KNOWLEDGE, OPINIONS, AND BEHAVIORS OF NORTH CAROLINA NURSES AND DENTAL HYGIENISTS REGARDING ELECTRONIC CIGARETTES

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A thesis submitted to the faculty at the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Science in the Department of Dental Ecology in the School of Dentistry (Dental Hygiene).

Chapel Hill
2018

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ABSTRACT

Kayla Marie Cunningham: Knowledge, Opinions, and Behaviors of North Carolina Nurses and Dental Hygienists Regarding Electronic Cigarettes
(Under the direction of Rebecca Wilder)

Purpose: To assess North Carolina dental hygiene (DH), nursing students’ and practitioners’ knowledge, opinions, and behaviors regarding e-cigarettes. Methods: A convenience sample of DH students, registered dental hygienists (RDHs), nursing students and registered nurses (RNs) completed surveys to assess practice behaviors, knowledge, opinions, and curriculum/training about E-cigarettes. Data was analyzed with Cochran-Mantel-Haenszel tests. Results: Students (n= 146) and 144 practitioners completed surveys. Only 55.0% of DH and 18.5% nursing students reported E-cigarettes were included in their curriculum. DH students were more likely than nursing students to always ask about cigarette and e-cigarette use in health histories, to advise patients to quit e-cigarettes, and to know that e-cigarettes deliver less nicotine per puff and hold similar health risks to smokeless tobacco. RNs were more likely to refer patients for quitting assistance than RDHs. Conclusion: DH and nursing curricula and continuing education programs must address e-cigarettes, their health effects, and how to deliver tobacco/alternative tobacco product cessation counseling.
I would like to dedicate this thesis to my family who have always been a constant source of support and encouragement in achieving my dreams. Thank you for your continued love and belief in me.

“Never give up on education. It’s the most important part of your success that you’ll ever have... Education is not just books, it’s learning from others, it’s learning new techniques, it’s the most important aspect in regards to achieving success.”

–Ronald Robinson, grandfather
ACKNOWLEDGEMENTS

I would like to give special thanks to Professor Rebecca Wilder for all of her guidance and encouragement throughout this entire endeavor. I would also like to thank Professor Lynne Hunt, Dr. Lauren Patton, and Dr. Devon Noonan for their insight and feedback. Special thanks are given to Dr. Ceib Phillips with her expertise in statistical analysis, without which I wouldn’t have been able to complete this project.

Finally, I would like to acknowledge my “Dream Team” classmates: Roxanne Dsouza, Yuri Oh, and Jackie Smith for their constant love and support without which I wouldn’t have made it through—I have forever gained lifelong friends.
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<td>DH</td>
<td>Dental Hygiene</td>
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<td>Electronic Nicotine Delivery System</td>
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<td>Food and Drug Administration</td>
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<td>Registered Dental Hygienist</td>
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INTRODUCTION

Tobacco is the number one preventable cause of death in the United States.\textsuperscript{1} Since 1964, an estimated 20 million have died because of smoking.\textsuperscript{2} As the detrimental effects of smoking have become more well-known, smoking rates have decreased from 20.5\% in 2005 to 15.5\% in 2016.\textsuperscript{3} There are multiple smoked and smokeless tobacco products still in the United States market and commonly used today. Tobacco products have been linked to damage and disease in almost all the bodies organ systems; including directly causal relationships with lung, liver, prostate, breast, and colorectal cancer.\textsuperscript{1}

Current approved nicotine replacement therapies (NRTs) include both over-the-counter and prescription therapies. Common over-the-counter therapies come in transdermal nicotine patches, nicotine gum, and nicotine lozenges.\textsuperscript{4} These types of therapies should only be used for a short time to manage nicotine cravings and withdrawal symptoms.

Electronic nicotine delivery systems (ENDS), otherwise known as electronic cigarettes (e-cigarettes, e-cigs), consist of: a liquid cartridge, an atomizer, and a battery.\textsuperscript{5} E-cigarettes were invented in 2003 in China and arrived on the US market in 2007.\textsuperscript{6,7} E-cigarettes are the latest trend in nicotine, but little is known about the safety and suitability of their use in place of traditional tobacco products. Currently, there is little research regarding the negative impacts e-cigarettes have on overall health.

It is within dental hygienists’ and nurses’ scope of professional responsibilities to counsel patients regarding tobacco and nicotine use due to the known detrimental effects on the oral cavity and overall well-being of the patient. Dental hygiene and nursing students
must be educated about e-cigarettes regarding Food and Drug Administration (FDA) regulations, effects on the oral cavity and overall body, and counseling of patients using e-cigarettes. Primary healthcare providers should be aware that e-cigarettes are not as harmless as they are advertised and should be advising patients to use alternative approved nicotine replacement therapies. Long term effects (i.e. 20-30 years) of e-cigarettes are unknown and dental hygienists and nurses must be aware of these health facts and advise patients appropriately that are using or are considering using e-cigarettes as nicotine cessation products.

The purpose of this study was to gain insight about North Carolina dental hygiene and nursing students and practitioners regarding their knowledge, behaviors, and opinions of e-cigarettes. In addition, this study explored their behaviors with patients regarding cigarettes and alternative tobacco products (ATPs) and their comfort levels. The information gained from this study is intended to contribute to the development of curricula modifications for dental hygiene and nursing students and promote continuing education for practicing clinicians.
REVIEW OF THE LITERATURE

Recent Reports on Tobacco Use Status

As the detrimental effects of tobacco have become more well known, the percentage of U.S. adults that smoke has decreased from 20.9% in 2005 to 15.5% in 2016. Since the 1964 Surgeon General’s report, cigarette smoking has been linked to disease and damage in almost all of the body organ systems, including the establishment of direct causal relationships with lung cancer, liver cancer, colorectal cancer, prostate cancer, and breast cancer. Cigarette smoking has been linked to adverse health outcomes in cancer patients and quitting smoking or opting for nicotine replacement therapy can improve prognosis.

Research has continued to identify a relationship between cigarette smoking and diabetes mellitus and rheumatoid arthritis. The risk of developing diabetes for smokers is 30-40% higher than nonsmokers. Cigarette smoking is known to affect inflammatory processes and immune function, both of which contribute to diabetes and rheumatoid arthritis, as well as overall inflammation and immune function.

Second-hand smoke exposure in children and infants has been linked to cancer, respiratory issues, cardiovascular disease, and adverse health effects. Since the Surgeon General’s report in 1964, nearly 20 million premature infant deaths can be linked to cigarette smoking. Nicotine during prenatal maturity could have lasting effects on brain development and women are cautioned to stay away from nicotine products during pregnancy. Evidence is appropriately strong to conclude that nicotine negatively affects both maternal and fetal health outcomes and contributes to both preterm birth and stillbirth. In addition to effects on
a developing fetus and infant, nicotine exposure during adolescence may have lasting consequences on brain development and effects on brain function as adults.\textsuperscript{1} Smoking during pregnancy has been linked to orofacial clefts and other congenital malformations such as club foot, gastrochisis, and atrial septal heart defects.\textsuperscript{1} In addition, maternal smoking has been linked to ectopic pregnancies and spontaneous abortions.\textsuperscript{1}

In 2014, smoking was reported more often in individuals insured via Medicaid and those who were uninsured than those with private insurance.\textsuperscript{8} Smoking is more prevalent among those with lower educational levels (general education development certificate) than those with more education (graduate degree).\textsuperscript{8} In addition, people living below the poverty level have a higher prevalence of smoking than those above that level.\textsuperscript{8} Prevalence was also highest in the Midwest, among adults with a disability, and among lesbian, gay, and bisexual adults.\textsuperscript{8} The effects of cigarette smoking and tobacco on the body are well known and extremely detrimental.

**Current Tobacco Products**

There are multiple smoked and smokeless tobacco products on the market in the United States today that are commonly used. Smoked tobacco products include: cigarettes, light cigarettes, menthol cigarettes, cigars, pipes, Bidis, Kreteks, and Hookahs.\textsuperscript{9,10} A cigarette is any roll of tobacco wrapped in paper and is the most widely used tobacco product in the United States.\textsuperscript{9} Tobacco smoke contains over 7000 chemicals, of which more than 100 chemicals are toxic, and 70 are known to cause cancer.\textsuperscript{9} Some of the cancer-causing chemicals in tobacco smoke include: formaldehyde, benzene, polonium 210, and vinyl chloride.\textsuperscript{9} Light cigarettes have less tar or tobacco; however, they have been found to have the same exposure as traditional cigarettes with long or frequent puffs.\textsuperscript{9} Light cigarettes have
not been found to have any reduced health benefits in comparison to traditional cigarettes. Tobacco manufacturers were banned from using the term light cigarettes in June of 2010 because all cigarettes are harmful and the term was misleading for consumers. Menthol cigarettes are traditional tobacco products with menthol added for a minty flavor. Tobacco companies market menthol cigarettes as healthier; however, menthol only reduces the harshness of cigarette smoke making it more appealing for children and teens to smoke. Cigars are large rolls of unbundled tobacco and include cigars, cigarillos, and little cigars. Traditional tobacco can also be purchased and smoked from a pipe. Bidis are small, hand-rolled cigarettes imported from India and Southeast Asia and Kretks are clove cigarettes imported from Indonesia and typically contain 60% tobacco and 40% cloves. In order to stay lit bidis must be puffed more rapidly and the concentration of nicotine, tar, and carbon monoxide is higher than in traditional cigarettes. Kretk cigarettes contain cloves and eugenol. Eugenol has a local anesthetic effect and can induce more intense smoking and is suspected to be a carcinogen. Hookah smoking has become extremely popular among younger populations and involves inhaling flavored tobacco over a water bowl. An average hookah smoking session is typically one-hour long and involves inhaling 100-200 times the volume of smoke inhaled from a normal cigarette.

Smokeless tobacco products include: chewing tobacco, snuff, dip, snus, and dissolvable products (lozenges, orbs, sticks, strips). These products are easily concealable and therefore are more likely to be used by young people, although these products are not smoked these products are not a safe alternative to smoking cigarettes. Betel quid, imported from India and Asia, is as detrimental as other smokeless tobacco products and has been linked to oral cancers.
**Current Approved Nicotine Replacement Therapies**

Individuals wanting to quit traditional tobacco products often turn to nicotine replacement therapies to make quitting easier on their body. Tobacco users should always consult a health care provider before turning to any nicotine replacement therapies. Approved nicotine replacements therapies can include both over-the-counter and prescription therapy. These types of therapies should be used for a short time to help manage nicotine cravings and withdrawal symptoms. Some approved over-the-counter nicotine replacement products include: transdermal nicotine patches, nicotine gum, and nicotine lozenges. Nicotrol® (Pfizer, Inc., Mission, KS) is a prescription nicotine replacement product and comes in both a nasal spray and oral inhaler. Chantix® (Pfizer, Inc., Mission, KS) and Zyban® (GlaxoSmithKline, Research Triangle Park, NC) are prescription medications in a tablet form without nicotine that have FDA approval as smoking cessation products. Chantix® acts at sites in the brain that are affected by nicotine; conversely, the pharmacokinetics of Zyban® in nicotine replacement are unknown. Prescription medications may have some side effects including: behavior changes, depressed mood, hostility, aggression, and suicidal thoughts or actions.

**Electronic Nicotine Delivery Systems—What are they? Are they safe?**

Electronic nicotine delivery systems (ENDS), otherwise known as electronic cigarettes (e-cigarettes, e-cigs), consist of: a liquid cartridge, an atomizer, and a battery. E-cigarettes were invented in 2003 in China and arrived on the US market in 2007. In 2014, 12.6% of adults reported trying an electronic cigarette, with the highest percentage of use being in adults aged 18-24 years with declining use as age increased. Current smokers and recent (<1 year) former smokers were more likely to use e-cigarettes than former smokers (>
1 year).\textsuperscript{12} The liquid for e-cigarettes has various concentrations of nicotine and flavoring dissolved in propylene glycol and water.\textsuperscript{5,12} Propylene glycol is known to be an irritant and the long term effects of its inhalation are unknown.\textsuperscript{13} E-cigarettes create vapor by heating the liquid into an inhalable suspension. This behavior has been deemed “vaping”.\textsuperscript{5} E-cigarette vapor contains multiple toxic compounds, including tobacco-specific nitrosamines, polycyclic aromatic hydrocarbons, cadmium, lead, nickel in trace levels, volatile organic compounds, phenolic compounds, and tobacco alkaloids.\textsuperscript{14,15} Yet, the toxin levels in e-cigarettes is 9 to 450 times less than in traditional cigarettes.\textsuperscript{12,16}

Marketing has promoted e-cigarettes as a reduction or quit method for traditional cigarettes; however, there is extremely limited data to support this claim.\textsuperscript{17} E-cigarettes are a more attractive quit method for many smokers due to the similarity to smoking (inhalation and vapor exhalation).\textsuperscript{14} The hand-to-mouth motion and visual cue of “smoke” provide the user with the feeling of smoking. Many cigarette smokers are switching to e-cigarettes for the cost reduction in comparison to traditional cigarettes.\textsuperscript{17} Some physiological effects of e-cigarettes include: mouth and throat irritation at initial use, no changes in heart rate, carbon monoxide levels, or plasma nicotine levels, increase in respiratory impedance, no changes in complete blood count, no changes in lung function, no change in cardiac function with an echocardiogram, and no increase in inflammatory markers.\textsuperscript{17} Early evidence suggests that second-hand vapor from ENDS may adversely affect the health of non-users as the aerosol emitted contains nicotine and additional toxins.\textsuperscript{15}

Currently, data limited to assess the safety of e-cigarettes and further studies must be done in order to assure their efficacy and safety.\textsuperscript{14} It is proposed that the health risks of e-cigarettes are similar to that of smokeless tobacco.\textsuperscript{14} The first assessment of e-cigarette use
was in 2014; therefore, it is not possible to determine long-term patterns of use at this time.\(^8,17\) However, potential benefits of e-cigarettes could include: use as a tobacco cessation tool or a harm reduction tool as a substitute for traditional tobacco cigarettes.\(^5\) In 2013 3.3% of U.S. adults used e-cigarettes and e-cigarette use more common in current smokers versus former or never cigarette smokers.\(^15\)

E-cigarettes were not regulated by the FDA until June, 2016.\(^18\) Before this new rule, e-cigarettes could be sold without any reviews of ingredients, how they were made, and potential dangers.\(^19\) The FDA has been regulating cigarette, cigarette tobacco, and smokeless tobacco products since 2009 under the Family Smoking Prevention and Tobacco Control Act.\(^11\) This act was extended in June 2016 to allow FDA regulation of e-cigarettes, all cigars, hookah, pipe tobacco, nicotine gels, and dissolvables.\(^18\) The FDA does not support e-cigarettes as an approved tobacco cessation aid at this time.\(^15\)

**Knowledge and Behaviors of Nursing Students Regarding Tobacco Use and Tobacco Cessation Counseling**

As primary health care providers, nurses must be knowledgeable in tobacco products, tobacco alternatives, and tobacco cessation counseling. Due to the burden of tobacco on overall health, nurses must provide evidence-based tobacco cessation in all settings.\(^20\) VanDevanter et al., found that undergraduate and graduate nursing students have a lack of knowledge regarding alternative tobacco products (hookahs, cigars, cigarillos, bidis, kreteks, smokeless tobacco, and e-cigarettes) despite high rates of self-reported tobacco product use.\(^21\) Zhou noted that students report feeling less comfortable discussing alternative tobacco products and cessation counseling and were less likely to talk to patients about these types of products.\(^22\) Schwindt et al. reported that nursing programs have an absence of standardized tobacco cessation training which can lead to diminished confidence in nurses ability to
provide tobacco cessation counseling.\textsuperscript{20} Nurses report being more comfortable with tobacco cessation interventions with additional tobacco education training outside of the normal tobacco education programs currently offered in nursing schools.\textsuperscript{20}

Nurses must receive more education in tobacco cessation counseling and alternative tobacco products in order to discuss these topics with patients. In their study, Schwindt et al. concluded that a theory-based tobacco education program should be integrated into curricula so that nurses will be proficient in the delivery of tobacco cessation counseling.\textsuperscript{20} Nurses lack of understanding about the evolving use and health threats associated with alternative tobacco products compromises their ability to provide accurate tobacco cessation counseling to their patients.\textsuperscript{19} Nurses must have knowledge of approved nicotine replacement therapies in order to best provide information and recommendations to their patients. Currently the American Heart Association, suggests that practicing clinicians should not recommend e-cigarettes as a primary cessation method and should work with patients using e-cigarettes to set a quit date and not plan to use e-cigarettes indefinitely.\textsuperscript{23}

**Knowledge and Behaviors of Dental Hygiene Students Regarding Tobacco Use and Tobacco Cessation Counseling**

As primary health care providers, dental hygienists have the responsibility to provide tobacco cessation counseling and education to their patients that use tobacco products. Dental hygienists have abundant opportunities to provide vital tobacco cessation counseling that can reduce or prevent tobacco-related morbidity and mortality.\textsuperscript{24} Current research shows that there is limited and inconsistent evidence of tobacco cessation counseling occurring in dental practice.\textsuperscript{24} Dental hygiene educators report a significantly greater time spent on tobacco dependence education than either physician’s assistant or nursing programs; however, there is still a lack of training in motivational interviewing, medications for tobacco cessation, and
creating tobacco cessation programs for the patient. Enhanced training in tobacco cessation counseling for dental hygiene students could reduce rates of oral cancer, periodontitis, impaired healing, and dental caries in children exposed to second-hand smoke. Clinician’s should be aware of current approved nicotine replacement therapies and should not be promoting e-cigarettes as a primary method for tobacco cessation as there is insufficient evidence on their efficacy and e-cigarettes can cause acute lung disease, atrial fibrillation, and nicotine poisoning.

Dental hygienists believe that tobacco cessation counseling is within their scope of professional responsibilities; however, dental professionals are failing to provide adequate counseling on tobacco cessation. Shearston et al. found that dental, dental hygiene, and advanced dental students reported feeling more confident counseling on cigarettes and received more education regarding cigarettes than ATPs. Dental health professional students reported low confidence in helping patients quit tobacco and felt they did not receive enough training on intervening with patients regarding cigarettes and ATPs. Monson et al. reported that even after receiving tobacco cessation training, dental hygiene graduates do not provide tobacco cessation counseling to the majority of their patients, but they are more likely to discuss tobacco habits with patients that have periodontal disease. Monson et al. suggests that access to tobacco education materials and emphasis on tobacco cessation education for all patients may increase counseling provided.

Franks et al. found that substantial gaps in e-cigarette knowledge exist among medical, nursing, pharmacy, public health, and allied health (audiology and speech pathology, dental hygiene, dietetics and nutrition, emergency medical services, genetic counseling, health information management, imaging and radiation sciences, laboratory
sciences, ophthalmic medical technology, physical therapy, physician assistant, respiratory care, and surgical technology) students. Zhou et al. found that a majority of medical students reported ever using tobacco products and more than 50% reported using ATPs. Despite the high percentage of self-use, medical students stated they lacked the knowledge, education, and cessation counseling skills necessary to provide correct information to patients.

Research suggests that even after receiving tobacco cessation training, dental hygienists do not provide tobacco cessation counseling to the majority of their patients, but that they are more likely to discuss tobacco habits with patients that have periodontal disease. Dental hygienists must receive more education to improve tobacco education with their patients and provide better nicotine replacement options education.

What is the current knowledge and behaviors of North Carolina dental hygiene and nursing students regarding electronic cigarettes?

The present evidence for the efficacy and safety of e-cigarettes as a nicotine replacement therapy is limited. What should dental professionals be telling patients about the use of e-cigarettes? Dental hygienists and nurses need to be aware of the rise in the use of e-cigarettes. Dental hygienists and nurses should be prepared to discuss e-cigarette usage with patients. However, current research shows that many health care providers may not be comfortable with counseling patients on tobacco use in general and are not currently being taught about e-cigarettes. Nurses and dental hygienists play a fundamental role in tobacco dependence and cessation education of their patients. Current curricula in North Carolina teach tobacco cessation counseling, and the students believe that tobacco cessation education is within a dental hygienist’s scope of professional responsibilities. It was found that the majority of dental hygiene students ask about and counsel their patients on tobacco
use and cessation, but are less likely to recommend over-the-counter nicotine replacement products, and have not been taught about e-cigarettes or how to counsel a patient regarding e-cigarettes. Dental hygienists and nurses should be asking patients in their histories about electronic cigarette use, as nicotine is considered a risk factor in the onset and progression of periodontal disease and other health conditions. Currently the American Heart Association suggests that clinicians should not recommend e-cigarettes as a primary cessation and if a patient is using an e-cigarette, he/she should be advised to consider a quit date and not plan to use them indefinitely. However, smokers have reported fewer withdrawal symptoms when using e-cigarettes, so for those patients who are unsuccessful with approved smoking cessation strategies, e-cigarettes may be a desirable alternative. The current knowledge and behaviors of dental hygiene students and nursing students in North Carolina regarding e-cigarettes is unknown. Thus, the aim of this study is to survey dental hygiene and nursing student and practitioners as to their knowledge, behaviors, and opinions regarding e-cigarettes.
REFERENCES


INTRODUCTION AND REVIEW OF THE LITERATURE

Tobacco is the number one preventable cause of death in the United States. Since 1964, an estimated 20 million Americans have died because of smoking. As the detrimental effects of tobacco have become more well-known, the prevalence of U.S. adults who smoke has decreased. For example, smoking rates have decreased from 20.9% in 2005 to 15.5% in 2016.2

There are multiple smoked and smokeless tobacco products on the market in the United States today that are commonly used. Tobacco smoke contains over 7000 chemicals, of which more than 100 chemicals are toxic, and 70 are known to cause cancer.3 Some of the cancer-causing chemicals in tobacco smoke include: formaldehyde, benzene, polonium 210, and vinyl chloride.3

Electronic Cigarettes

Electronic nicotine delivery systems (ENDS), otherwise known as electronic cigarettes (e-cigarettes, e-cigs), consist of: a liquid cartridge, an atomizer, and a battery.4 Electronic cigarettes were invented in 2003 in China and arrived on the US market in 2007.5,6 In 2014, 12.6% of adults reported ever trying an electronic cigarette, with the highest percentage of use being in adults aged 18-24 years with declining use as age increased.7 Current smokers and recent (less than 1 year) former smokers were more likely to
use e-cigarettes than former smokers (more than 1 year).\textsuperscript{7} The liquid for e-cigarettes has various concentrations of nicotine and flavoring dissolved in propylene glycol and water.\textsuperscript{4} Propylene glycol is known to be an irritant with unknown long term inhalation effects.\textsuperscript{8} E-cigarettes create vapor by heating the liquid into an inhalable vapor. This behavior has been termed “vaping”.\textsuperscript{4} E-cigarette vapor contains multiple toxic compounds, including tobacco-specific nitrosamines, polycyclic aromatic hydrocarbons, cadmium, lead, nickel in trace levels, volatile organic compounds, phenolic compounds, and tobacco alkaloids.\textsuperscript{9,10} Yet, the toxin levels in e-cigarettes are 9 to 450 times less than in traditional cigarettes.\textsuperscript{11}

Some physiological effects of e-cigarettes include: mouth and throat irritation at initial use, no changes in heart rate, carbon monoxide levels, or plasma nicotine levels, increase in respiratory impedance, no changes in complete blood count, no changes in lung function, no change in cardiac function with an echocardiogram, and no increase in inflammatory markers.\textsuperscript{12} However, early evidence suggests that second-hand vapor from ENDS may adversely affect the health of non-users as the aerosol emitted contains nicotine and additional toxins.\textsuperscript{10}

Marketing campaigns have promoted e-cigarettes as a reduction or quit-method for traditional cigarettes; however, there is extremely limited data to support this claim.\textsuperscript{12} E-cigarettes are a more attractive quit method for many smokers due to the similarity to smoking (inhalation and vapor exhalation).\textsuperscript{9} The hand-to-mouth motion and visual cue of
“smoke” provide the user with the feeling of smoking. Many cigarette smokers are switching to e-cigarettes for the cost reduction in comparison to traditional cigarettes.12

Currently, there is limited data assessing the safety of e-cigarettes, and further studies must be conducted in order to assure their efficacy and safety.9 The first assessment of electronic cigarette use was in 2014; therefore, it is not possible to determine long-term patterns of use at this time.13,12 However, potential benefits of e-cigarettes could include use as a tobacco cessation tool or a harm reduction tool as a substitute for traditional tobacco cigarettes.4 In 2013, approximately 3% of U.S. adults used e-cigarettes and electronic cigarette use was more common among current smokers than among former or never cigarette smokers.10

E-cigarettes were not regulated by the U.S. Food and Drug Administration (FDA) until June, 2016.14 Before this new rule, e-cigarettes could be sold without any reviews of ingredients, how they were made, or potential dangers.15 The FDA has been regulating cigarette, cigarette tobacco, and smokeless tobacco products since 2009 under the Family Smoking Prevention and Tobacco Control Act.16 This act was extended in June 2016 to allow FDA regulation of e-cigarettes, all cigars, hookah, pipe tobacco, nicotine gels, and dissolvables.14 The FDA does not support e-cigarettes as an approved tobacco cessation aid at this time.10

Individuals wanting to quit traditional tobacco products often turn to nicotine replacement therapies (NRTs) to make quitting easier on their body. These types of therapies
should be used only for a short time to help manage nicotine cravings and withdrawal symptoms. Several products are approved as over-the-counter nicotine replacement choices. Prescription medications are also available and may have some side effects including: behavior changes, depressed mood, hostility, aggression, and suicidal thoughts or actions.17

**Knowledge, Confidence, and Practice Behaviors of Health Care Providers Regarding E-Cigarettes**

It is critical as primary healthcare providers that both nurses and dental hygienists have the knowledge and confidence to converse with patients about tobacco products, alternative tobacco products (ATPs), and tobacco cessation counseling. E-cigarettes are new to the alternative tobacco product market and healthcare professionals need current information in order to discuss these with patients.

VanDevanter et al assessed undergraduate and graduate nursing students’ knowledge, behaviors, and beliefs related to ATPs (i.e. hookahs, cigarillos, bidis, kreteks, smokeless tobacco, and e-cigarettes) and found that although higher accounts of use were reported, students demonstrated a low level of knowledge of health consequences.18 Schwindt et al reported that nursing programs have an absence of standardized tobacco cessation training which can lead to diminished confidence in nurses ability to provide tobacco cessation counseling.19 Nurses report being more comfortable with tobacco cessation interventions with additional tobacco education training outside of the normal tobacco education programs currently offered in nursing schools.19 In their study, Schwindt et al concluded that a theory-based tobacco education program should be integrated into curricula so that nurses will be proficient in the delivery of tobacco cessation counseling.19 Nurses must receive more
education in tobacco cessation counseling and ATPs in order to discuss these topics with patients. Nurses must have knowledge of approved NRTs in order to best provide information and recommendations to their patients.

Dental hygienists have abundant opportunities to provide vital tobacco cessation counseling that can reduce or prevent tobacco-related morbidity and mortality. Current research shows that there is limited and inconsistent evidence of tobacco cessation counseling occurring in dental practice. Dental hygiene educators report a significantly greater time spent on tobacco dependence education than either physician’s assistant or nursing programs; however, there is still a lack of training in motivational interviewing, medications for tobacco cessation, and creating tobacco cessation programs for the patient. Enhanced training in tobacco cessation counseling for dental hygiene students could reduce rates of oral cancer, periodontitis, impaired healing, and dental caries in children exposed to second-hand smoke. Clinician’s should be aware of current approved NRTs and should not be promoting e-cigarettes as a primary method for tobacco cessation as there is insufficient evidence on their efficacy and e-cigarettes can cause acute lung disease, atrial fibrillation, and nicotine poisoning.

Dental hygienists believe that tobacco cessation counseling is within their scope of professional responsibilities; however, dental professionals are failing to provide adequate counseling on tobacco cessation. Shearston et al found that dental, dental hygiene, and advanced dental students reported feeling more confident counseling on cigarettes and received more education regarding cigarettes than ATPs. Dental health professional
students reported low confidence in helping patients quit tobacco and felt they did not receive
enough training on intervening with patients regarding cigarettes and ATPs.\textsuperscript{22} Monson et al
reported that even after receiving tobacco cessation training, dental hygiene graduates do not
provide tobacco cessation counseling to the majority of their patients, but they are more
likely to discuss tobacco habits with patients that have periodontal disease.\textsuperscript{23} Monson et al
suggests that access to tobacco education materials and emphasis on tobacco cessation
education for all patients may increase counseling provided.\textsuperscript{23}

Franks et al found that substantial gaps in e-cigarette knowledge exist among
medical, nursing, pharmacy, public health, and allied health (audiology and speech
pathology, dental hygiene, dietetics and nutrition, emergency medical services, genetic
counseling, health information management, imaging and radiation sciences, laboratory
sciences, ophthalmic medical technology, physical therapy, physician assistant, respiratory
care, and surgical technology) students.\textsuperscript{24} Zhou et al found that a majority of medical
students reported ever using tobacco products and more than 50% reported using ATPs.
Despite the high percentage of self-use, medical students stated they lacked the knowledge,
education, and cessation counseling skills necessary to provide correct information to
patients.\textsuperscript{25} Currently the American Heart Association, suggests that practicing clinicians
should not recommend e-cigarettes as a primary cessation method and should work with
patients using e-cigarettes to set a quit date and not plan to use e-cigarettes indefinitely.\textsuperscript{26}

Dental hygienists and nurses should be prepared to discuss e-cigarette usage with
patients. However, current research shows that many health care providers may not be
comfortable with counseling patients on tobacco use in general and are not currently being taught about e-cigarettes.\textsuperscript{19,25,20,21} Nurses and dental hygienists play a fundamental role in tobacco dependence and cessation education of their patients. Current curricula in North Carolina teach tobacco cessation counseling, and the students believe that tobacco cessation education is within a dental hygienist’s scope of professional responsibilities.\textsuperscript{21}

The current knowledge and behaviors of dental hygiene students and nursing students and practitioners in North Carolina regarding e-cigarettes is unknown. Thus, the overall purpose of this study is to survey dental hygiene and nursing students as well as registered nurses and registered dental hygienists regarding their knowledge, behaviors, and opinions about the use of e-cigarettes.
METHODS AND MATERIALS

The study population consisted of two groups: 1) North Carolina dental hygiene and nursing students; and, 2) North Carolina registered dental hygienists and registered nurses. Initially, the survey was emailed to DH and nursing program directors across North Carolina for distribution to their senior students. A second recruitment surveyed students and practitioners via convenience samples of those in attendance at the 2017 North Carolina Nursing Association Annual Convention and the 2017 North Carolina Dental Hygienists’ Association Annual Fall Scientific Conference. All subjects were over the age of 18 and able to read and write in English. Subject participation was voluntary. The study was reviewed and deemed exempt by the University of North Carolina Institutional Review Board.

The survey was administered online via Qualtrics. There were two different but similar surveys for the two groups (student/practitioner). The survey questions were developed by the research team and were modified and edited by the Odum Institute for Research in Social Science at the University of North Carolina at Chapel Hill. The survey questions solicited information on the knowledge, opinions, and behaviors of the individual regarding e-cigarette use and personal comfort levels about tobacco cessation counseling and discussing tobacco products with patients. Specific domains for questions included: practice behaviors (5 questions), knowledge of e-cigarettes (10 questions), opinions (11 questions), curriculum/training (2 questions), demographics (7 questions), and an open-ended comments section. The survey questions utilized a Likert Scale as well as True/False/Don’t Know
options. Data were reported in aggregate form in frequencies and percentages. The Cochran-Mantel-Haenszel test was used for data analysis. Alpha was set at p < 0.05.
RESULTS

A total of 144 practitioners (54 RDH/ 90 RN) and 146 students (81 DH/ 65 Nursing) completed the Qualtrics survey. The mean age for each group was: DH students 27.2 years, nursing students 30.4 years, RDH 40.3 years, and RN 49.2 years. The highest degree earned for RDHs was associates (41.5%), bachelors (45.3%), masters (11.3%), and doctorate (1.9%). The highest degree earned to date for RNs was associates (14.4%), bachelors (35.6%), masters (36.7%), and doctorate (13.3%). There was a statistically significant difference among the practitioner group regarding highest degree earned to date (p < 0.001). Some of the students had earned other degrees prior to matriculating into dental hygiene school. The highest degree earned to date for DH students was associates (41.9%), bachelors (16.1%), masters (2.5%), and N/A (39.5%). The highest degree earned to date for nursing students was associates (27.7%), bachelors (29.2%), masters (9.2%), doctorate (3.1%), and N/A (30.8%). There was a statistically significant difference among the practitioner groups regarding highest degree earned to date (p=0.02).

Greater than 78% of practitioners reported never using tobacco and greater than 71% of DH students and 53% of nursing students reported never using tobacco products. Students had an overall higher reported previous or current use of tobacco products than practitioners. The majority of students and practitioners (74.4%-87.3%) reported a friend or family member that used tobacco products. Students reported knowing a friend or family member using e-cigarettes at a higher percentage (52.3% nursing/ 70.9% DH) than practitioners (20.0% RN/ 46.3% RDH).
DH students were more likely than nursing students to always ask about cigarette use (p=0.002) and e-cigarette use (p=0.02) during health histories. There was a statistically significant difference between DH and nursing students regarding the behavior of advising a patient to quit e-cigarettes (p=0.03) with DH students always advising more often than nursing students. RDHs and RNs were equally likely to always ask about cigarette use (~50%); however, RNs were more likely than RDHs to always ask about e-cigarettes use and to refer patients to specialists to assist in quitting (21% vs. 6%). Approximately one-fifth of nurses (22.5%) reported never asking patients about cigarette use in health histories. (Table I)

The majority of students and practitioners were knowledgeable regarding long-term safety of e-cigarettes. Table II shows that there were four questions with statistically significant differences among the student groups. DH students were more likely than nursing students to know that e-cigarettes deliver less nicotine per puff and that they hold similar health risks to smokeless tobacco. Interestingly, RNs were more likely than RDH practitioners to know that the health risks of e-cigarettes are similar to smokeless tobacco, with knowledge of this health risk rising in the nursing profession after graduation. In regards to knowledge of FDA regulations, both students and practitioners answered either incorrectly or that they don’t know the answer to these questions, with statistically significant differences only among the student groups.

The majority of students were comfortable discussing NRTs, tobacco products, tobacco cessation counseling, ATPs, and risks and benefits of e-cigarettes with patients. Whereas, in the practitioner groups the majority of RDHs and RNs were comfortable discussing tobacco products and tobacco cessation with patients, with RNs feeling more comfortable than RDHs in discussing tobacco products and cessation with patients. Both
practitioner groups felt similarly less comfortable discussing NRTs, ATPs, and risks/benefits of e-cigarettes with patients. Refer to Table III and Table IV.

There was a statistically significant difference in agreement among the practitioner groups regarding responsibility to discuss tobacco products (p=0.03) and provide cessation counseling (p=0.01) to patients, with the RDHs agreeing more often than the RNs. The majority of students understood approved NRTs and agreed it was their responsibility to discuss tobacco products and tobacco cessation counseling with their patients (52.5%-90.8%). Table V

Neither students or practitioners were likely to recommended e-cigarettes as a quit method to patients (57.5%-72.3%). In addition, practitioners and students were likely (70.0%-84.6%) to advise a patient to quit using e-cigarettes and to switch to an approved cessation aid. There were no statistically significant differences between students or practitioners regarding likelihood of recommendations or advisement.

The majority of students reported that traditional tobacco products (89.2%-90.1%), ATPs (56.9%-66.3%), and tobacco cessation counseling (84.6%-91.3%) were included in their curriculum. However, only 55.0% of DH students and only 18.5% of nursing students reported that e-cigarettes were included in their curriculum (p < 0.0001). The bulk of the students (78.5%-83.1%) want more training on e-cigarettes, tobacco cessation counseling on ATPs (51.9%-58.5%), and tobacco cessation counseling involving e-cigarettes (64.6%-69.2%). Most practitioners reported that information on traditional tobacco products (54.4%-75.9%) and tobacco cessation counseling (60.0%-75.9%) were included in their curriculum; however, only 5.6% reported ATPs were included and 23.3% or less reported that education on e-cigarettes was included in their curriculum. Practitioners want more training on e-
cigarettes (72.2%-88.9%) and tobacco cessation counseling involving e-cigarettes (52.2%-64.8%).
DISCUSSION

The results of this study support three main findings: a lack of knowledge among students and practitioners regarding e-cigarettes, diminished confidence in tobacco cessation counseling, and a deficiency in curricula for both dental hygiene and nursing students. To our knowledge, this study is the first to document, the knowledge, opinions, and behaviors of NC DH and nursing students and practitioners about e-cigarettes.

This study provided the opportunity to bring to the forefront the practice behaviors of DH and nursing students and practitioners regarding tobacco products and e-cigarettes. Students were asking about cigarette use in health histories more often than practitioners. While students are in training they are more likely practice what they are taught; however, the fact that only approximately one-half of practitioners were always asking about cigarette use during health histories was alarming and almost one-fifth of nurses reported not asking about cigarette use at all suggests that behavior changes after graduation. As students transition into practice, they need to continue to ask patients about tobacco use and need tobacco use cessation continuing education (CE) and incorporation of a standardization about always asking about cigarette, e-cigarette, and ATPs use with patients. Students and practitioners alike need more information provided in their curricula or CE to assist them in making referrals to specialists or community resources that could assist in quitting.

Students and practitioners alike lacked knowledge regarding FDA regulations and safety testing of e-cigarettes. Shearston et al found similar findings in that dental professional students had less knowledge about ATPs than cigarettes. VanDevanter concluded that
nursing students had low levels of knowledge regarding ATPs (including e-cigarettes) and their health consequences despite high rates of self-use and that nurses lack of knowledge undermines their ability to provide appropriate tobacco cessation counseling.\textsuperscript{18} Franks et al found that for multiple health professional students, substantial gaps in e-cigarette knowledge exists including gaps in knowledge regarding: smoking cessation, perceived harm reduction, and enhanced regulations.\textsuperscript{24}

Dental hygiene and nursing students and practitioners reported feeling more comfortable discussing approved NRTs, tobacco products, and tobacco cessation counseling; however, they were less comfortable discussing ATPs and risks/benefits of e-cigarettes. These findings are consistent with Shearston’s study that found that students reported low confidence levels on ATPs and tobacco cessation counseling.\textsuperscript{22} In a similar study assessing the use, knowledge, and beliefs about cigarettes and ATPs conducted at New York University School of Medicine, Zhou et al also found that a large percentage of the medical students lacked knowledge about the use of tobacco products and cessation counseling and were uncomfortable in providing accurate information to patients.\textsuperscript{25} The findings of VanDevanter et al were consistent with our findings regarding comfort levels with ATPs and e-cigarettes. To account for our findings and the findings of previous research, curricular modifications should be made in NC to address general information about ATPs (including e-cigarettes) and FDA regulations in order to provide practitioners with accurate and up-to-date information for their patients.

In the current study, students and practitioners reported that e-cigarettes and ATPs were not included in their curriculum; whereas, tobacco products and traditional tobacco
cessation counseling was. This is consistent with multiple other studies where traditional tobacco products are more stressed than ATPs, which are quickly rising in prevalence.\textsuperscript{18,22,24,25,27} In addition, both DH and nursing students and practitioners want more training on e-cigarettes and tobacco cessation counseling involving e-cigarettes. Efforts should be made in North Carolina to modify curricula and CE to meet the needs of the healthcare workforce and should focus on interprofessional education as a method to teach these two primary healthcare disciplines.

There were limitations to this study that should be noted. Data was collected from a one-time convenience sample (144 practitioners, 146 students) of students and practitioners in attendance at one of the two statewide conferences. Therefore, this information may not be generalizable to the entire population of DH and nursing students and practitioners across North Carolina. Those in attendance at the conferences were already those practitioners and students that were motivated to participate in extra education outside of school and could not be representative of the entire student population or workforce of these two disciplines.

Further studies are recommended to expand the sample size of respondents in order to assess on a larger scale the knowledge, behaviors, and opinions of DH and nursing students and practitioners. A nationwide survey would be beneficial to see if geographic differences exist.
CONCLUSION

The findings from this study support the need for standardization among healthcare professions (DH and nursing) in asking patients about their cigarette, e-cigarette, and alternative tobacco product use. Modifications must be made to dental hygiene and nursing curricula in North Carolina to include e-cigarettes and how to counsel patients who are using them. Once in practice, RDHs and RNs need continuing education regarding e-cigarettes and the effects on patient health. Practitioners need more resources to assist them in referring their patients to specialists to assist in quitting tobacco use or e-cigarettes. Current and future primary healthcare providers need to be knowledgeable and comfortable discussing e-cigarettes with patients as their use in the United States continues to rise and adverse health effects continue to be discovered.
# APPENDIX

## Table I. Student and Practitioner Practice Behaviors

<table>
<thead>
<tr>
<th>How often do you…</th>
<th>STUDENT</th>
<th></th>
<th>P Value</th>
<th>PRACTITIONER</th>
<th></th>
<th></th>
<th>P Value</th>
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<td></td>
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<td>Nurse</td>
<td></td>
<td>DH</td>
<td>Nurse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ask about cigarette use</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
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<tr>
<td>Always</td>
<td>65</td>
<td>80.3</td>
<td>37</td>
<td>56.9</td>
<td>28</td>
<td>51.9</td>
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<tr>
<td>Usually</td>
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<td>11.1</td>
<td>14</td>
<td>21.5</td>
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<td>16.7</td>
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<td>7</td>
<td>10.8</td>
<td>11</td>
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<td>7</td>
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<td>2</td>
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<td>Ask about e-cigarette use</td>
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<tr>
<td>Always</td>
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<td>10</td>
<td>15.4</td>
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<td>11.1</td>
<td>23</td>
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<td>Usually</td>
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<td>9.9</td>
<td>6</td>
<td>9.2</td>
<td>3</td>
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<td>Sometimes</td>
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<td>14</td>
<td>21.5</td>
<td>12</td>
<td>22.2</td>
<td>8</td>
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<tr>
<td>Rarely</td>
<td>12</td>
<td>14.8</td>
<td>15</td>
<td>23.1</td>
<td>18</td>
<td>33.3</td>
<td>20</td>
</tr>
<tr>
<td>Never</td>
<td>16</td>
<td>19.8</td>
<td>20</td>
<td>30.8</td>
<td>15</td>
<td>27.8</td>
<td>29</td>
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<tr>
<td>Advise a patient to quit e-cigarettes</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>27</td>
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<td>13</td>
<td>20.0</td>
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<td>24.1</td>
<td>26</td>
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<tr>
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<td>10</td>
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<td>Sometimes</td>
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<td>18.5</td>
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<td>22.2</td>
<td>8</td>
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<tr>
<td>Rarely</td>
<td>14</td>
<td>17.3</td>
<td>12</td>
<td>18.5</td>
<td>9</td>
<td>16.7</td>
<td>17</td>
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<tr>
<td>Never</td>
<td>13</td>
<td>16.1</td>
<td>19</td>
<td>29.2</td>
<td>13</td>
<td>24.1</td>
<td>28</td>
</tr>
<tr>
<td>Refer patients to assist in quitting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>12</td>
<td>14.8</td>
<td>4</td>
<td>6.2</td>
<td>3</td>
<td>5.6</td>
<td>19</td>
</tr>
<tr>
<td>Usually</td>
<td>11</td>
<td>13.6</td>
<td>13</td>
<td>20.0</td>
<td>6</td>
<td>11.1</td>
<td>10</td>
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<tr>
<td>Sometimes</td>
<td>21</td>
<td>25.9</td>
<td>15</td>
<td>23.1</td>
<td>12</td>
<td>22.2</td>
<td>15</td>
</tr>
<tr>
<td>Rarely</td>
<td>19</td>
<td>23.5</td>
<td>20</td>
<td>30.1</td>
<td>12</td>
<td>22.2</td>
<td>16</td>
</tr>
<tr>
<td>Never</td>
<td>18</td>
<td>22.2</td>
<td>13</td>
<td>20.0</td>
<td>21</td>
<td>38.9</td>
<td>29</td>
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<td>Statement</td>
<td>Correct %</td>
<td>Incorrect %</td>
<td>Don't Know %</td>
<td>Correct %</td>
<td>Incorrect %</td>
<td>Don't Know %</td>
<td>Correct %</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-----------</td>
<td>--------------</td>
<td>--------------</td>
<td>-----------</td>
<td>--------------</td>
<td>--------------</td>
<td>-----------</td>
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<tr>
<td>Long term safety of e-cigarettes is unknown (T)</td>
<td>71.6</td>
<td>16.1</td>
<td>12.4</td>
<td>70.8</td>
<td>9.2</td>
<td>20.0</td>
<td>0.27</td>
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<tr>
<td>E-cigarettes deliver less nicotine per puff than cigarettes (F)</td>
<td>50.0</td>
<td>31.3</td>
<td>18.8</td>
<td>43.1</td>
<td>13.9</td>
<td>43.1</td>
<td>0.002</td>
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<tr>
<td>Health risks of e-cigarettes are similar to smokeless tobacco (T)</td>
<td>58.0</td>
<td>13.6</td>
<td>28.4</td>
<td>32.3</td>
<td>23.1</td>
<td>44.6</td>
<td>0.008</td>
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<tr>
<td>FDA currently regulates e-cigarettes use in the US (T)</td>
<td>20.1</td>
<td>59.3</td>
<td>19.8</td>
<td>16.9</td>
<td>44.6</td>
<td>38.5</td>
<td>0.04</td>
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<td>FDA is authorized to test e-cigarettes for safety (T)</td>
<td>27.5</td>
<td>46.3</td>
<td>26.3</td>
<td>24.6</td>
<td>29.2</td>
<td>46.2</td>
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<td>E-cigarettes are approved by the FDA a NRT (F)</td>
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<td>14.8</td>
<td>28.4</td>
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<td>46.9</td>
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</table>

NRT = Nicotine Replacement Therapy; FDA = Food and Drug Administration; T = True; F = False
Table III. Student Comfort Levels Discussing Tobacco Products

<table>
<thead>
<tr>
<th>How comfortable you feel …</th>
<th>DH</th>
<th>Nursing</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Extremely-</td>
<td>Neither</td>
<td>Somewhat-Extremely Comfortable</td>
</tr>
<tr>
<td></td>
<td>Somewhat-Uncomfortable</td>
<td>29.6</td>
<td>18.5</td>
</tr>
<tr>
<td>Discussing approved NRT with patients</td>
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<td>14.8</td>
<td>61.7</td>
</tr>
<tr>
<td></td>
<td>Discussing tobacco products with patients</td>
<td>25.9</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Discussing tobacco cessation with patients</td>
<td>32.1</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td>Discussing alternative tobacco products</td>
<td>23.5</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td>Discussing risks and benefits of e-cigarettes with patients</td>
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</table>

NRT= Nicotine Replacement Therapy
Table IV. Practitioner Comfort Levels Discussing Tobacco Products

<table>
<thead>
<tr>
<th>How comfortable you feel ...</th>
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<th>P Value</th>
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</thead>
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<td></td>
<td>Extremely-Somewhat Uncomfortable</td>
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<td>Somewhat-Extremely Comfortable</td>
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<td>Discussing approved NRT with patients</td>
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<td>14.8</td>
<td>50.0</td>
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<td>Discussing tobacco products with patients</td>
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<td>61.1</td>
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<tr>
<td>Discussing tobacco cessation with patients</td>
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<td>66.7</td>
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<tr>
<td>Discussing alternative tobacco products</td>
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<td>45.3</td>
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<tr>
<td>Discussing risks and benefits of e-cigarettes with patients</td>
<td>44.2</td>
<td>19.2</td>
<td>36.5</td>
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NRT= Nicotine Replacement Therapy
### Table V. Professional Responsibility and Preparedness

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<th></th>
<th></th>
<th></th>
<th>P Value</th>
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<td>DH</td>
<td>Nursing</td>
<td>DH</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Understand approved alternatives for NRT</td>
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<td>26.3</td>
<td>21.3</td>
<td>52.5</td>
<td>21.5</td>
<td>18.5</td>
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<td>Think it is my responsibility to discuss tobacco products</td>
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<tr>
<td></td>
<td>7.5</td>
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<td>7.7</td>
<td>3.1</td>
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</tr>
<tr>
<td></td>
<td>10.0</td>
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<td>87.5</td>
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<td>90.8</td>
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NRT= Nicotine Replacement Therapy
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2016 Nov 15]; Available from: http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm506676.htm


