization/disinfection	25.4% (214)	74.6% (630)
HIV/hepatitis patients: treated in isolated operatory	11.5% (97)	88.5% (747)
HIV/hepatitis patients: referred to public health clinic	7.1% (60)	92.9% (783)

Respondents were asked to indicate which source(s) they felt could transmit HIV. Transmission by means of blood (n=809, 94.8%) and needle stick or instrument injury (n=831, 97.4%) were the most common responses; however, saliva (n=382, 44.9%), splash/spatter (n=354, 41.5%), and aerosols (n=259, 30.4%) were also reported as means of HIV transmission. Respondents were also asked to rate the importance of minimizing aerosols when using the air/water syringe, ultrasonic scaler, and air polisher. The majority (n=619, 72.5%) reported aerosol reduction as very important during dental hygiene treatment. Another 20.1% (n=172) felt that minimizing aerosols was somewhat important, while 7.4% (n = 63) selected somewhat unimportant or very unimportant. Most of the respondents stated no need for further training in infection control and occupational safety (n=610, 72.3%) and reported that adequate infection control materials and equipment were being used in daily practice (n=745, 88.4%). When asked if oral health care professionals should be concerned about dental unit water and waterlines, 79.2% (n=668) reported yes, while 20.8% (n=175) reported no concern for the quality of water and condition of dental unit waterlines.

Practices

Practice alterations according to disease status are summarized in Table IV. When treating a patient with known or suspected infectious disease, the majority of responders reported always or often using extra infection control precautions with HIV/AIDS (n=532, 63.5%) and hepatitis (n=503, 60.1%) patients. Most respondents also reported they would not use an ultrasonic or sonic scaler when treating HIV/AIDS (n=559, 65.8%) or hepatitis (n = 499, 58.9%) patients. A greater majority stated they would not use an air polisher with an HIV/AIDS (n=656, 77.8%) or hepatitis (n=603, 71.4%) patient.

Table IV. Practice Alterations According to Disease Status

PRACTICE QUESTIONS	n	%
Extra infection control precautions with HIV/AIDS patients		
Always/Often	532	63.5%
Sometimes	76	9.1%
Rarely/Never	230	27.5%
Use of an ultrasonic/sonic scaler with HIV/AIDS patients		
Yes	290	34.2%
No	559	65.8%
Use of an air polisher with HIV/AIDS patients		
Yes	187	22.2%
No	656	77.8%
Extra infection control precautions with hepatitis patients		
Always/Often	503	60.1%
Sometimes	93	11.1%
Rarely/Never	241	28.8%
Use of an ultrasonic/sonic scaler with hepatitis patients		
Yes	348	41.1%
No	499	58.9%
Use of an air polisher with hepatitis patients		
Yes	242	28.6%
No	603	71.4%

The majority of respondents reported always using disinfectant and barriers on the dental unit, with the exception of hand pieces, in which only 48.2% (n = 355) reported always using barriers over hand pieces. When compared to the other dental unit equipment, the x-ray unit and switches were another area in which respondents reported less frequent use of disinfectants (n=592, 72.6%) and barriers (n=422, 54.5%). Barriers used to cover the air/water syringe (n=473, 62.0%), suctions (n=427, 57.4%), and hand pieces (n=355, 48.2 %) were less frequently reported than the dental chair (n=560, 72.4%), bracket tray (n=541, 74.0%), and light handles/switches (n=624, 76.8%).

Approximately 57% (n=478) reported flushing waterlines for two to three minutes at the beginning of the day. Another 38.5% (n=325) reported using separate water reservoirs, and 31.7% (n=268) reported periodic chemical treatment as a means to improve dental unit water and waterlines. Other reported measures taken for waterline management were the use of filters, such as iodine cartridges, (n=106, 12.5%) and continuous chemical treatment (n=64, 7.6%). Approximately 14% (n = 119) reported taking no measures to improve dental unit water.

Approximately 67.5% (n=551) of respondents reported always wearing a lab coat, whereas 13.7% (n=106) reported always using a disposable gown. Of those surveyed, a majority indicated always using safety glasses (n=547, 68.9%), while approximately 41% (n=307) reported always using prescription glasses for protective eyewear. Items chosen less frequently for PPE were visor face shield (n=121, 16.6%), facemask with shield (n=94, 12.6%) and side shields for prescription glasses (n=108, 15.3%). Most respondents reported using a facemask on a daily basis (n=764, 93.2%,). Almost 100% of respondents reported always using gloves (n=549).

The most common reasons reported by respondents for not using PPE were 1) "too hot" (n=116, 13.9%) and 2) "interferes with working skills" (n=93, 11.2%). Other reported reasons included: "PPE unavailable" (n=65, 7.8%), "forget" (n=35, 4.2%), "bothers the patient" (n=20, 2.4%), and "too much trouble" (n=19, 2.3%). A majority of respondents (n=596, 71.6%) reported that there was never a time when PPE was not used.

Approximately 50% (n=424) said they always or often took contaminated clothing (scrubs/lab coat) home. Another 50.2% (n = 420) stated rarely or never changing contaminated clothing between patients. Less than half (n=328, 38.5%) of respondents changed face masks after each patient, while 39% (n=332) reported changing face masks after several patients. Eighteen percent (n=153) reported changing facemasks once a day and a small percentage (n=35, 4.1%) indicated not wearing a facemask.

Responders also reported sometimes (n=330, 38.7%) having patients wear protective eyewear, whereas only 28.4% (n=242) stated always or often supplying protective eyewear for their patients. A very low percentage (n=160, 18.8%) of dental hygienists surveyed said they always or often use a pre-procedural mouth-rinse prior to treatment. A very low percentage of respondents indicated having received education on the clinical use of aerosol reduction devices for the ultrasonic (Safety Suction(tm) n=75, 8.8%) and air polisher (Jetshield(tm) n=81, 9.6%). Approximately 19% (n=157) reported that they had never received clinical training from an educational institution or continuing education course on the use of ultrasonic scalers, air polishers, or aerosol reduction devices.

Cross-tabulations were conducted among respondents who reported percutaneous injuries with practices in handling contaminated instruments and preventive measures taken after injury with a contaminated instrument. Respondents who reported two or more percutaneous injuries also indicated a higher rate of using exam gloves and bare hands when handling or cleaning contaminated instruments than those reporting one or no injury. Altogether, those that reported an incident of injury were less likely to use utility gloves when handling or cleaning contaminated instruments. The cross-tabulations were used only to report trends in incidents of occupational exposure and post-exposure protocol in relation to infection control practices associated with handling instruments. Respondents were not asked how they were injured with contaminated instruments, only how many incidents had occurred over the past two years. Therefore, details as to practices and procedures at the time of occupational exposures are unknown.

The majority of responders reporting three or more percutaneous injuries also indicated that no preventive measures were taken following an exposure (n=11, 61.1%). This group was also less likely to report blood testing of the clinician (n=1, 5.6%) or patient (n=1, 5.6%). The most frequent preventive measure reported among all three groups was the completion of an incident report after an injury. Several respondents selected "other" and commented that they bled the area and washed the site thoroughly with soap and water. Cross-tabulation results also showed that those reporting one or two injuries indicated clinician blood testing (n=41, 32.5%; n=10, 21.7%) more frequently than patient blood testing (n=22, 17.5%; n=4, 8.7%).

Chi-square analysis indicated differences in infection control attitudes and practices among ADHA members and non-members. As summarized in Table V, ADHA members were more likely to have patients wear protective eyewear (X^2=17.837, p<0.001) and rinse with mouthwash prior to treatment (X^2=19.947, p<0.001). A significantly greater number of ADHA members also reported that there was never a time when they did not use recommended PPE (X^2 , p=0.033). ADHA non-members reported a greater use of extra infection control precautions with HIV (X^2=12.271, p=0.002) and hepatitis (X^2=12.207, p=0.002) patients. Non-members were more likely to state they felt an increased personal risk when treating HIV patients (X^2=18.320, p<0.001) and altering infection control practices by double-gloving (X^2=11.028, p=0.001). When asked which source the respondent believed was a means for HIV transmission, a greater number of non-members responded that HIV could be transmitted through dental aerosols (X^2=4.244, p=0.039).

Table V. Chi-square Analysis of ADHA Members and Non-members Regarding Attitudes and Practices.

QUESTIONS		Member	Non-Member	χ^2	*p*-value*
Patients Wear Protective Eyewear During Treatment	Always/Often	37.5% (94)	24.5% (147)	17.837	<0.001
	Sometimes	37.8% (95)	39.2% (235)		
	Rarely/Never	24.7% (62)	36.3% (218)		
Pre-rinse Used Prior to Treatment	Always/Often	27.5% (69)	15.2% (91)	19.947	<0.001
	Sometimes	34.3% (86)	34.2% (205)		
	Rarely/Never	38.2% (96)	50.6% (303)		
Extra Infection Control Precautions with HIV/AIDS Patients	Always/Often	56.2% (136)	66.4% (395)	12.271	0.002
	Sometimes	7.9% (19)	9.6% (57)		
	Rarely/Never	36.0% (87)	24.0% (143)		
Extra Infection Control Precautions with Hepatitis Patients	Always/Often	51.8% (127)	63.5% (375)	12.207	0.002
	Sometimes	11.0% (27)	11.2% (66)		
	Rarely/Never	37.1% (91)	25.4% (150)		
Never a Time When PPE is Not Used	Yes	77.0% (187)	69.3% (407)	4.535	0.033
	No	23.0% (56)	30.7% (180)		
Treating HIV Patients Increases Personal Risk for Disease	Yes	42.3% (105)	58.8% (349)	18.320	<0.001
	No	57.7% (143)	41.2% (245)		
Double-Glove to Treat HIV Patients	Yes	29.3% (72)	41.8% (249)	11.028	0.001
	No	70.7% (174)	58.2% (347)		
HIV Transmitted Through Aerosols	Yes	25.1% (63)	32.5% (195)	4.244	0.039
	No	74.9% (188)	67.5% (405)		

*Significance level set at alpha <0.05.

Discussion

This study is the first national survey conducted of dental hygienists' infection control attitudes and practices. Questions in this survey were developed to gather new information, as well as traditional infection control data, in order to evaluate the current attitudes and practices of dental hygienists. As reported in previous studies, this study supports the conclusion that dental hygienists have embraced the infection control guidelines established by OSHA and CDC to prevent disease transmission. However, dental hygienists continue to feel the need to use additional infection control precautions and alter clinical practices when providing treatment for patients with HIV/AIDS and hepatitis.

Results from this survey are similar to previous studies that surveyed dental hygienists' infection control knowledge, attitudes and practices.[1,13-20] Respondents in this study expressed some of the same attitudes and practices that were described in previous studies dated as far back as 1980, thereby revealing more than two decades of unchanging attitudes and practices associated with infectious disease.[1-20] Persistent attitudes and practices among oral health care professionals may stem from their fear of contracting a disease that can alter and/or shorten life. These perceptions could also contribute to the clinical practice choices made by clinicians.

Previous studies addressed issues such as willingness to treat HIV patients and fears associated with treating this population; however, treatment and infection control alterations had not been explored. In a 1996 survey of Mississippi dental hygienists, 40% of respondents reported that HIV/AIDS patients were best treated in public clinics.[15] Results from this study show a decline in this attitude, with only 7.3% of respondents indicating that HIV/AIDS patients should be treated in public health clinics. This finding supports those of Cohen and Daniel, which show an increased willingness to treat individuals with HIV/AIDS and less desire to refer HIV/AIDS patients elsewhere for dental treatment.[3,15]

This study revealed that the majority of dental hygienists felt that being in the dental hygiene profession placed them at a higher risk for contracting infectious diseases. An even greater number believed that treating HIV/AIDS patients would increase their personal risk for contracting the disease. Respondents within this group were also more likely to report a need to alter infection control measures and practices. One respondent reported not wishing to see "these patients."

Blood is the single most important source of HIV transmission in the dental environment.[23-27] HIV may be transmitted by needle stick or injury with a contaminated instrument; however, the occurrence of such transfer is low.[24-28] A 1995 study reported that of 710 health care workers (HCW) who were percutaneously exposed to HIV, the risk of acquiring the disease was directly related to three factors: 1) deep tissue penetration into an artery or vein, 2) visible blood contamination on the instrument that caused the injury, and 3) a source patient in the terminal stages of AIDS.[25] To this date, there has been no evidence to support the transmission of HIV or hepatitis C through aerosols or saliva in the dental setting.[21,24-29]

Data from this study also reveal a conflict in the attitudes and practices of respondents. While the majority believe that HIV patients should be treated the same as others, most respondents in this study still admit an unwillingness to use the ultrasonic scaler and feel the need to double- glove and alter disinfection and sterilization practices when treating this population. Further results revealed that, although most clinicians in this study were using appropriate PPE and infection control measures, respondents still felt the need to use added precautions when treating HIV/AIDS and hepatitis patients, suggesting an uncertainty of universal/standard precautions in protecting against blood-borne diseases. Furthermore, respondents may have adopted certain practices, such as double-gloving, due to a learned or observed behavior from an educator or colleague. Future studies should inquire as to where or from whom these practices were learned. Some respondents may have incorporated their own standards due to a fear of contracting HIV.

Respondents chose dental aerosols, splash/spatter and saliva frequently as a means for HIV disease transmission. These findings are similar to those reported by Gershon et al.[2] and Gerbert.[6] Approximately 45% of dental hygienists surveyed in this study reported HIV transmission through saliva and 41% through splash/spatter, indicating an attitude that has survived even with the implementation of standard precautions. However, the most surprising percentage in this study were the 30 % of respondents who felt HIV could be transmitted through dental aerosols.

The new CDC guidelines recognize bacteria laden aerosols and recommend minimizing dental aerosols to reduce the potential for disease transmission.[21] Several studies have found bacteria and blood in aerosols produced during ultrasonic scaling and air polishing.[30-32] Use of PPE, such as gloves, mask, and protective eyewear, protect the clinician from skin and mucous membrane exposures. Since respondents from this study indicate uncertainty in how HIV is transmitted, this may explain the reluctance to use clinical devices that create aerosols, such as the ultrasonic scaler and air polisher.

Although the majority of dental hygienists surveyed felt it was "very important" or "important" to minimize dental aerosols, very few used the high-volume suction or aerosol reduction devices for the ultrasonic scaler or air polisher. Low use of the high-volume suction may occur because of difficulty in managing the suction without the benefit of a dental assistant during dental hygiene treatment. Dental hygienists are less likely to have a dental assistant to assist with minimizing dental aerosols. Several new products designed for the ultrasonic scaler and air polisher have been developed to minimize dental aerosols. Studies evaluating aerosol reduction devices have shown a significant decrease in the number of microorganisms generated during ultrasonic scaling and air polishing.[30-32] Very few dental hygienists surveyed reported use of and education on aerosol reduction devices, which indicates an area that may need to be addressed in dental hygiene curricula and continuing education courses.

Recent research reports suggest that use of a mouth rinse prior to treatment reduces the amount of bacteria present in the oral environment.[21,22] A surprisingly low percentage of dental hygienists surveyed reported always or often using a pre-procedural mouth rinse. Although pre-procedural mouth rinses are recommended, future studies should explore the reasons associated with non-use.

Results from this study show improvement over previous studies in compliance with OSHA guidelines regarding soiled work clothing. A 1991 survey of Pennsylvania dental hygienists reported 94% of respondents took or wore contaminated work clothing home, and 82% did not change soiled, contaminated clothing between patients.[13] A comparison with data

from this study shows a 44% and 58% decline in these practices. These findings suggest that more dentists are complying with OSHA guidelines by providing employees with laundry service or facilities. This study also showed an increase in respondents that changed soiled, contaminated clothing between patients.

Unlike previous studies of dental hygienists, this survey questioned respondents about dental unit waterlines. Although the majority reported being concerned about the quality of water coming from the dental unit, less than half reported using separate water reservoirs, filters, or chemical treatments to improve water quality. However, the majority of respondents did report beginning the day by flushing waterlines for two to three minutes. While most dental hygienists surveyed were concerned about dental unit water and waterlines, implementing the appropriate measures to improve water quality may not be possible due to equipment and supplies available in dental offices.

Data from this study show that of respondents who reported a percutaneous injury, the majority took no preventive measures. Those who reported more than one incident were also less likely to complete an incident report or have clinician or patient blood testing completed. These findings raise concern as to why recommended post-exposure measures are not being implemented in dental practices and may need to be evaluated in future studies. Further studies should also gather more information regarding the cause and details of percutaneous injuries reported by respondents.

Table V highlights the major infection control attitudes and practice differences between ADHA members and non-members. Results support the assumption that studies using a convenience sample, such as only ADHA members, may bias research results and limit inference to the general practicing dental hygiene population.[8] The sampling measures taken in this study were done to achieve a true representation of dental hygienists' infection control attitudes and practices across the United States. The difference between ADHA members and non-members may be due to members having greater access to research publications and continuing education programs through national, state, and local associations. Furthermore, results indicate that members of ADHA may be more knowledgeable about infectious disease transmission, thus decreasing the likelihood of feeling a need to alter clinical practices.

The limitations of this study are consistent with those found in survey research. Although this questionnaire was pre-tested and revised, misinterpretation of questions and a desire by the respondent to answer questions correctly cannot be controlled.

Conclusion

Data from this research reveal new and old attitudes and practices that may be affecting the level of care provided to those with infectious diseases. Therefore, it is crucial that dental and dental hygiene educators lead the way in changing attitudes and practices of future and currently practicing oral health care professionals. New graduates should be provided the most current scientific information and equipment to treat infectious disease patients. Students should also have multiple experiences in providing treatment for individuals with infectious diseases, such as HIV/AIDS or hepatitis. Education can be accomplished at all levels and is the first step in changing the attitudes and practice habits of oral health care professionals.

In conclusion, the findings from this study confirm that recommended infection control measures and personal protective equipment have been incorporated into the daily practice of most dental hygienists. However, the attitudes and practices reported by some respondents suggest a lack of understanding of the concept of standard precautions and the mode of transmission for HIV and hepatitis. This uncertainty may be the primary reason for alterations in clinical practices when treating infectious disease patients. Further results indicated that ADHA members were less likely to alter practices when treating infectious disease patients. These findings suggest that professional affiliation may have impacted the attitudes and practices of respondents possibly through exposure to current research in disease transmission. Therefore, education is an indispensable key to effecting change in the attitudes and practices of dental hygienists, whether treating infectious disease patients or treating patients with "unknown" disease.

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Notes

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North Carolina Dental Hygienists' Assessment of Patients' Tobacco and Alcohol Use

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Purpose. North Carolina is the 11th most populous state and ranks 14th among all states in the age-adjusted mortality rate for oral and pharyngeal cancer (OPC). This study assessed North Carolina dental hygienists' knowledge of tobacco and alcohol use as OPC risk factors, assessment practices of tobacco and alcohol use in patient medical histories, and opinions regarding tobacco and alcohol cessation education. Characteristics of dental hygienists who screen for tobacco and alcohol use in medical histories were also analyzed.

Methods. A 40-item survey was mailed to a simple random sample of 1,223 dental hygienists from a registry of 4,076 licensed in North Carolina. Data were included from 651 completed surveys, giving an effective response rate of 57%.

Results. Most respondents correctly identified tobacco and alcohol use as risk factors for OPC. A majority assessed patients' tobacco and alcohol use. Less than 10% assessed no tobacco factors, while nearly 42% assessed no alcohol factors. A number of background and practice characteristics were found to be positively associated with tobacco and alcohol screening in patient medical histories. A majority agreed or strongly agreed that dental hygienists should be trained to provide tobacco and alcohol cessation education to their patients; however, few felt trained to provide such education.

Conclusion. Improvements in knowledge regarding tobacco and alcohol use as OPC risk factors are needed. Future interventions might include educational programs for currently practicing dental hygienists and increased tobacco and alcohol cessation education in the professional entry-level dental hygiene curricula.

Keywords: Tobacco, tobacco use cessation, alcohol, dental hygienist, professional education, medical history, oral cancer

Introduction

Oral and pharyngeal cancer (OPC) is the 12th most common type of cancer in the world and accounts for approximately 3% of all cancers in the United States.[1,2] The most common form is squamous cell carcinoma, which accounts for 96% of all oral carcinomas.[3] Etiological factors include tobacco use, alcohol consumption, a diet poor in fresh fruits and vegetables, infective agents, immune deficiency, and exposure to sunlight (lip cancer).[4] The two major risk factors, the use of tobacco

and excessive alcohol consumption, combined are estimated to account for 75% of all cases in the United States.[5] Patterns and risks associated with tobacco and alcohol use have also been shown to account for nearly all of the observed racial differences in incidence and mortality rates.[6]

The age-adjusted (world standard) incidence rate for OPC was 8.1 per 100,000 population from 1995 to 1999, but it varied greatly according to race and sex.[7] In 2002, estimations of OPC were 28,900 new cases and 7,400 deaths in the United States.[8] North Carolina is the 11th most populous state and ranks 14th among all states in age-adjusted mortality rate for OPC.[8,9]

Preventable oral diseases compromise the health status of many Americans. Oral health care providers have the opportunity to become more involved in preventing or reducing the occurrence of these diseases. Dental hygienists, in particular, can serve as valuable resources for promotion of sustained oral health through prevention and early detection of oral cancer. The following research provides information about dental hygienists' assessment of tobacco and alcohol use in patient medical histories and is intended to help in the design of interventions to improve overall oral cancer control.

Review of the Literature

Many factors have been related to the development of OPC. Accepted modifiable behavioral risk factors for this disease include tobacco use, excessive alcohol consumption, over-exposure to the sun (for lip cancer), and a diet low in fruits and vegetables. In addition, a recent association of human papillomavirus with oral cancer has been established.[10] Some factors that have been erroneously associated with increasing oral cancer risk include hot foods and beverages, spicy foods, obesity, poor oral hygiene, poor fitting dentures, familial clustering, and family history.[11]

The strongest risk factor for oral cancer is the use of inhaled or smokeless tobacco and chewing substitutes that usually contain tobacco, such as pan masala or betel nut quid (common in some Middle and Far Eastern countries).[12] Risk associated with cigarette use, in particular, grows with increased consumption, and studies have shown that, for both men and women, increased tobacco use tends to increase oral cancer risk.[13-16] Tobacco smoking was found to be the leading risk factor for all of the cancers analyzed in one study, with both current and former use seen as harmful.[13] Another study concluded that a decrease in very high levels of cigarette and cigar smoking is key to overall oral cancer prevention.[14]

The results of a study involving 100 cases and 47,773 controls indicated tobacco chewing as a strong risk factor for erythroplakia.[15] Chewers who swallowed the tobacco fluid and chewers who kept the chewing tobacco in their mouths overnight both had higher risks for erythroplakia than chewers who did not swallow or orally store tobacco fluid. A dose-responsive relationship for the frequency of chewing tobacco with the risk of erythroplakia was seen. This study also indicated alcohol use as a strong risk factor for erythroplakia, showing a dose-responsive relationship for the frequency and duration of alcohol use with the risk of erythroplakia.[15]

Alcohol Consumption

Excessive alcohol use has been associated with oral cancer as a risk factor, and studies have shown that alcohol consumption may be involved in a multiplicative interaction with smoking.[16] Alcohol may possibly act as a solvent, allowing the carcinogens from tobacco to penetrate into the tissues, or it may act as a catalyst in metabolically activating tobacco carcinogens. Another possible mechanism is that alcohol lessens the protective effect of fruits and vegetables by decreasing the nutrient intake or absorption.[17]

There is indication that the relative risk for OPC in heavy consumers of both products exceeds the risks for abstainers up to 37-fold.[17] A study involving 195 female cases and 1,113 controls showed that an elevated consumption of both alcohol and tobacco produced an approximately 15-fold increased risk in OPC cases.[16] The study also indicated that oral cancer

is associated with alcohol drinking in those who never smoke and with tobacco smoking in non-drinkers.[16] Another study emphasized the findings of this study when former drinkers participating in the research showed a significant steady decline in oral cancer risk.[14]

A study involving 1,207 patients hospitalized for alcoholism found increased risk for oral, pharyngeal, esophageal, laryngeal, and lung cancer among alcoholics.[18] Most notable increases were observed for cancer of the hypopharynx, the mesopharynx (without appreciable differences between the tonsil and the anterior pillar), the floor of the mouth, and the base of the tongue. The results of this study support the hypothesis of a carcinogenic effect of alcohol involving direct contact with oral and pharyngeal mucosa.[18]

Public Perception and Awareness of Oral Cancer Risk Factors

Public awareness about the risk factors and methods of early detection of oral cancer is very low.[19] Being aware of the risk factors, early signs and symptoms, and common oral lesions can help both patients and health care providers detect lesions at their earliest stage. The fact that habits such as smoking and alcohol drinking cause oral cancer is well recognized in the medical community, but those who have the disease may not be as well informed. Ideally, patients should be informed, their risk factors modified, and the implemented changes reinforced by repetition and psychological support. Even if patients cannot reverse their habits, reductions may decrease their overall risk.[20]

A study involving three focus groups of male alcohol drinkers and tobacco smokers over the age of 44 set out to examine their perceptions and understanding of oral cancer.[21] There was common agreement among the participants on issues of general health. Fitness, diet, and lifestyle were regarded as important to both physical and psychological health, as was age. Smoking, alcohol drinking, and obesity all had unhealthy connotations. There was agreement on the inadvisability of smoking (about half of the participants smoked), although drinking was better tolerated. There was consensus on how little should be smoked, but no consensus on how much alcohol was safe.[21]

When the group discussions turned to diseases that might affect the mouth or throat, only thrush, foot and mouth disease, and colds were mentioned. Awareness of oral cancer was related to level of education, with more educated participants being better informed about the causes of oral cancer. Most of the men had not come across information regarding oral cancer and indicated that they would probably not seek advice about prevention unless they had personal experience of the disease.[21]

Role of the Dental Hygienist

Primary prevention through the avoidance or limitation of tobacco and alcohol use is the key to lowering the incidence of OPC. The elimination of all tobacco use is the single most important way to reduce the likelihood of the disease. Dental hygienists, in particular, are in a position to inform their patients and to make the public aware of the risk factors, signs, and ramifications of oral cancer.

Purpose and Objectives of the Study

Due to high OPC incidence and mortality rates in North Carolina, dental hygienists were surveyed about their knowledge of tobacco and alcohol use as OPC risk factors, assessment practices of tobacco and alcohol use in patient medical histories, and opinions regarding tobacco and alcohol cessation education. Information gathered from the study was projected to help obtain a good understanding of existing practices in dental offices across the state and to aid in the development of initiatives for promoting oral cancer prevention and early detection. This article will review North Carolina dental hygienists' knowledge of tobacco and alcohol use as risk factors for oral cancer, assessment practices of tobacco and alcohol use in patient medical histories, and opinions regarding the adequacy of their tobacco and alcohol cessation education abilities. Characteristics of dental hygienists who screen for tobacco and alcohol use in medical histories will also be discussed.

Methods and Materials

To address the aims of this study, data from the "North Carolina State Survey of Dental Hygienists: Oral Cancer" was analyzed. The survey was developed in part using the "Maryland Oral Cancer Survey of Dental Hygienists."[11] A list of names and addresses of all licensed dental hygienists in North Carolina (n = 4,076) was obtained from the North Carolina State Board of Dental Examiners. In November 2002, a piloted 40-item survey questionnaire, cover letter, and business reply envelope were mailed to a simple random sample of 1,223 North Carolina dental hygienists.

The chosen sample size represented approximately 30% of dental hygienists licensed in North Carolina at the time, and it was presumed to be large enough to provide accurate generalizations to the target population. Distribution of the randomly selected sample was as follows for each of the six geographic Health Service Areas of the state: 1. Western - 16.4%, 2. Piedmont - 18.3%, 3. Southern Piedmont - 22.2%, 4. Capitol - 17.7%, 5. Cardinal - 14.1%, and 6. Eastern - 11.4%. Inclusion criteria required respondents to be licensed to practice dental hygiene in North Carolina and to currently be providing clinical, educational, and/or referral services.

Two weeks after the initial mailing, a reminder/thank you postcard was sent to each dental hygienist and, approximately six weeks after the initial mailing, a second complete mailing was sent to all non-respondents with a revised letter stating the importance of the survey. Five respondents, randomly selected from a drawing, received a $25 gift certificate to a gourmet food store/mail order business as an incentive for participating in the study. Approval for this voluntary confidential survey was obtained from the Committee on Research Involving Human Subjects of the University of North Carolina School of Dentistry.

A total of 651 usable surveys were received, which represented an effective response rate of 57% of the 1,223 sampled dental hygienists who were eligible for the study. Descriptive analyses of the unweighted data were computed by calculating measures of central tendency and variation for the continuous variables and frequency tables for the categorical data. Bivariate and logistic regression modeling was performed with Statistical Analysis System (SAS) Software [Version 8.2, Cary, NC]. Analyses were evaluated using a standard alpha level $P<0.05$. Odds ratios and 95% confidence intervals were calculated to make comparisons of categorical variables within the sample group.

Results

Response Frequency and Sample Characteristics

Descriptive characteristics of the survey respondents are illustrated in Table I. Of the total respondents to the survey, 99% were female. Most of the respondents were between 31 and 50 years of age (65%). Graduation year from an entry-level dental hygiene program was almost evenly dispersed among the following year categories: 1995 to 2002 (30%), 1985 to 1994 (27%), and 1975 to 1984 (29%). The most frequently earned degree awarded upon graduation from an entry-level dental hygiene program was specified as an associate degree (88%), which was also most frequently reported as the highest degree ever obtained (72%). Nearly 60% of the respondents obtain continuing education through a professional organization. Of those respondents, a majority (58%) indicated being a member of one of two dental hygiene national organizations, the American Dental Hygienists' Association (ADHA) or the National Dental Hygienists' Association. The majority of the respondents indicated a general practice as their primary practice setting (83%). Distribution of the survey respondents across the six Health Service Areas in North Carolina closely resembled that of the randomly selected sample of practitioners in those areas.

Table I. Descriptive characteristics of dental hygienist survey respondents

Characteristics	Number	Percent
All respondents	651	100.0
Gender		
Female	625	99.7
Male	2	0.3
Age (years)		
<24	28	4.4
24-30	110	17.4
31-40	195	30.8
41-50	218	34.4
51-59	74	11.7
60-64	9	1.4
65+	0	0.0
Graduation year from entry-level dental hygiene program		
1995-2002	187	30.0
1985-1994	173	27.3
1975-1984	181	28.6
pre-1975	92	14.5
Degree awarded upon graduation from entry-level program		
Certificate in Dental Hygiene	45	7.1
Associate Degree in Dental Hygiene	510	87.5
Baccalaureate Degree in Dental Hygiene	79	12.5
Highest degree earned		
AA/AAS	413	72.2
BS/BA	135	23.6
Masters	16	2.8
Doctorate	2	0.3
Other	6	1.0
Membership of those who obtain CE through professional organizations		
American Dental Hygienists' Association	197	52.4
National Dental Hygienists' Association	22	5.9
American Public Health Association	8	2.1
American Association of Public Health Dentistry	5	1.3
American Dental Education Association	12	3.2
International Association for Dental Research	14	18.4
Other	69	21.1
Practice setting		
General practice	542	83.3
Specialty practice	39	6.0
Public health/government	21	3.2
Hospital	4	0.6
Other	33	5.1
North Carolina Health Service Area		
I – Western	107	16.4
II – Piedmont	129	19.8
III – Southern Piedmont	124	19.0
IV – Capital	125	19.2
V – Cardinal	95	14.6
VI – Eastern	70	10.8

Source: North Carolina State Survey of Dental Hygienists: Oral Cancer

Knowledge of Tobacco and Alcohol Use as Risk Factors for Oral Cancer

Most respondents correctly identified a history of tobacco (99.8%) and alcohol (86.5%) use as risk factors for disease. However, very few of the respondents knew that smokeless tobacco risk is less than that of cigarette use (15.3%). Smokeless tobacco lesions were thought to resolve with discontinued use by 41.8% of the respondents.

Assessment of Tobacco and Alcohol Use in Medical Histories

Table II demonstrates the percentage of dental hygienists assessing factors of tobacco and alcohol use in patient medical histories - past use, present use, and type and amount used. A high percentage of dental hygienists indicated that they assessed patients' present tobacco use (92%), but only 77% and 80% assessed patients' past tobacco use and type and amount used, respectively. A majority of the respondents reported assessment of patients' present alcohol use (55%) and only 41% and 31% assessed patients' past alcohol use and type and amount used, respectively. A majority of the respondents (67%) indicated that they evaluated all three factors of tobacco use in patient medical histories (past use, present use, and

type and amount used). However, only a small percentage reported evaluating all three factors of alcohol use (23%). Although fewer than 10% of the respondents reported assessing no tobacco factors, nearly 42% indicated that they did not assess any of the alcohol use factors when reviewing patient medical histories. As shown in Table III, more than half of the dental hygiene respondents specified that they evaluated present use of both tobacco and alcohol in patient medical histories (54%), but only 39% and 29% of the respondents indicated evaluating tobacco and alcohol past use and type and amount used, respectively. In addition, more dental hygienists screened for past tobacco use and present alcohol use (47%) than did dental hygienists who screened for past alcohol use and present tobacco use (40%).

Table II. Dental hygienists' assessment of tobacco and alcohol use

	Tobacco	Alcohol
Assess **past** use	76.5%	40.6%
Assess **present** use	91.5%	55.4%
Assess **type and amount** used	79.3%	30.5%
Assess none of the above	7.8%	41.2%

Table III. Overall patterns of tobacco and alcohol screening in medical histories (percentage of dental hygienists who assess each item)

	Tobacco Past Use	Tobacco Present Use	Tobacco Type/ amount Used
Alcohol Past Use	39.0%	39.7%	35.1%
Alcohol Present Use	46.8%	54.4%	47.1%
Alcohol Type/amount Used	26.9%	30.3%	29.5%

Bivariate Associations with Tobacco and Alcohol Risk Assessment

The extent to which dental hygienists assessed factors of alcohol and tobacco use (past use, present use, and type and amount used) in patient medical histories was calculated in relation to selected background and practice characteristics. Bivariate associations with tobacco and alcohol use screening are demonstrated in Table IV, along with corresponding *P* values. Eleven background characteristics were used: primary practice setting, age, year of graduation, entry- level dental hygiene degree received, typical volume of patients seen, majority age group of patients seen, belief that oral cancer knowledge is current, professional organization membership (ADHA members and non-members), continuing education gained through a professional organization (yes/no), interval since last continuing education course, and North Carolina Health Service Area of professional practice.

Table IV. Bivariate associations on three indices of the completeness of dental hygienists' screenings for tobacco and alcohol use in medical histories

	All 3 Tobacco Items	All 3 Alcohol Items	All 6 Tobacco & Alcohol Items
Practice Setting			
General practice	64.9 **	20.9 **	19.8 **
Other	78.4	34.7	34.7
Age (years)			
≤age 40	67.2	24.8	23.9
> age 40	66.9	21.2	20.0
Year of graduation			
1985-2002	68.7	24.4	23.6
before 1985	64.9	21.5	20.2
Entry level Dental Hygiene degree received			
Certificate	71.8	20.5	21.0
Associate	66.9	23.0	21.7
Baccalaureate	66.7	25.7	25.7
Volume of patients typically seen			
< 32 patients per week	68.4	28.3 *	27.3 *
≥ 32 patients per week	66.1	19.7	18.7
Majority age of patients seen (years)			
< age 65	66.5	21.9	20.7
≥ age 65	62.8	17.9	16.9
Belief that oral cancer knowledge is current			
High	72.8 **	31.9 ****	30.4 ****
Low	60.5	13.4	12.8
Membership			
American Dental Hygiene Association	73.4 *	28.6 *	27.9 *
Other	64.1	18.5	19.5
Obtain continuing education through professional organization	73.3 ****	26.6 *	25.6 *
Yes	58.5	18.5	17.4
No			
Interval since last oral cancer continuing education course			
Within the past year	74.8 **	32.1 *	31.6 *
During the past 2-5 years	70.6	23.5	22.5
More than 5 years ago	58.5	17.4	15.4
Never	50.8	12.3	10.7
Not attended (recent grad)	64.7	17.6	17.6
Don't know	54.6	18.2	18.2
North Carolina Health Service Area			
I – Western	67.3 *	16.7 *	16.8 *
II - Piedmont	60.3	18.1	15.8
III - Southern Piedmont	77.3	35.4	33.6
IV - Capital	57.0	28.9	22.1
V - Cardinal	68.1	19.8	19.8
VI – Eastern	75.0	25.0	25.4

* *P<0 .05*
** *P<0.01*
**** *P<0.0001*

Regarding complete assessment of all three tobacco items, six background characteristics were found to be positively associated: continuing education gained through a professional organization ($P<0.0001$), primary practice setting ($P<0.01$), belief that oral cancer knowledge is current ($P<0.01$), interval since last continuing education course ($P<0.01$), North Carolina Health Service Area ($P<0.01$), and ADHA membership ($P<0.05$). Regarding complete assessment of all three alcohol items, seven background characteristics were found to be positively associated: continuing education gained through a professional organization ($P<0.05$), primary practice setting ($P<0.01$), belief that oral cancer knowledge is current ($P<0.0001$), interval since last continuing education course ($P<0.05$), North Carolina Health Service Area ($P<0.05$), ADHA membership ($P<0.05$), and typical volume of patients seen ($P<0.05$). Regarding complete assessment of all six tobacco and alcohol items, the same background characteristics and significance levels associated with complete assessment of all three alcohol items were found to be positively associated in this case as well.

Multivariate Model of Factors Significantly Associated with Tobacco and Alcohol Risk Assessment

Table V provides a multivariate model of factors associated with tobacco and alcohol risk assessment using patient medical histories. Regarding the completeness of dental hygienists screening for tobacco and alcohol use in medical histories, only three background characteristics remained in the model and were found to be positively associated: dental hygienists' age (Wald $P=0.0291$), belief that their oral cancer knowledge is current (Wald $P<0.0001$), and North Carolina Health Service Area of practice (Wald $P=0.0072$).

Table V. Multivariate model of factors significantly associated with the completeness of dental hygienists' screening for tobacco and alcohol use in medical histories

Effect	Odds Ratio	95% Confidence Interval	Wald *P* Value
Age (years)			
≤ age 40	1.0	Reference	**0.0291**
> age 40	1.7	1.1 – 2.7	
Belief that oral cancer knowledge is current			
Low	1.0	Reference	**<0.0001**
High	3.7	2.3 – 6.0	
North Carolina Health Service Area			
VI - Eastern	1.0	Reference	**0.0072**
V - Cardinal	0.5	0.2 – 1.2	
IV - Capital	0.8	0.4 – 1.8	
III – Southern Piedmont	1.6	0.7 – 3.4	
II - Piedmont	0.5	0.2 – 1.1	
I - Western	0.5	0.2 – 1.2	

Opinions Regarding Adequacy of Tobacco and Alcohol Cessation Education

A majority of the respondents either agreed or strongly agreed that dental hygienists should be trained to provide tobacco and alcohol cessation education to their patients (81% and 63%, respectively). However, only a few of the respondents felt adequately trained to provide such education (36% and 16%, respectively).

Discussion

The response rate for this study was similar to the 60% response rate achieved in the "Maryland Oral Cancer Survey of Dental Hygienists."[11] The response rate obtained for this survey is, nonetheless, consistent with other surveys mailed to health practitioners.[23] Therefore, although the small sample size limits generalizations beyond the target population, the information gathered from the study can be very beneficial toward the development of initiatives for promoting oral cancer prevention and early detection in North Carolina. In addition, due to the random selection of dental hygienists in North Carolina, a representative sample of providers from each of the six Health Service Area was obtained. This allowed determination of relative regional assessment of the need to advocate interventions within specific practice areas in the state.

Although non-response bias can still be present, even with a suitable response rate,[24] we will acknowledge the likely effect of incomplete capture of data from all respondents. Namely, information gathered from this study most likely under-represents dental hygienists' lack of knowledge regarding OPC risk factors. It has been found that non-responders to postal questionnaire surveys are different from responders in relation to their overall well-being and behavior.[25-29] In this study, dental hygienists responding to the survey may have a higher level of oral cancer knowledge, a higher interest in oral cancer control and continuing education, better patient assessment practices, and more positive feelings about their training and patient education skills than those who failed to return completed surveys. Those not responding to the survey may have little knowledge and, therefore, are discouraged from submitting their responses; they may have very little interest in oral cancer control in their state, either because they have had inadequate OPC training or are not aware of the increasing threat of this disease in North Carolina; or they may not think their input is valuable and, therefore, do not desire to participate in professional activities or continuing education courses that could improve their awareness of oral cancer.

A relatively high percentage of dental hygienists correctly identified having a history of tobacco use as a true risk factor for OPC, and this knowledge was exhibited in their response regarding their conduct of tobacco use screening. However, only a small percentage of the respondents knew that smokeless tobacco risk is less than that of cigarette use and that lesions caused by smokeless tobacco typically resolve with discontinued use. This finding is similar to that reported among Maryland dental hygienists, where 98% correctly identified tobacco as a risk factor, and 79%, 94%, and 79% assessed past and present use, and type and amount of tobacco used.[11] In addition, only 10% of Maryland dental hygienists knew that cigarette use is a greater risk factor than use of smokeless tobacco for oral cancer, and 33% knew that smokeless tobacco lesions usually diminish when use of the product is discontinued.[11] Although a high percentage of dental hygienists

correctly identified a history of alcohol use as a real risk factor for disease, a smaller percentage of dental hygienists assessed all three factors of alcohol use than did those who assessed all three elements of tobacco use. Again, this finding is very similar to assessment practices found among Maryland dental hygienists.[11]

A number of background and practice characteristics were found to be positively associated with tobacco and alcohol screening in patient medical histories. Most significantly associated were the belief that oral cancer knowledge is current and obtaining continuing education through a professional organization, with high belief in their oral cancer knowledge being current subsequently found significant in the multivariate model. This finding suggests that oral cancer continuing education courses may contribute to better tobacco and alcohol risk assessment practices, or that having confidence in one's oral cancer knowledge lends to increased participation in oral cancer prevention efforts. Members of ADHA were significantly more likely to completely screen for all aspects of tobacco and alcohol use in medical histories than those who were not members. In addition, respondents who indicated they had received continuing education credit through a professional organization were significantly more likely to screen for all aspects of tobacco and alcohol risk.

Most interesting was the finding that dental hygienists who had either attended an oral cancer continuing education course within the past five years or who had never attended a continuing education course because they were recent graduates were significantly more likely to assess all aspects of tobacco and alcohol use, further establishing that continuing education increases awareness, motivates practitioners, and results in improved practices. It was interesting to note that dental hygienists who treated a typical patient volume of 32 or more patients per week were significantly less likely to screen for all three alcohol factors or all six tobacco and alcohol factors combined than were those who saw fewer patients. This finding is very discouraging as it suggests that most dental hygienists simply do not have time to adequately assess their patients for oral cancer risk factors. However, it at least provides some suggestion of where to begin our efforts to decrease the burden of oral cancer in this state.

Several suggestions could be made to assist in this prevention endeavor. The first suggestion would be to encourage dental offices across the state to allow more appointment time for dental hygienists to assess new patients and to determine if these patients participate in certain behaviors that might increase their predisposition to oral cancer. Secondly, dental offices might be encouraged to implement tobacco and alcohol cessation education in their office via one-on-one consultations with the dental hygiene professional. In addition, educational videos in the dental office might be a tool to increase the dissemination of information to all patients in the practice. In this way, dental hygienists would be communicating to patients that they care about their oral and general health and, in turn, patients might begin to ask more questions about oral cancer and methods to prevent disease.

Significant differences were evident across the six Health Service Areas in North Carolina with regards to medical history assessment of tobacco and alcohol use as OPC risk factors. Providers in the Southern Piedmont region were notably more likely to completely assess patients for all factors of tobacco and alcohol use in medical histories than were providers in other regions. This finding suggests that it might be beneficial to examine the specific reason why dental hygienists practicing in the Southern Piedmont region tend to have better patient assessment practices. This examination might include looking at regional community college dental hygiene program curricula, public programs available, and/or patient awareness of oral cancer in this region.

Regarding opinions relating to tobacco and alcohol cessation education, a majority of the respondents felt that dental hygienists should be trained to provide tobacco and alcohol cessation education to their patients. However, only a few felt adequately trained to provide such education. This finding is consistent with that found in Maryland, where only 32% of dental hygienists felt they were adequately trained to provide tobacco cessation services and only 13% for alcohol cessation.[11]

The information revealed by this survey provides only a brief synopsis of the status of North Carolina dental hygienists' knowledge of tobacco and alcohol use as risk factors for OPC, their assessment practices of tobacco and alcohol use in patient medical histories, and their opinions regarding the adequacy of their training as it relates to tobacco and alcohol cessation patient education. However, it does offer a rationale for implementing oral cancer education programs that include tobacco and alcohol use assessment and cessation training in both the dental hygiene curricula as well as for continuing education courses for existing providers.

Conclusion

In beginning to implement oral cancer education initiatives, it is important to target areas where OPC has increasing incidence. This study explored potential professional practice deficits that may have indirectly contributed to the high incidence of OPC in North Carolina.[9] Dental hygienists nationally have been called upon to increase their tobacco use knowledge and their efforts toward preventing adolescent tobacco use onset and assisting adults in cessation efforts. Acknowledging and addressing deficiencies in assessment practices for tobacco and alcohol control may be the first step in facilitating oral cancer control. Future interventions might include educational programs for currently practicing hygienists and increased tobacco and alcohol cessation education in dental hygiene curricula. All health care providers must participate in risk reduction and early detection efforts. North Carolina dental hygienists have an excellent opportunity to assist in this worthwhile endeavor and to serve as effective resources for oral health promotion.

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Notes

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A Dental Hygiene Professional Practice Index (DHPPI) and Access to Oral Health Status and Service Use in the United States

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Purpose. The purpose of this article is to summarize a larger study that developed a statistical index that defines the professional practice environment of dental hygienists (DHs) in the United States, and to determine the extent to which the index scores are related to the number of DHs and dentists, the utilization of dental services, and selected oral health outcomes across the 50 states.

Methods. A Dental Hygiene Professional Practice Index (DHPPI) defines the professional status, supervision requirements, tasks permitted, and reimbursement options for DHs in each of the 50 states and the District of Columbia, as of December 31, 2001. Spearman rank order correlations between the DHPPI and numbers of oral health professionals, utilization of oral health services, and oral health outcomes in the 50 states are also presented.

Results. The analyses revealed that:

- There are significant differences in the legal practice environments (as reflected in the DHPPI) across the 50 states and the District of Columbia.

- Between 1990 and 2001, the number of DHs per capita increased by 46% in the United States, while the number of dentists per 100,000 population increased by only 10%.

- The DHPPI was not significantly correlated with the number of DHs or dentists in the 50 states in 2001.

- The DHPPI was significantly positively correlated with the salaries of DHs in 2001.

- The DHPPI was also significantly and positively correlated with a number of indicators of utilization of oral health services and oral health outcomes.

Conclusions. Both access to oral health services and oral health outcomes are positively correlated with the DHPPI. This suggests that states with low DHPPI scores would be logical candidates for revised DH practice statutes and regulations to accomplish these objectives.

Keywords: Scope of practice, dental hygiene, oral health outcomes, access to oral health services

Introduction

A major study of the legal scope of practice of dental hygienists (DHs) in the 50 states and the District of Columbia was conducted in 2002 and 2003. This article summarizes the key findings from the full report prepared as part of that study[1], and presents some conclusions for consideration by planners and policy makers interested in the evolving roles and responsibilities of DHs in the United States.

DHs played a much greater role in the oral health system in 2000 than they did a decade earlier. Some of the increase in roles and responsibilities was numerical, reflecting the significant increase in the number of DHs, from around 72,000 in 1990 to more than 120,000 in 2001 (Table I)[2, 3, 4]. As important as was the growing number of DHs across the 50 states, much of the expansion in roles and responsibilities of DHs was qualitative, reflecting the increasing involvement of DHs in providing preventive and restorative oral health services. The contributions of DHs to both quality of care and access to care-and their potential for even greater contributions in the future-did not go unnoticed in state legislatures and governors' offices. Over the past decade, virtually every state expanded the legal scope of practice of DHs. DH roles, which were historically rooted in preventive care, have been slowly expanding into a variety of basic restorative services, stimulated in part by government and private initiatives to increase access to care for underserved population groups[5].

Table I. Dental Hygienists and Dentists per 100,000 Population, by State, Selected Years

	DHs per 100K Pop			Percent Change		DDS/100K			DH '01:
State	1980	1990	2001	'80 - '90	'90 - '01	1987	1998	% Chg	DDS '98
Alabama	29.5	30.7	54.1	4.0%	76.4%	36.7	38.2	4.0%	1.42
Alaska	21.4	36.5	54.7	70.8%	49.8%	52.5	67.6	28.8%	0.81
Arizona	19.6	27.5	33.3	40.6%	21.1%	45.6	39.3	-13.9%	0.85
Arkansas	11.9	21.9	35.8	83.5%	63.4%	37.4	36.6	-2.2%	0.98
California	20.5	26.5	31.9	28.8%	20.6%	56.6	58.4	3.3%	0.55
Colorado	23.6	32.1	46.7	36.3%	45.3%	63.7	58.6	-8.0%	0.80
Connecticut	32.4	46.1	61.6	42.0%	33.8%	72.6	68.9	-5.1%	0.89
Delaware	35.5	48.0	57.6	35.2%	19.9%	41.8	41.3	-1.1%	1.39
District of Columbia	6.1	16.5	24.2	169.5%	47.0%	75.5	100.2	32.7%	0.24
Florida	23.3	30.5	44.1	31.2%	44.4%	46.1	43.8	-4.8%	1.01
Georgia	26.5	33.4	40.9	25.9%	22.4%	41.4	37.9	-8.5%	1.08
Hawaii	15.5	20.2	24.8	30.0%	22.6%	72.8	74.9	2.9%	0.33
Idaho	14.3	26.5	47.9	85.5%	80.7%	50.1	47.3	-5.5%	1.01
Illinois	16.0	26.4	37.3	65.1%	41.4%	57.0	58.5	2.8%	0.64
Indiana	15.8	26.8	40.2	69.9%	49.7%	43.7	42.7	-2.2%	0.94
Iowa	13.8	25.5	36.8	85.3%	44.5%	50.3	49.2	-2.3%	0.75
Kansas	16.6	24.6	42.7	48.1%	73.3%	46.7	45.3	-3.0%	0.94
Kentucky	11.7	15.3	31.9	30.7%	109.0%	47.2	48.1	1.9%	0.66
Louisiana	12.4	16.4	27.6	31.7%	68.7%	41.2	42.2	2.5%	0.65
Maine	30.9	38.3	63.6	23.7%	66.0%	44.5	45.1	1.4%	1.41
Maryland	21.0	29.1	53.1	38.5%	82.4%	58.6	63.3	8.0%	0.84
Massachusetts	35.4	41.8	63.4	18.2%	51.5%	66.4	65.9	-0.7%	0.96
Michigan	26.4	42.8	64.4	61.9%	50.6%	57.1	53.4	-6.5%	1.21
Minnesota	27.2	42.9	55.7	57.7%	29.8%	61.2	55.4	-9.5%	1.01
Mississippi	6.9	19.0	23.0	174.3%	20.6%	32.8	34.2	4.1%	0.67
Missouri	10.8	14.9	27.6	38.6%	84.9%	48.4	44.4	-8.3%	0.62
Montana	19.3	18.3	17.1	-5.4%	-6.3%	57.4	49.8	-13.3%	0.34
Nebraska	16.6	20.6	37.5	23.9%	82.1%	54.6	57.3	4.9%	0.65
Nevada	7.0	32.0	37.2	356.4%	16.4%	43.9	32.5	-26.0%	1.14
New Hampshire	21.4	58.9	63.6	175.2%	8.1%	55.7	52.2	-6.2%	1.22
New Jersey	19.4	32.7	41.4	68.2%	26.8%	66.8	67.1	0.5%	0.62
New Mexico	14.0	22.4	37.1	60.2%	66.0%	39.2	36.6	-6.7%	1.02
New York	25.0	32.2	35.6	28.7%	10.8%	71.0	66.1	-6.9%	0.54
North Carolina	24.9	29.9	51.9	20.2%	73.6%	37.4	36.9	-1.2%	1.41
North Dakota	13.9	39.1	54.8	180.8%	40.0%	44.6	46.0	3.1%	1.19
Ohio	20.1	30.8	53.1	53.4%	72.7%	50.6	48.1	-4.8%	1.10
Oklahoma	13.2	19.9	32.2	50.6%	62.3%	41.8	43.4	3.9%	0.74
Oregon	24.3	42.2	74.6	73.3%	76.9%	63.8	58.4	-8.6%	1.28
Pennsylvania	18.0	25.0	43.6	38.5%	74.2%	56.5	56.7	0.5%	0.77
Rhode Island	25.3	35.6	54.0	40.4%	51.7%	51.8	51.0	-1.6%	1.06
South Carolina	16.6	25.6	35.8	54.4%	39.9%	36.9	38.6	4.7%	0.93
South Dakota	11.7	18.2	38.7	55.7%	111.8%	43.4	43.6	0.4%	0.89
Tennessee	15.7	30.7	37.3	95.6%	21.7%	48.5	44.6	-8.1%	0.84
Texas	15.9	22.0	37.1	38.9%	68.3%	42.6	40.5	-5.0%	0.92
Utah	9.4	16.1	32.1	70.2%	99.8%	62.5	52.8	-15.6%	0.61
Vermont	46.6	40.0	88.7	-14.2%	122.0%	53.9	54.3	0.9%	1.63
Virginia	14.0	23.6	35.6	68.0%	51.0%	47.8	49.9	4.5%	0.71
Washington	28.7	41.1	57.7	43.4%	40.5%	61.4	56.3	-8.3%	1.03
West Virginia	19.2	27.7	45.0	43.8%	62.8%	38.6	41.1	6.6%	1.09
Wisconsin	25.9	35.3	58.6	36.2%	66.2%	60.4	52.6	-12.9%	1.11
Wyoming	20.9	15.9	22.9	-23.9%	44.1%	50.3	46.8	-6.9%	0.49
US	**20.4**	**29.1**	**42.4**	**42.8%**	**45.6%**	**46.6**	**51.4**	**10.4%**	**0.82**

Sources: ADHA, 2002; ARF; US Bureau of Census

This expansion of the legal scope of practice was the subject of the larger study summarized herein. The larger study:

- created a Dental Hygiene Professional Practice Index (DHPPI) based on statutes and regulations for 2001;

- compiled a variety of statistics about DHs in the United States and several indicators of the oral health status of Americans and their access to oral health services; and

- performed a variety of statistical analyses to assess the extent to which the DHPPI is related to number of practicing DHs, number of practicing dentists, a number of oral health status indicators, and access to care for the underserved in the 50 states.

The DHPPI

To help planners and policy makers understand the extent of practice possibilities for DHs in each of the 50 states, a DHPPI was developed that assigned points for various practice options and possibilities deemed important by an advisory committee comprised of practitioners, researchers, educators, and regulators. The criteria in the index for 2001 were selected to represent the characteristics of an "ideal" professional practice for DHs, based on conversations with representatives of the ADHA in early 2002. By strictly applying the scoring rules for each of the criteria to the statutes and regulations in each state, the resulting index provides a basis for comparing the legal scope of practice across all states.

Once the index was developed and scored, the resulting DHPPI scores were subjected to an extensive review process. Drafts of the detailed state-level scoring protocols and the overall rankings for all 50 states were made available to interested parties in many of the 50 states. This review was accomplished with the assistance of the American Dental Hygienists' Association (ADHA), which provided access to state DH planning groups at the ADHA annual meeting in June 2002. This review process led to a number of modifications to the index and resulted in the final index scores summarized below.

The DHPPI has four broad components (regulation, supervision, tasks permitted, and reimbursement), which reflect the ways in which DHs can practice. Scores were determined only by options and restrictions found in legislation or regulation; variations in actual practice not supported by statutes or regulations were not considered. Higher scores on the DHPPI are generally associated with broader sets of tasks, more autonomous practice environments (i.e., less direct oversight by dentists), and greater opportunities for direct reimbursement for services.

DHPPI 2001 State Scores

Table II presents the DHPPI for the 50 states and the District of Columbia as of 2001. As with many such indices, the differences in professional practice that underlie small differences in the DHPPI scores are also small. Thus, states that are close on the indices are generally similar in their legal scopes of practice. The DHPPI ratings of "Excellent," "Favorable," "Acceptable," "Limiting," and "Restrictive" in Table II were added to help readers characterize the practice environments in the different states in a more qualitative way. Although assignment of states to the five categories was subjective, these categories generally conform to objective characterizations of the practice environments in states as revealed in the field review process of the study.

Table II
Dental Hygiene Professional Practice Index, 2001
Index Components by State

	DHPPI Component					
State	**Regs**	**Sup**	**Tasks**	**Reimb**	**Total**	**DHPPI**
Maximum Score	**10**	**47**	**28**	**15**	**100**	**Rating**
Colorado	9	47	26	15	97	
Washington	10	45	26	15	96	
Oregon	10	41	22	15	88	**Excellent**
California	8	37	26	15	86	
New Mexico	10	37	24	15	86	
Connecticut	9	33	18	15	75	
Missouri	8	29	22	15	74	
Nevada	9	36	20	0	65	
Minnesota	8	36	20	0	64	**Favorable**
Maine	8	30	18	0	56	
Utah	7	21	20	5	53	
New York	9	23	18	0	50	
Arizona	6	21	18	0	45	
Idaho	7	18	20	0	45	
South Carolina	8	21	16	0	45	
Nebraska	7	21	16	0	44	
Wisconsin	7	21	16	0	44	**Satisfactory**
Pennsylvania	8	18	16	0	42	
South Dakota	6	16	20	0	42	
Louisiana	8	15	18	0	41	
Montana	9	16	16	0	41	
Texas	8	23	10	0	41	
Kansas	7	14	18	0	39	
New Hampshire	9	16	14	0	39	
Tennessee	7	14	18	0	39	
Vermont	9	16	14	0	39	
Ohio	6	16	16	0	38	
Indiana	8	19	10	0	37	
New Jersey	6	15	16	0	37	
Iowa	8	10	18	0	36	
Illinois	7	11	18	0	36	
Maryland	10	16	10	0	36	
Alaska	9	12	14	0	35	**Limiting**
Michigan	7	18	10	0	35	
Massachussetts	6	16	12	0	34	
Wyoming	4	14	16	0	34	
Florida	6	21	6	0	33	
Rhode Island	7	16	10	0	33	
District of Columbia	6	16	10	0	32	
Delaware	8	16	8	0	32	
Hawaii	5	11	16	0	32	
North Dakota	6	16	10	0	32	
Oklahoma	6	7	18	0	31	
North Carolina	6	9	14	0	29	
Arkansas	6	5	16	0	27	
Georgia	8	9	6	0	23	
Alabama	6	12	0	0	18	**Restrictive**
Kentucky	6	8	4	0	18	
Virginia	7	8	2	0	17	
Mississippi	6	7	2	0	15	
West Virginia	6	2	2	0	10	

Relationships Between DHPPI and Other Factors

The relationships between the DHPPI, numbers of DHs, and numbers of dentists helps to understand the practice environment for DHs in the US. Three different analyses are summarized below.

Table III shows the Spearman rank order correlations between the DHPPI and the numbers of dentists per capita in 2001 and the number of DHs per capita across the 50 states and the District of Columbia in 2001. These correlations provide insights about the relationship between the professional practice environments for DHs and the relative supply of dentists and DHs.

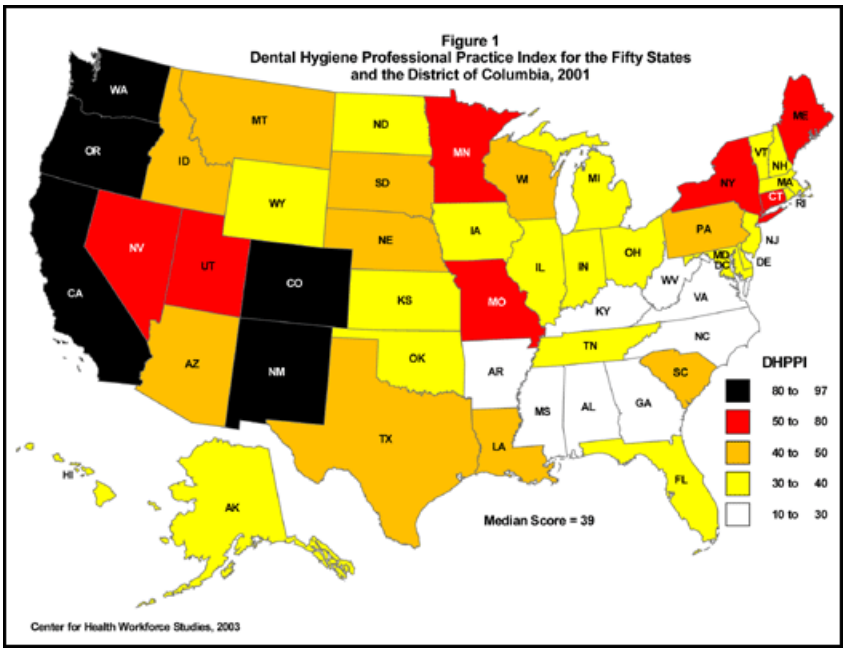
Table III. Relationship Between the 2001 DHPPI and the Supply of Oral Health Professionals

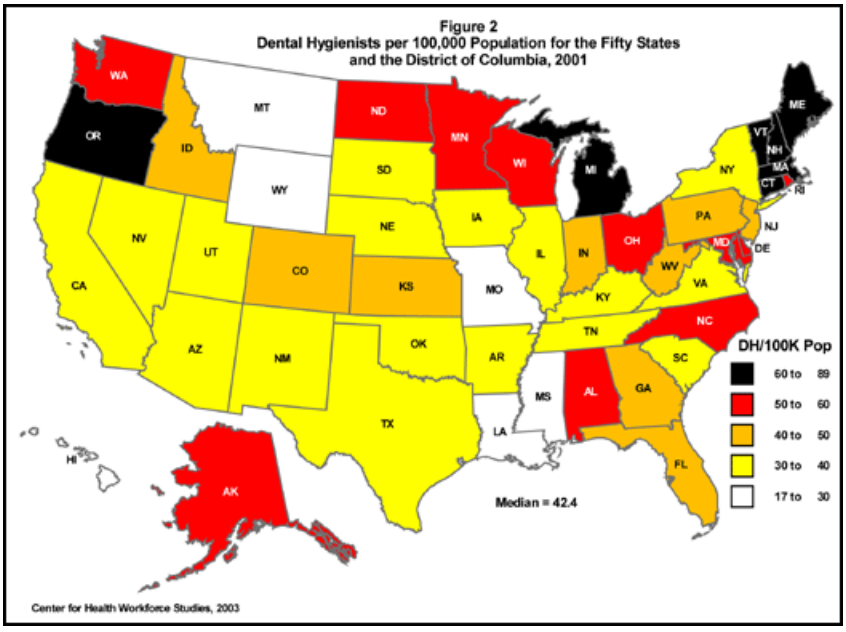
Dentists per capita, 2001	+0.13 (p=0.365)
Dental Hygienists per capita, 2001	+0.13 (p=0.355)

The Spearman rank order correlation between the DHPPI and numbers of DHs per 100,000 populations in 2001 is positive, but not statistically significant (Spearman's Rho = +0.13, p = 0.355). This indicates that states with more favorable practice environments for DHs (as measured by the DHPPI) show only slight tendencies to have more DHs per capita and more dentists per capita.

The correlation between the DHPPI and the ratio of DHs to dentists is also not statistically significant (Spearman's Rho = -0.038, p = 0.79). This suggests that the numbers of DHs are generally determined not by the legal practice environment of DHs, but rather by such factors as practice structures of dentists and demand for preventive oral health services.

The data also reveal some interesting geographic patterns. Figure 1 shows that states in the West have generally given DHs more autonomy in their practices (as indicated by the DHPPI) than have states in the Southeast. Figure 2, based on data in Table I, reveals relatively higher penetration of DHs in the Northeast and relatively lower penetration in the Southwest and Northern Plains.





The correlation of DHs per 100,000 population in 2001 with dentists per 100,000 population in 2001 is also positive, but not statistically significant (Spearman's Rho = +0.212, p = 0.136). This suggests that the numbers of DHs per capita are not driven by the number of dentists per capita, which suggests that dentists' hiring of DHs does not follow a consistent pattern across the states.

Other Findings of Interest

To test the hypothesis that DH salaries are higher in states with broader professional practice for DHs (as indicated by the DHPPI), Spearman rank order correlations were computed between the 2001 DHPPI and median hourly, mean hourly, and mean annual salaries for DHs in 2001. The positive and statistically significant correlations shown in Table IV confirm this hypothesis. This indicates clearly that DH salaries are higher in states that permit broader sets of tasks, have less restrictive supervision requirements, and have greater opportunities for direct reimbursement, although the precise mechanism of this relationship cannot be determined from these data.

Table IV. Relationship Between the 2001 DHPPI and Salaries of Dental Hygienists in 2001

Dental hygienist median hourly salary, 2001	+0.57 **
Dental hygienist mean hourly salary, 2001	+0.60 **
Dental hygienist mean annual salary, 2001	+0.66 **

** = p < 0.01

A second hypothesis tested in the study is that the DHPPI is positively correlated with the use of dental services by the general state populations because services are more widely available. A third hypothesis is that DHPPI scores are positively correlated with indicators of oral health outcomes in the population. Table V confirms both of these hypotheses using state-level estimates of dental service use and oral health outcomes constructed from the Behavior Risk Factor Surveillance System (BRFSS) survey[6]. The table shows that states with higher DHPPI scores tend to have smaller percentages of the population not visiting a dentist in the past year, smaller percentages of the population with teeth removed due to tooth decay or gum disease, and larger percentages of the population with *no* teeth removed due to tooth decay or gum disease. The p-values for all these statistical tests are less than 0.05.

Table V. Relationship Between the 2001 DHPPI and Several Measures of Access to Care and Extent of Oral Health Problems

% not visiting a dentist in the past year due to no reason to go	-0.29 *
% having 1 to 5 permanent teeth removed due to tooth decay or gum disease	-0.38 **
% having 6 or more, but not all, teeth removed due to tooth decay / gum disease	-0.52 **
% having all teeth removed due to tooth decay or gum disease	-0.39 **
% having no teeth removed due to tooth decay or gum disease	+0.49 **

* = $p < 0.05$
** = $p < 0.01$

Moreover, although not statistically significant, the DHPPI was positively correlated with the percent having their teeth cleaned by a dentist or DH within the past year and negatively associated with the percent having their teeth cleaned by a dentist or a DH further back in time (one to two years ago, two to five years ago, or never).

Unfortunately, it was not possible with existing data resources to confirm statistically that states with higher DHPPI scores offered greater access to dental services for underserved populations. Data do not exist for all 50 states that identify dental and DH practice locations, visits to dentists, utilization of dental services, and oral health outcomes in dental shortage areas. However, field work conducted as part of the larger study on which this article is based did reveal anecdotally that this is true. Until it is possible to locate individual DHs and dentists in dental shortage areas and isolate the services these practitioners provide in data systems like the Medical Expenditures Panel Survey (MEPS) and BRFSS, policy makers must be satisfied with anecdotal evidence about access to services in underserved areas.

Key Findings and Conclusions

Although it is not possible to establish causal relationships based on the analyses reported in this article, a number of general findings and conclusions about DHs and the DHPPI are justified by the results presented above.

- The number of DHs increased much faster than did the number of dentists in most states throughout the 1990s.

- There are substantial differences in the legal practice environments (as reflected in the DHPPI) across the 50 states and the District of Columbia.

- The DHPPI was *not* significantly correlated with the numbers of DHs per capita or dentists per capita across the 50 states and the District of Columbia as of 2001.

- The DHPPI was significantly positively correlated with the salaries of DHs as of 2001, indicating that DH salaries were higher in states permitting DHs more tasks and more professional autonomy.

- The DHPPI was also significantly correlated with a number of indicators of utilization of oral health services and oral health outcomes.

Despite the progress made in both numbers and professional practice of DHs across the United States, more can be done to increase the impact of these professionals on improved access and quality of care and reduced costs of care. In particular, more effort should be put into aligning DH professional practice with demonstrated DH clinical skills and competencies.[7] This alignment would promote greater autonomy for DHs in clinical situations in which they are competent to act/practice, and it would promote better access to basic preventive care in many geographic areas that cannot economically sustain the practice of a dentist, but could sustain the practice of a dental hygienist.

Discussion

Access to oral health services is widely recognized to be an important public health issue in the United States.[8] The research summarized above has shown that the professional practice environment for DHs (as measured by the DHPPI) is positively correlated with both utilization of dental services and oral health outcomes across the 50 states and the District of Columbia.

Is there enough evidence to justify a recommendation that states modify their practice environments in order to achieve oral health outcomes? While the current study does not confirm a causal relationship between legal practice environment and access to oral health services, studies in two states support an affirmative answer to this question. Studies in California and Colorado, both of which were demonstration projects to assess the impact of greater autonomy for DHs, have revealed that:

- Patients in California's Health Manpower Pilot Project (HMPP) 139 were generally satisfied with services provided by DHs in unsupervised practices. The researchers concluded that "independent practice by DHs provided access to dental hygiene care and encouraged visits to the dentist."[9]

- Both structural and procedural aspects of unsupervised DH practices in the California HMPP 139 demonstration were generally acceptable to patients, with 98% of DH patients expressing satisfaction with their care. In most structural aspects, the care of patients surpassed that in traditional dental practices. The researchers concluded that "independent DH practice did not increase the risk to the health and safety of the public."[10] A study of six independent DH practices in Colorado reached the same conclusion.[11]

- Patients in unsupervised DH practices in the California HMPP 139 demonstration were more likely to have low incomes and to be non-white than patients in traditional dental practices. In addition, the independent DH practices were able to attract new patients. The researchers concluded that if an independent DH practice can attract sufficient patients, the practice may be a viable alternative to traditional dental practices. They also stated that "an independent [DH] practice might increase access to care, contain fees, and direct the flow of patients to dentists."[12] Other options for less restrictive practice models have been tried in a number of states, all of which appear to have improved access to care for one or another underserved population group.[13]

The findings of this study, when taken in conjunction with the findings based on the study of the California and Colorado initiatives, suggest that expanding the professional practice environment of DHs can improve access to oral health services, utilization of oral health services, and oral health outcomes. The time would appear right for careful studies in other states to confirm this conclusion.

Conclusion

Although the ADHA and others continually monitor changes in dental practice acts affecting DH practice in the 50 states and the District of Columbia, the DHPPI described above is the first attempt to create a single standard index that summarizes multiple aspects of professional practice that permits comparisons across states. The DHPPI offers policy makers an easy way to identify significant differences in practice environments for DHs in different states. The fact that statistical correlations exist between the DHPPI and several indicators of access to dental care, utilization of dental services, and oral health outcomes suggests that the index may provide valuable insights to planners and policy makers concerned about improving access to oral health care in the U.S. There are interesting opportunities for more sophisticated statistical analyses using multi-variable techniques to help understand some of the relationships revealed in this preliminary study.

The findings suggest that increasing the legal scope of practice of DHs and expanding opportunities for independent DH practice offer real opportunities to extend access to cost-effective DH services to low-income, non-white populations, with no health and safety risks to the public.

Defining and Applying the DHPPI

To create the DHPPI described in this article, researchers established strict criteria that were rigorously applied in the scoring process. The researchers were concerned about the accuracy and reproducibility of the reported index scores, but not about whether a particular state earned a high or low score.

The DHPPI had four broad components, each addressing a different aspect of the legal practice environment for DHs in the 50 states and the District of Columbia.

- Regulations has four components (type of oversight board, licensure by credential/endorsement, scope of practice defined in law or regulation, and lack of restriction to patients of record of primary employing dentist), with a maximum total score of 10 points.

- Supervision has 10 components (highest level of supervision in state laws and regulations, supervision requirements in dentist offices, long-term care facilities, schools, public health agencies, correctional facilities, mental health facilities, hospitals, and home settings, and no limits on settings allowed for practice by DHs), with a maximum total score of 47 points.

- Tasks Permitted has 13 components (prophylaxis - physical presence of dentist not required (PPDNR), fluoride treatment - PPDNR, sealant application - PPDNR, X-rays - PPDNR, place amalgam restorations, administer local anesthesia, administer nitrous oxide, DH allowed to perform initial screening, DH allowed to refer patient, DH may be self-employed other than as independent contractor, DH may supervise a dental assistant, DH may be supervised by a medical provider, and expanded functions available in state), with a maximum total score of 28 points.

- Reimbursement has two components (Medicaid reimbursement directly to DHs, and DH may be paid directly for services), with a maximum total score of 15 points.

A score was awarded or withheld for a component of the index only if it was explicitly permitted, stated, or prohibited in state statute or regulation. Actual practice conditions, if different from statutory or regulatory requirements, were not used as the basis for the indices because project staff had no basis for knowing about all the subtle variations in practice traditions and mores in different states.

All index scores represent legal standards in effect or passed as of December 31, 2001. Changes in statutes or regulations after that date were not scored, although many are noted in the full report. The actual scores assigned to the states for each component of the index can be found in the full study report.[1]

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Notes

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Should Dental Hygienists Replace Dental Directors in Screening High-Needs Children?

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Purpose. The purpose of this research was to determine whether dental hygienists are as effective as dental directors in screening high-needs children who require emergency care.

Methods. In 2000, the Community Dentistry Health Services Research Unit (CDHSRU) at the University of Toronto completed a prospective cohort study to determine whether care proposed by dental directors exposed to evidence-based practices was significantly different from the care provided by dental hygienists who screened children enrolled in the provincially mandated Children in Need of Treatment (CINOT) program.

Results. The dental directors and dental hygienists each prepared a treatment plan for the 71 children enrolled in this study. These plans were analyzed using a paired t-test model after being translated into relative value units (RVU). It was determined that there was no statistically significant difference between the overall dental treatment proposed by the dental hygienists and the treatment proposed by the dental directors (p=.749). A similar analysis stratified by subject site and by service type also showed no significant differences.

Conclusions. The results suggest that dental hygienists are equally as effective as dental directors in screening high-needs children and may be capable of assuming the role of first point of contact for children within high-need dental programs.

Keywords: Screening, high-need patients, emergency care, children, CINOT, dental hygienists, public health, dentistry

Introduction

Public health dental hygienists (henceforth referred to as PHDH) are an integral part of the dental screening programs in Ontario schools. As part of the Province's Health Promotion and Protection Act, Public Health Units (PHUs) are mandated to screen all junior and senior kindergarten entrants (five- and six-year-olds), as well as provide screening in high-need elementary schools and at the PHU itself.

While the general screening is performed by a licensed PHDH and a certified dental assistant, screening to determine the eligibility of a high-need child for treatment under the Children in Need of Treatment (CINOT) program is the responsibility of the PHU dental director. This is a resource-intensive responsibility often held by one person within each PHU.

Review of the Literature

There is limited but encouraging evidence in the literature that dental hygienists can be as effective as dentists in screening patients. In Sweden, where dental hygienists are licensed to practice independently, a study comparing dental hygienists' capabilities at diagnosing dental decay relative to dentists' showed that there was no significant difference in the identification and recording of dental decay, with the exception of initial lesions, which were identified more frequently by the dental hygienists.[1] A US study also demonstrated that dentists and dental hygienists had good inter-examiner reliability when screening for dental caries among children in the first and fifth grades.[2]

A 2000 Swedish study in a nursing home setting also showed that there was "acceptable" inter-examiner agreement between dentists and dental hygienists.[3] The authors noted that the difference was often due to a dental hygienist's propensity to err on the side of caution, thereby over-reporting oral conditions as compared to dentists.

Conversely, a British study measuring the validity of having dental hygienists perform school screenings following a standard training program showed that the dental hygienists did not achieve the required levels of sensitivity and specificity. The authors concluded that this training was insufficient for the dental hygienists.[4]

The limited evidence provided by the literature seems promising, and there is also literature to support community-based interventions by dental hygienists,[5] but the current body of evidence is insufficient in determining whether or not the role of Canadian PHDH should be expanded. Furthermore, the available evidence does not necessarily apply to the very specific conditions that surround children enrolled in the CINOT program. With these limitations in mind, this study's objective was to determine whether PHDH would be as effective as dental directors in screening high-need children, thereby decreasing the current burden on dental directors.

Methods and Materials

In 2000, the Community Dentistry Health Services Research Unit (CDHSRU) at the University of Toronto completed a 12-month prospective cohort study to determine whether care proposed by dental directors exposed to evidence-based practices was significantly different from the care provided by private practitioners treating children enrolled in the CINOT program. A secondary research question of this study was whether the care that PHDH would propose significantly differed from the care proposed by dental directors and, if this was the case, what were the differences in treatment cost. This paper looks specifically at the partial data collected for the purpose of addressing the secondary research question.

The subjects under study were PHDH who were part of the screening program for children enrolled in the Ontario CINOT program. Each participating PHU had one PHDH and dental director team. Subject pairings were therefore not random. In Ontario, PHDH hold the same credentials as registered dental hygienists, but have opted to work in a public health setting. Working in this setting does not require additional certification.

Children enrolled in CINOT are routinely screened by dental directors from their local PHU and, if they require urgent care, are eligible for coverage through CINOT, sent to a practitioner in the community to receive treatment. In this study, the children themselves were not the actual subjects, but they were used to compare practice patterns of different private practitioners. Children for this study were recruited by the dental directors of four PHUs who agreed to participate in this study. Prior to participating in this study, all the dental directors completed a one-day training course on a number of evidence-based guidelines that were devised by the CDHSRU at the University of Toronto.[6] Topics covered included topical fluoride use, dental prophylaxis, and sealant use. Details on these guidelines are available elsewhere in the literature.[7,8] The participating PHDH also attended these training courses. The trained dental directors approached parents of CINOT-eligible children to recruit them as part of this study. Parents agreeing to enroll their children were required to sign an informed consent form.

In addition to requesting treatment information and x-rays, dental directors were also responsible for conducting a clinical exam on each child and preparing a treatment proposal, which included both Ontario Dental Association (ODA) procedure and tooth codes (henceforth referred to as Plan B). The same was expected of the PHDH who screened the enrolled children

(henceforth referred to as Plan A). Each study participant was allowed as much time as they deemed necessary for screening each individual child. However, no data were collected on the amount of time required for each screening. Participants (both PHDH and dental directors) did not work with other staff during their screenings, but children were screened by both the PHDH and dental director during the same visit. It is unknown, although likely, that the PHDH and dental director discussed their findings following the completion of the screening forms.

The following inclusion and exclusion criteria were used to select children for participation in this study:

Inclusion:

- Child had been identified as needing urgent care;

- Parents did not have dental insurance;

- Parents had declared that dental care would create a financial burden for them;

- Child was an Ontario resident up to/including age 13 or on last school day of eighth grade, whichever came later;

- Parents consented to have their child included in the study;

- The invoice for complete dental care under CINOT was received;

Exclusion:

- Children for whom consent was not given;

- Children who were still receiving care at the end of the study period, as determined from the submitted CINOT claim form.

The different treatment plans were recorded using relative value units (RVU). RVU is a formula developed by the ODA which permits the calculation of relative values of different services. Each service is assigned an estimated time factor required to perform the service (measured in 15-minute increments), as well as a measure of its difficulty or responsibility. The product of these two variables are then used to calculate the RVU. The basic unit of service used to calculate an RVU is an occlusal amalgam restoration on a bicuspid tooth.[9] The rationale behind the RVU system is that this "system embodies information respecting current methods and practices in the delivery of dental care which have a bearing on the resulting time and responsibility."[10]

RVUs were used because they allowed the researchers to standardize collected information across all dentists; determine a composite measure of time and complexity or responsibility of procedures; establish a monetary value for the services rendered; and compare similar and dissimilar services. This was done using an Statistical Package for Social Scientists (SPSS v. 10, Chicago, IL) syntax file designed specifically for this purpose.

All procedures were classified into one of eight categories according to the ODA's classification system: diagnostic, preventive, restorative, surgical, endodontic, periodontic, orthodontic, and adjunctive. The dependent variable in this study was the individual difference in RVUs for each child enrolled in the study-overall, by PHU, and by service category. The child was used as a proxy for each subject pair (PHDH versus dental director) involved in this study.

Based on the results collected, five analyses were conducted:

RVU for all cases by plan;

RVU by service type and plan;

RVU by plan, stratified by PHU;

RVU by service type and plan, stratified by PHU;

Procedure counts by service type and plan, stratified by PHU.

A paired t-test analysis was performed in order to look at the difference in care proposed by the dental director (Plan B), and the care proposed by the PHDH for each individual (Plan A). As the dental directors were trained in evidence-based practices targeted specifically at this subset of the population, their treatment plans were considered to be the gold standard with which PHDH treatment plans were to be compared. Data were determined to be normally distributed, and a level of significance of p=<0.05 was used for all analyses.

Results

Analysis of RVU for all cases by plan

A total of 71 children were recruited to participate in this study, with an unequal distribution of cases between PHUs. PHU A recruited eight cases, PHU B recruited 25 cases, PHU C recruited 24 cases, and PHU D recruited 14 cases. Using a paired t-test model, comparing Plan A and Plan B for each child, it was determined that there was no statistically significant difference between the overall treatment proposed by the PHDH (Plan A) and the treatment proposed by the dental directors (Plan B) (p=.749).

Analysis of RVU by service type and plan

Table I shows a comparison of RVUs by service type and plan. All of the paired t-tests in Table I included all 71 children. None of the service types displayed a statistically significant difference. Endodontic services approached significance (p=.06).

Table I. Mean RVUs of Dental Services Provided to Children by Service Type and Plan

Service	Plan A – Mean RVU	Plan B – Mean RVU	P-value
Diagnostic	0.48	0.45	.457
Preventive	1.03	0.98	.614
Restorative	7.78	7.94	.702
Surgical	0.62	0.60	.877
Adjunctive	0.09	0.00	.159
Endodontic	0.65	0.85	.060
Total	**10.65**	**10.81**	**.749**

Analysis of RVU by plan, stratified by PHU

Despite the small number of cases for each PHU (especially PHU A), a comparison of total RVUs for Plan A and Plan B, stratified by PHU, resulted in no statistically significant differences within PHUs (Table II). Although Plan B overall is moderately more RVU-intensive than Plan A, this is primarily due to PHU B. All other PHUs had more RVU-intensive Plan As than Plan Bs, although this was not statistically significant.

Table II. Mean RVUs and Range of Dental Services Proposed/Provided to Children by PHU

PHU	Plan A – Mean RVU (Range)	Plan B – Mean RVU (Range)	P-value
A (n=8)	9.29 (3.39-18.14)	9.23 (3.14-18.14)	.966
B (n=25)	14.47 (1.0-41.42)	15.31 (1.25-40.17)	.385
C (n=24)	8.11 (3.0-29.95)	7.89 (1.25-34.33)	.742
D (n=14)	8.98 (3.64-20.04)	8.69 (2.89-27.39)	.835
Total (n=71)	**10.65 (1.0-41.42)**	**10.81 (1.25-40.17)**	**.749**

Analyses of Procedure Count and RVU by service type and plan, stratified by PHU

Table III highlights mean RVUs of dental services by service type and plan. With respect to Plan A, three of the four participating PHUs did not propose diagnostic care. Also, three of the four PHUs did not propose adjunctive care. Finally, one PHU did not prescribe any preventive care, and another PHU did not prescribe any endodontic care.

Table III. RVUs of Dental Services Provided to Children by PHU, Service Type and Plan

		Plan A	Plan B	
PHU	Service	Mean RVU per Child	Mean RVU per Child	P-value
A	Diagnostic	0	0	1.0
(n=8)	Preventive	0.95	1.10	.563
	Restorative	5.90	6.63	.455
	Surgical	1.50	0.56	.140
	Adjunctive	0	0	1.0
	Endodontic	0.94	0.94	1.0
	SUBTOTAL	**9.29**	**9.23**	**.966**
B	Diagnostic	0	0	1.0
(n=25)	Preventive	1.65	1.31	.126
	Restorative	11.05	11.64	.389
	Surgical	0.36	0.66	.327
	Adjunctive	0.25	0	.161
	Endodontic	1.15	1.7	.02
	SUBTOTAL	**14.47**	**15.31**	**.385**
C	Diagnostic	0	0	1.0
(n=24)	Preventive	1.02	1.18	.346
	Restorative	6.75	6.37	.552
	Surgical	0.34	0.34	1.0
	Adjunctive	0	0	1.0
	Endodontic	0	0	1.0
	SUBTOTAL	**8.11**	**7.89**	**.742**
D	Diagnostic	2.42	2.27	.474
(n=14)	Preventive	0	0	1.0
	Restorative	4.78	4.74	.976
	Surgical	1.07	0.96	.671
	Adjunctive	0	0	1.0
	Endodontic	0.71	0.71	1.0
	SUBTOTAL	**8.98**	**8.69**	**.835**
OVERALL	**Diagnostic**	**0.48**	**0.45**	**.457**
(n=71)	**Preventive**	**1.03**	**0.98**	**.614**
	Restorative	**7.78**	**7.94**	**.702**
	Surgical	**0.62**	**0.60**	**.877**
	Adjunctive	**0.09**	**0**	**.159**
	Endodontic	**0.65**	**0.85**	**.06**
	TOTAL	**10.65**	**10.81**	**.749**

While the paired t-test analysis stratified by service type (Table I) demonstrated that there were no significant differences in the treatment plans drawn up by PHDH and by dental directors for any service type (Table III), the paired t-test analysis stratified by PHU and by service showed a statistically significant difference in the RVU intensity reported for endodontic services prescribed in PHU B (p=.02). Furthermore, the difference in the procedure count for endodontic services was also statistically significant (p=.036), while none of the other subgroups was statistically significant, both in terms of RVUs and procedure counts (Table IV).

Table IV. Count of Dental Services Procedures Provided to Children by PHU, Service Type and Plan

		Plan A	Plan B	
PHU	Service	Total Count	Total Count	P-value
A	Diagnostic	0	0	1.0
(n=8)	Preventive	12	14	.563
	Restorative	22	4=26	.227
	Surgical	8	3	.140
	Adjunctive	0	0	1.0
	Endodontic	6	6	1.0
	SUBTOTAL	**48**	**49**	**.732**
B	Diagnostic	0	0	1.0
(n=25)	Preventive	48	44	.356
	Restorative	95	89	.387
	Surgical	8	16	.327
	Adjunctive	2	0	.161
	Endodontic	19	28	.036
	SUBTOTAL	**172**	**177**	**.744**
C	Diagnostic	0	0	1.0
(n=24)	Preventive	39	45	.341
	Restorative	87	79	.363
	Surgical	6	6	1.0
	Adjunctive	0	0	1.0
	Endodontic	0	0	1.0
	SUBTOTAL	**132**	**130**	**.862**
D	Diagnostic	65	56	.309
(n=14)	Preventive	0	0	1.0
	Restorative	40	34	.082
	Surgical	13	12	.671
	Adjunctive	0	0	1.0
	Endodontic	5	5	1.0
	SUBTOTAL	**123**	**107**	**.205**
OVERALL	**Diagnostic**	**65**	**56**	**.295**
(n=71)	**Preventive**	**99**	**103**	**.626**
	Restorative	**244**	**228**	**.181**
	Surgical	**35**	**37**	**.825**
	Adjunctive	**2**	**0**	**.159**
	Endodontic	**30**	**39**	**.060**
	TOTAL	**475**	**463**	**.597**

Discussion

There is very limited literature on the clinical appropriateness of relying on dental hygienists to screen patients for oral health and treatment. Moreover, the available evidence does not address screening in communities with very specific needs, such as those of the children enrolled in this study. Therefore, the results presented below provide new evidence that should be considered in the debate.

The results described above showed that there was no overall statistically significant difference in the quantity and types of services prescribed by PHDH relative to what was deemed appropriate by dental directors, based on evidence-based practice guidelines. However, a few observations are worth noting and discussing.

Despite a small sample size (n=70), the overall differences reported here were clearly non-significant. The only service type that approached statistical significance was endodontic service (p=.06). However, this difference does not represent a large absolute difference in the amount of RVUs recommended by each group (0.20 RVUs); the difference is primarily due to the large relative difference due to the small values of the actual totals prescribed (0.65 versus 0.85 RVUs).

Furthermore, when the analysis was stratified both by service type and by PHU, the differences remained strongly non-significant, with the notable exception again of endodontic services. In many instances, there were no differences at all between the paired values for Plans A and B, resulting in p-values of 1. Ten subgroups (services stratified by PHU) had p-values of 1; of those, eight were due to both Plans A and B having no RVUs prescribed. However, two subgroups (endodontic services in PHU A, and surgical services in PHU C) both prescribed services of the same magnitude. A further investigation into the prescribed procedure codes and the related tooth codes showed the following.

With respect to endodontic services in PHU A, the total and average RVUs were the same for both plans, and each plan included four children. In addition, both plans reported the same number of recommended procedures. However, of the four children who were proposed for endodontic care, two were given slightly different treatment plans, while the other two children were prescribed identical endodontic care. With respect to the two children with disparate treatment plans, the first one was due to an additional tooth being prescribed endodontic care by the dental director, and the second one was due to an additional tooth being prescribed endodontic care by the PHDH. In both cases, both children were prescribed some endodontic care by both groups, but evidently there was some discrepancy in the amount prescribed by each group.

In the case of surgical services prescribed by both the PHDH and dental directors in PHU C, a closer investigation of tooth and procedure codes show that both plans were identical. In the case of endodontic services in PHU B, it appears that the differences in both RVUs and in the number of procedure codes were statistically significant. Closer inspection shows that, while both PHDH and dental directors prescribed more treatment for some disparate cases, overall, the majority of additional procedures were prescribed by the dental directors than by the PHDH. Overall, this translated into an additional nine procedures, equal to an average of an extra 0.55 RVUs (CAN$16.50) per child.

How do these results translate in terms of practice? Despite the sample size and subsequent power being insufficient to justify a policy change, this study's results are encouraging enough to warrant further research. Given this study's population and its very specific needs, this limited evidence suggests that it may be sufficient to train PHDH to identify these needs, thereby reducing the screening burden that is currently placed on dental directors, and potentially reducing costs.

Given that the study group included only children who required emergency dental care, it was not possible to calculate kappa coefficients for the two groups under study, as this would have required the enrollment of children with varying degrees (including absence) of oral health conditions. Further studies should include children with varying dental health to truly test inter-examiner agreement.

Those who argue that there would be a significant difference in the quality of screening and in the resulting amount of care recommended need only look at the results from this study and from studies mentioned previously.[1,2] Differences in the magnitude of RVUs across PHUs were not systematically in the same direction, nor were differences in the total procedure counts. However, it should be noted that endodontic services, which were not covered in the one-day course, were the services that seemed to display the most discrepancy between PHDH and dental directors, with the difference being systematically due to additional care being prescribed by the dental director. It is plausible that this was due to the additional post-secondary education required for dental directors. While this observation is of clinical importance and may warrant additional PHDH endodontic education, the total difference in the value of mean treatment per child was under $5 (one RVU equals $30), which was not statistically significant.

Conclusion

The potential cost savings resulting from shifting the screening responsibility from the dental directors to the PHDH could be considerable. Given that CINOT financing is a municipal burden, shifting the screening responsibility could result in important cost savings and potential resource redistribution at the municipal level. This study also demonstrates the skill set that dental hygienists can bring to promoting oral health in their communities, provided that they are offered additional training in certain services, such as endodontics.

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Notes

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Notices

Call to the Annual Session

The 82nd annual session of the American Dental Hygienists' Association will be held June 22-29, 2005 at the Riviera Hotel in Las Vegas, Nevada. The meeting will feature continuing education, exhibits, and networking opportunities, as well as the House of Delegates sessions. For registration information, please call 1/800-243-2342, ext. 211.

ADHA Institute for Oral Health Releases $50,000 RFP on Access to Care Issue

The ADHA Institute for Oral Health is seeking proposals for a research study on the topic of "Measuring Access to Care for Low-Income School Children by Dental Hygienists in States that Allow Direct Access to Dental Hygiene Services." Please visit the foundation's website at www.adha.org/institute for eligibility and application details.

Global Health Summit

Individual health professionals and organizations are invited to the June 5, 2005 Global Health Summit, to be held in Philadelphia. During this conference, U.S. Surgeon General Richard Carmona will present his "Global Health Call to Action" and seek advice on collaborative action to advance world health.

The main purpose of the summit will be to shape the Surgeon General's final report, which is intended to highlight the importance for the United States to take a global stance on health. Oral health will be among the issues discussed by stakeholders and considered for the report.

Please visit www.globalhealthsummit.org for more detail and registration information.