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Florida Orthodontists' Willingness To Provide A Human Papillomavirus Educational Intervention

Marc Edward Weber
Nova Southeastern University

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MARC E. WEBER, D.D.S.

A Thesis Presented to the Faculty of the College of Dental Medicine of

Nova Southeastern University in Partial Fulfillment of the Requirements for the

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Approved as to style and content by:

APPROVED BY: _____
Richard Singer, D.M.D., M.S., (Committee Chair) Date

APPROVED BY: _____
Saulius Drukteinis, D.M.D., M.S., Ph.D. Date
(Committee Member)

APPROVED BY: _____
Dr. Nydia Cummings, Ph.D. (Committee Member) Date

APPROVED BY: _____
Linda Niessen, D.M.D., M.P.H. Date
(Dean, College of Dental Medicine)

NOVA SOUTHEASTERN UNIVERSITY

Health Professions Division
Department of Orthodontics
College of Dental Medicine

STUDENT NAME: Marc E. Weber, D.D.S.

STUDENT E-MAIL ADDRESS: mw1564@mynsu.nova.edu

STUDENT TELEPHONE NUMBER: (704)-491-8918

COURSE DESCRIPTION: Masters of Science

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I certify that I am the sole author of this thesis, and that any assistance I received in its preparation has been fully acknowledged and disclosed in the thesis. I have cited any sources from which I used ideas, data, or words, and labeled as quotations any directly quoted phrases or passages, as well as providing proper documentation and citations. This thesis was prepared by me, specifically for the M.Sc.D. degree and for this assignment.

STUDENT
SIGNATURE: _____
Marc E. Weber, D.D.S. Date

DEDICATION

To my husband Julian, for his unwavering support throughout my academic endeavors and for always believing in me every step of the way.

To Mom, Dad, Kirby, and Caroline for their confidence in me from the day I announced I was going to dental school and for their constant encouragement over the years. Without them I would not be where I am today.

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FLORIDA ORTHODONTISTS' WILLINGNESS TO PROVIDE A HUMAN PAPILLOMAVIRUS EDUCATIONAL INTERVENTION

DEGREE DATE: December 2017

MARC E. WEBER, D.D.S.

COLLEGE OF DENTAL MEDICINE NOVA SOUTHEASTERN UNIVERSITY

Thesis Directed By: Richard Singer, D.M.D., M.S., Committee Chair

Saulius Drukteinis, D.M.D., M.S., Ph.D., Committee Member

Nydia Cummings, Ph.D., Committee Member

Abstract

Introduction: Human Papillomavirus (HPV) is the most common sexually transmitted infection with an estimated fourteen million new cases each year in the United States alone. HPV infections generally resolve with little or no incident, but persistent infections can lead to more serious sequelae such as oral and cervical cancers. The Centers for Disease Control and Prevention recommends that all 11-12 year olds receive the HPV vaccine; yet, the prevalence of HPV vaccination in the U.S. population is far below the prevalence of routine childhood vaccinations. Clearly, there is a public health imperative to increase the HPV vaccination rate among American youth. Because orthodontists see patients of the vaccination target age monthly, for 2 or more years, they are particularly well positioned to influence vaccination rates by educating patients and their parents about HPV and the HPV vaccine. Therefore, the goals of this study were to examine the determinants of orthodontists' willingness to provide an HPV educational intervention to adolescent patients, and orthodontists' agreement that HPV is within the scope of orthodontic practice. **Methods**: A survey instrument informed by the Integrated Behavior

Model of health behaviors was used to obtain cross-sectional data from a representative sample of Florida Orthodontists' that assessed personal and practice demographics, knowledge regarding HPV and the HPV vaccine, and their willingness to provide an HPV educational intervention. Univariate, bivariate, principle component, and multivariable logistic regression analyses were used to evaluate the specific aims. **Results**: For each year that participants' aged, the adjusted odds of willingness increased 12% (AOR = 1.12, 95% CI 1.02, 1.23). Additionally, those participants who agreed that HPV causes cancer in females, were four times more willing to provide an HPV educational intervention than those who disagreed (AOR = 4.07, 95% CI 1.51, 10.94). *Perceived Control* (AOR = 2.03, 95% CI 1.06, 3.90), and *Salience* (AOR = 3.09, 95% CI 1.35, 7.09) were also significant determinants of orthodontists' willingness to provide an HPV educational intervention. The amount of office time respondents were willing to provide to deliver HPV information to patients was a significant predictor of agreement that HPV was within the scope of orthodontic practice; less than 1 minute (AOR = 7.55, 95% CI 1.09, 52.33), 1-2 minutes (AOR = 21.20, 95% CI 3.44, 130.52), and 3-4 minutes (AOR = 41.05, 95% CI 6.04, 279.12). Neither self-rated knowledge nor agreement that HPV is within the scope of orthodontic practice, were significant determinants of orthodontists' willingness to provide an HPV educational intervention. In addition, encouragement to discuss HPV or recommend the HPV vaccine during professional education were not significant predictors of respondents' agreement that HPV is within the scope of orthodontic practice. **Conclusions**: Our findings suggest an opportunity to impact orthodontists' willingness to provide an HPV educational intervention through encouraging orthodontists to discuss HPV and the HPV vaccine effectively in

professional school and continuing education, the availability and dissemination of informational pamphlets, and support and guidance from the American Association of Orthodontists (AAO). Also, support and guidance from the AAO may promote orthodontists' understanding that HPV is within the scope of orthodontic practice.

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Chapter 1: Introduction

1.1. Background

1.1.1. The Human Papillomavirus

Human Papillomavirus (HPV) is the most common sexually transmitted virus that infects most men and women at some point in their lives.[1] It is estimated that there are more than fourteen million new cases of HPV each year in the United States.[1] While most infections resolve spontaneously, HPV can cause a number of health sequelae that range from benign warts to invasive cancers.[1,2] HPV plays a prominent role in the development of cervical cancer, the second most prevalent cancer among women.[3] The incidence and prevalence of different HPV-related cancers vary by sex and race/ethnicity. The United States Centers for Disease Control and Prevention (CDC) cancer registry data reveals a higher incidence of HPV-related cervical cancers among black and Hispanic women than women of other race/ethnicities.[4] Similarly, the incidence of HPV-related vaginal cancers are greater in Black and Hispanic women than others, while white women exhibit a higher incidence of HPV-related vulvar cancers.[4]

HPV is particularly pertinent for oral health professionals because it has been identified as an etiologic agent for oropharyngeal cancers.[5] A case study in the United States that examined 130 individuals with newly diagnosed oropharyngeal cancers found that 63% were attributable to HPV infection.[6,7] As with HPV-associated genital tract cancers, studies have also demonstrated that the incidence and prevalence of HPV-related oropharyngeal cancers vary by race/ethnicity and sex. Higher incidence of HPV-related oropharyngeal cancers exist among non-Hispanic whites compared to Hispanics and non-

Hispanic blacks. Moreover, the incidence of HPV-related oropharyngeal cancers is higher for men than for women.[4] According to the CDC, between 2008 and 2012, approximately 1:10,000 males and 1:50,000 females were diagnosed with an HPV-associated oropharyngeal cancer in the state of Florida alone.[8] These statistics are particularly discouraging considering that preventative vaccines have been available since 2006.[1]

1.1.2. The Human Papillomavirus - Microbiology & Pathogenesis

The Human Papillomavirus is composed of small, circular, non-enveloped double stranded DNA that infects both cutaneous and mucosal epithelium.[2,9] There are over 200 strains of the HPV virus that are each differentiated by a genetic sequence found in their outer protein capsule.[2,9] HPV viruses are further categorized by morbidity / oncogenicity, as either low-risk / non-oncogenic, or high-risk / oncogenic.[2] The non-oncogenic strains include HPV-6 and HPV-11 and have been implicated in benign lesions such as genital warts, while oncogenic strains include HPV-16 and HPV-18 and have been identified as etiologic agents for cervical and oropharyngeal cancers.[2] Specifically, HPV-16 is the cause of approximately 50% of cervical cancers worldwide, and HPV-16 and HPV-18 together account for about 70% of cervical cancers.[10] Likewise, 90% of HPV-positive oropharyngeal cancers are associated with HPV-16 and HPV-18.[6,11-14] Oncogenic strains of the HPV virus integrate into the host's genome and produce oncoproteins that in turn target and destroy tumor suppressor genes TP53 and RB1 that allow the virus to proliferate.[15]

Transmission of the virus is predominantly through skin-to-skin contact with an infected individual.[1] Infected individuals most commonly transmit the HPV virus through vaginal or anal sexual intercourse; however, it is also transmitted through oral sex and open-mouth kissing.[1,16] The virus is latent in most people, producing no clinical signs of infection. In such cases, the virus is usually cleared by host immune response in six to twenty-four months.[1,9,15] A small percentage of individuals do become symptomatic.[15] Genital warts are the most common clinical manifestation of the HPV virus and occur in 1% of the sexually active U.S. population. Other clinical manifestations of the HPV virus include anal warts, recurrent respiratory papillomatosis, cervical intraepithelial neoplasia, and more serious malignancies including vaginal, cervical, penile, anal, and oropharyngeal cancer.[2]

1.1.3. The Human Papillomavirus – Vaccinations and Guidelines

There is no treatment for existing HPV infections; however, The United States Food and Drug Administration (FDA) has approved three vaccines that can prevent infection of several oncogenic HPV strains. *Cervarix* is a bivalent intramuscularly administered vaccine, indicated for females, that evokes an immune response against HPV-16 and HPV-18.[17] The *Cervarix* regimen involves three doses; the second dose one month and third dose six months following the initial dose.[17] *Gardasil*, is a quadrivalent vaccine that protects against HPV strains 6, 11, 16, and 18.[9] *Gardasil*, indicated for both males and females, is also administered via intramuscular injection.[9,18] The *Gardasil* vaccine is also delivered in three doses, following the same regimen as *Cervarix*.[18] *Gardasil 9*, a 9-valent vaccine, also indicated for males and females, not only imparts

immunity for all HPV strains targeted by *Cervarix* and *Gardasil*, but also HPV strains 31, 33, 45, 52, and 58.[1] *Gardasil 9* is administered intramuscularly in either a two-dose or three-dose regimen.[19]

The CDC recommends HPV vaccination for males and females between the ages of 11-12 years.[1] This is the age group when children often begin experimenting sexually and are likely exposed to HPV.[1] A study by Finer and Philbin concluded that approximately 1% of 11-12 year old children engaged in sexual intercourse, however, Finer and Philbin did not examine other forms of sexual interaction, such as oral and anal sex.[20] As such, it is likely that Finer and Philbin's study underestimated the prevalence of sexual activity among 11-12 year old children and by extension, those susceptible to exposure. Importantly, studies have shown HPV vaccines are most efficacious if they are administered before children become sexually active and not efficacious once they have contracted the virus.[6]

1.1.4. The Human Papillomavirus Vaccine Safety and Efficacy

Each of the three vaccines recommended by the CDC and approved for use by the FDA are safe, when administered with awareness of the contraindications and their possible adverse reactions. Contraindications to vaccine administration include allergic reactions to vaccine components or a previous HPV vaccine, moderate or severe acute illnesses, and pregnancy.[2,21] Acute adverse reactions include fever, local cutaneous responses at injection sites, such as pain, redness, swelling, and syncope following injection.[2, 17-19] With respect to long-term adverse reactions, a three-year study evaluated

individuals following vaccination with *Gardasil* and found that with the over 600,000 doses administered, there were no increased risks of Guillian-Barre Syndrome, stroke, venous thromboembolism, appendicitis, syncope, allergic reactions, or anaphylaxis.[22]

Serious side effects have been reported to rarely occur after HPV vaccination. The U.S. Department of Health and Human Services (DHHS) formed The National Vaccine Injury Compensation Program (VICP) to address vaccination injuries. The VICP entitles seriously injured individuals to compensation.[23] The DHHS determines whether the cause of the individual's injury was due to vaccination, by reviewing a petition from the injured individual submitted to the VICP.[23] After a review of information presented by the petitioner and the DHHS, the United States Court of Federal Claims issues a final ruling.[23] The Health Resources and Services Administration (HRSA), a division of the DHHS, reports the frequency of serious complications due to all vaccines, including the HPV vaccine.[23] From 2006 to 2015, only 13 of the approximately 89,696,704 doses of the HPV vaccine that were administered to the U.S. population resulted in injury that lead to a financial award to the injured individuals.[23] Similarly, 23 of the approximately 88,814,104 doses of the common childhood vaccination DTaP resulted in injury that lead to a financial award to the injured individuals.[23] The HPV vaccine seemingly compares favorably with the safety observed among the routine DTaP vaccination.

The CDC has deemed HPV vaccines highly efficacious with over 99% of recipients developing antibody responses to target genotypes one month after completing the appropriate dosing regimen.[2] These vaccines provoke an immune response targeted

towards particular HPV strains, however, vaccine efficacy is dependent upon whether or not the individual was exposed to the specific HPV strains before vaccination. The vaccines have no therapeutic effect on pre-existing HPV infections.[2] A long-term study demonstrated that females vaccinated at ages 10-14 years maintained seropositivity up to seven years after immunization with the bivalent HPV vaccine, *Cervarix*.[24] Another study, including females and males ages 9-15 years, demonstrated persistent seropositivity eight years after immunization with the quadrivalent HPV vaccine, *Gardasil*.[25] The seropositivity observed in these studies demonstrated that long-term immunogenic response was elicited by both of these HPV vaccines.

1.2 The Human Papillomavirus Health Impact

1.2.1. Low Vaccination Rates

The CDC Advisory Committee on Immunization Practices (ACIP) recommends that adolescents between the ages of 11-12 years receive routine vaccination for tetanus-diphtheria-pertussis (DTaP), meningococcal disease, *and* HPV.[26] The ACIP recommends the administration of the HPV vaccine *together* with the DTaP and Meningococcal vaccines in a single visit to promote higher HPV vaccination rates, because co-administration does not negatively impact the immunogenicity of the vaccines.[27] Despite this recommendation, in 2016 only 49.5% of adolescent females and 37.5% of adolescent males had completed the HPV vaccination series, while vaccination coverage of males and females aged 13-17 years for ≥1 dose of the DTaP and Meningococcal vaccines were 88.0% and 82.2%, respectively.[26] It is not clear why a disparity in vaccination rates exists given that these vaccines are all equally safe and all recommended by the ACIP.

1.2.2. Potential Facilitators and Barriers

To effectively increase HPV vaccination rates in this country, public health research must identify the barriers and facilitators that impact vaccine-related discussions / recommendations and vaccine administration. An understanding of these barriers and facilitators provide opportunities for targeted public health interventions. In a recent study, Gilkey et al.,[28] assessed physician communication about adolescent vaccination for HPV. [28] Gilkey et al.,[28] reported that pediatricians and family physicians viewed discussions of HPV vaccination as burdensome, garnering less parental support, and lasting twice as long as discussions about other vaccinations.

Educating patients and parents about HPV will likely lead to increased HPV vaccination uptake. One study of male students at a two-year college in New York City reported that HPV knowledge was low but that acceptability of the vaccine was high.[29] The authors suggested that since individuals are amenable to receiving the vaccine, perhaps the low vaccination rates are due to deficiencies in doctor-patient communication about HPV.[29] The authors speculated that a dialogue between providers and their patients to increase HPV awareness, would promote an increase in vaccination rates.[29] Similarly, Bertram and Niederhauser[30] observed that male and female college students in Hawaii knew little about HPV or the virus's relationship to cancer. Their study reported confusion among students regarding the differences between high and low risk HPV strains and the respective health sequelae.[30] Bertram and Niederhauser[30] highlighted a need for healthcare providers to discuss HPV with their patients to increase patients'

awareness. Clearly, an opportunity exists for all health professionals to play a role in HPV education and prevention.

Evidence that HPV causes oral and oropharyngeal cancers highlights the important role for dentists in prevention of HPV infection.[5,6,9,31] To date, among the small number of studies that have focused on HPV provider/patient discussions, fewer have considered the potential role of dentists or dental specialists. Among the few studies that have considered a role for dentists, Daley et al.,[32] found that more than 52% of the Florida general dentists surveyed, reported no intention to discuss the HPV vaccine with female patients. Daley et al.,[32] found that dentists declined to discuss the HPV vaccine with patients because of discomfort discussing sexual health related topics, a lack of guidelines or oversight from dental professional organizations, and that dialogue regarding HPV was viewed as outside the scope of dental practice. As dental specialists, orthodontists' likely share the same aversions to discussing HPV vaccination as their general dental colleagues. Yet, it is important to recognize that because the orthodontic patient population is predominantly adolescent, efforts by orthodontists to increase HPV vaccine rates among their patients may be among the most impactful of all public health efforts to increase the HPV vaccination rates. In fact, according to Shapiro,[33] an orthodontist's recommendation for HPV vaccination was more important than a physician's recommendation, as a predictor of patients' parents' willingness to permit their child to receive the HPV vaccine.

1.2.3. The Orthodontists' Impact

In 2014, 83% of children aged 2-17 years had visited a dentist (including specialists such as orthodontists) in the past year.[34] As such, dentists are among the most frequently visited healthcare providers annually,[34] and have an opportunity to provide important educational information about HPV and the need to vaccinate that, to date, has been overlooked. Given that the majority of orthodontic patients are adolescents, the optimal age targeted by the CDC for HPV vaccination, among all dentists, orthodontists are perhaps the best positioned to provide important educational information about HPV and recommend vaccination. In 2014, American Association of Orthodontists (AAO) members in the U.S. and Canada treated a total of 5,419,000 patients.[35,36] Seventy-three percent (3,959,000) of these patients were 17 years of age or younger.[35,36] Patients generally visit the orthodontist once per month for two consecutive years. As such, there is repeated, frequent contact between orthodontists and their patients. Such contact provides opportunities for orthodontists to have discussions with patients, aimed towards increasing HPV vaccination uptake. Clearly, orthodontists have a unique opportunity and a responsibility to contribute to public health interventions to reduce the prevalence of HPV infection and associated cancers that are targeted towards their patients, the population most at risk. Yet according to Daley et al.,[32] dentists, and likely orthodontists, are hesitant to do so. Therefore, it is important to identify the barriers and facilitators determining orthodontists' willingness to discuss HPV with their patients in order to capitalize on their potential impactful role in HPV prevention. However, to our knowledge, previous studies have not yet examined the determinants of orthodontists' willingness to discuss HPV with patients.

1.3 Models of Behavior

It is important to understand whether orthodontists currently discuss HPV with patients and their parents and if not, then it is necessary to examine the determinants of their willingness to do so. Psychological models of health behavior are designed to explain a wide range of health behaviors by emphasizing that intent is the best predictor of performing a behavior.[37] The psychological constructs of health behavior models permit an understanding of the determinants of behavioral intent that can then be used to target and implement effective interventions to change behaviors.[37] One such psychological model is the Integrated Behavior Model (IBM). The IBM is an extension of the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB).[37] The IBM was used in this study to inform our survey instrument in order to identify the determinants of orthodontists' willingness to provide an HPV educational intervention to their patients and agreement that HPV is within the scope of orthodontic practice (Figure 1). In this context, "educational intervention" was defined as delivery of information related to HPV and the HPV vaccine via discussion with patients and parents, delivery of instructional videos or pamphlets.

1.3.1. History and Background – Psychological Health Behavior Models

The TRA was proposed by Martin Fishbein[38] in 1967 and emphasized that the best predictor of behavior is behavioral intention. The two constructs Fishbein described that influence intention were attitude and subjective norm.[38] Attitude is described as a person's overall favorableness or unfavorableness towards performing a behavior and an individual's attitude is a direct determinant of their behavioral intention.[38] Fishbein's

second construct, subjective norm, describes how the pressure one feels in social interactions influences their intent to perform or not perform a particular behavior.[38]

The TPB, postulated by Icek Ajzen[39-41] in 1985, improved upon the TRA by including the construct of perceived control over the performance of a behavior. Perceived control describes one's perceived ability to perform a behavior, after taking into account environmental factors that may make it easy or difficult to perform that behavior.[39] The TRA and TPB have been used for decades to explain health behaviors, including smoking, drinking, exercise, and the performance of health professionals.[37,42] Just as the TPB developed as a more explanatory extension of the TRA, the IBM is viewed as a more comprehensive extension of the TPB with the addition of constructs such as knowledge, salience, environmental constraints, and habits that increase our understanding of health behaviors.[37]

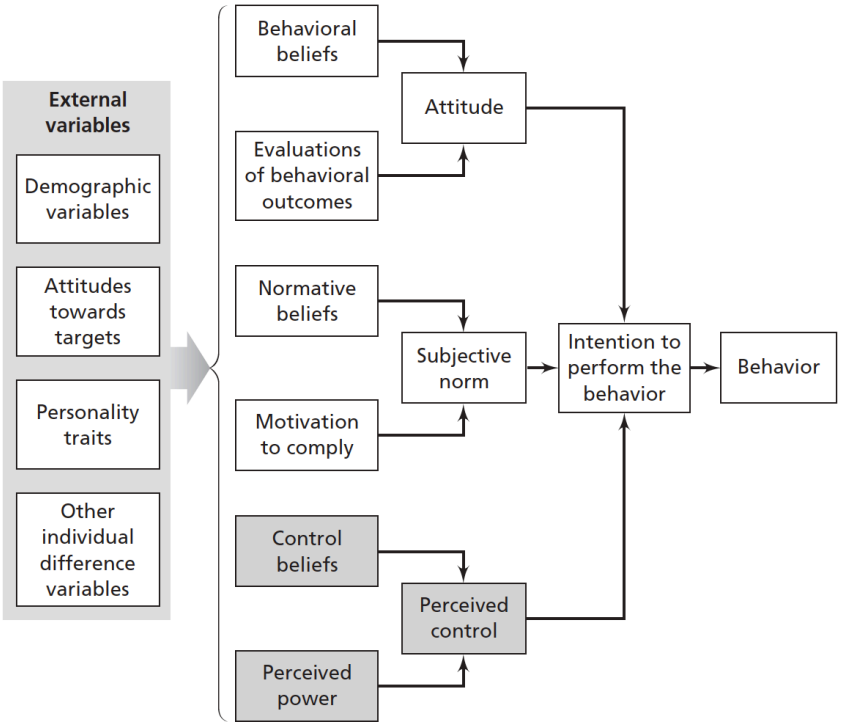

Figure 1: Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB).[37] The unshaded boxes model the TRA while the unshaded boxes together with the shaded boxes model the TPB.

1.3.2. The Integrated Behavior Model

The IBM, illustrated in Figure 2, is a validated model that, like the TRA and TPB, postulates intent as the best predictor of behavior.[37] Like previous models, the IBM includes three constructs that directly influence behavioral intent, attitude, normative beliefs, and control beliefs.[37] In the IBM, attitude is subdivided into experiential attitude and instrumental attitude.[37] Experiential attitude is one's emotional response to the idea of performing a behavior while instrumental attitude is determined by beliefs about the outcomes of a behavior.[37] Perceived norm is subdivided into injunctive norm and

descriptive norm.[37] Injunctive norm involves beliefs about what others think one should do while descriptive norm involves perceptions about what others in one's social or personal networks are doing.[37] Personal agency has two components including self-efficacy and perceived control.[37] Self-Efficacy involves the confidence needed to perform a behavior in the face of challenges and perceived control as previously explained, is ones perceived amount of control over behavioral performance.[37] The IBM introduces four additional constructs that directly affect behavior; knowledge, salience, environmental constraints, and habits.[37] These four constructs that impact behavior directly, reflect findings that an observed behavior is more likely to be performed if one has the knowledge and skills necessary to execute the behavior, the behavior is deemed important, there are no environmental influences preventing the behavior, and the behavior has been performed previously.[37]

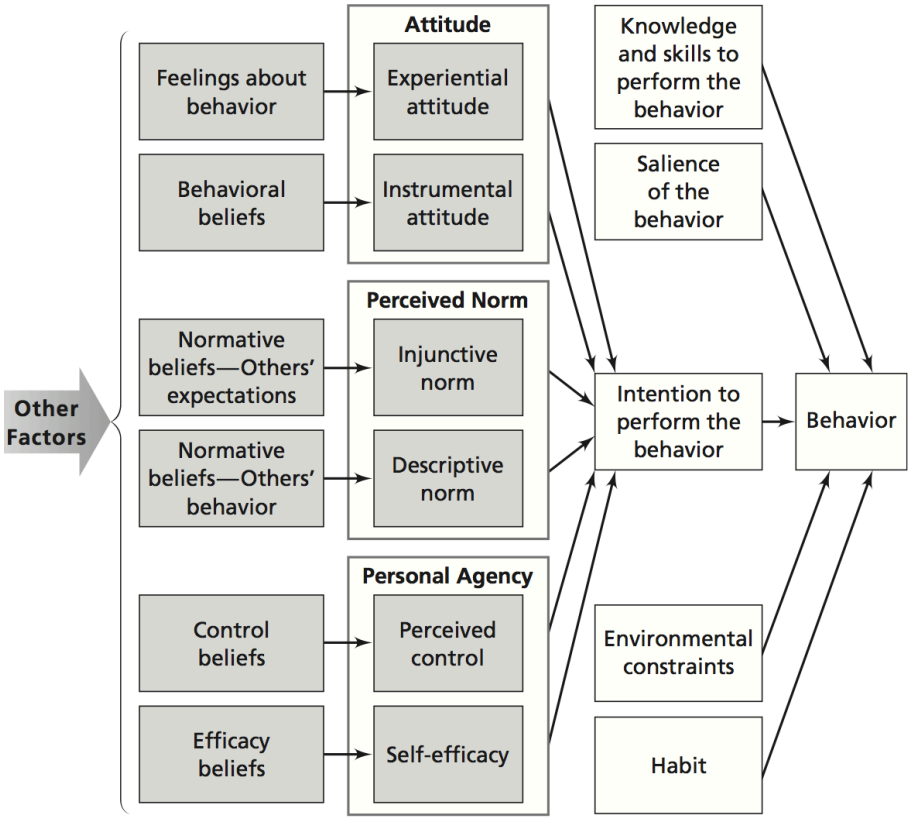

Figure 2: Integrated Behavior Model (IBM).[37]

1.4. Current Study

1.4.1. Purpose

HPV's etiologic role in oral and oropharyngeal cancers demands that dentists and dental specialists be proactive, armed with knowledge, and effectively communicate with patients and their parents about the pathogenicity of the virus and availability of prophylactic vaccines.[31] The prevalence of HPV vaccination in the U.S. population is far below the prevalence of routine childhood vaccinations.[26] Because the majority of orthodontic patients are the primary target age for HPV vaccination and are seen by the orthodontist on a frequent, long-term basis during orthodontic treatment, this study

examined the determinants of orthodontists' willingness to provide an HPV educational intervention to adolescent patients, and orthodontists' agreement that HPV is within the scope of orthodontic practice.

1.4.2. Specific Aims

Specific Aim 1: To describe the prevalence of Florida Orthodontists' willingness to provide patients with an HPV educational intervention and/or administer the HPV vaccination.

Specific Aim 2: To examine the association between Florida Orthodontists' self-rated knowledge of HPV and the HPV vaccine with their willingness to provide patients with an HPV educational intervention.

Hypothesis 1: Orthodontists' willingness to provide patients with an HPV educational intervention will increase with greater self-rated knowledge of HPV and the HPV vaccine.

Specific Aim 3: To examine the association between Florida Orthodontists' agreement that HPV is within the scope of orthodontic practice and their willingness to provide patients with an HPV educational intervention.

Hypothesis 2: Orthodontists' willingness to provide patients with an HPV educational intervention will increase with agreement that HPV is within the scope of orthodontic practice.

Specific Aim 4: To examine the association between Florida Orthodontists' encouragement during their professional education to either discuss HPV with their patients or recommend the HPV vaccine, and agreement that HPV is within the scope of orthodontic practice.

Hypothesis 3: Orthodontists' agreement that HPV is within the scope of orthodontic practice will increase with encouragement during their professional education to either discuss HPV with their patients or recommend the HPV vaccine.

Chapter 2: Materials and Methods

2.1. Study

This cross-sectional study used data obtained from a survey administered to a representative sample of Florida Orthodontists. The survey instrument, informed by the IBM, was used to assess these orthodontists' personal and practice demographic characteristics, knowledge regarding HPV and the HPV vaccine, orthodontists' willingness to provide an HPV educational intervention to adolescent patients, and agreement that HPV is within the scope of orthodontic practice. We examined the determinants of orthodontists' willingness to provide an HPV educational intervention and agreement that HPV is within the scope of orthodontic practice.

2.2. Participants

The sampling frame was derived from an exhaustive search of the AAO membership directory for the state of Florida and the Yellow Page listings for each county in Florida. The combined list was cross-checked for duplicate entries resulting in a comprehensive listing of all Florida Orthodontists, both non-members and members of the AAO. The sample of prospective participants for this study was a representative sample of 474 orthodontists selected from the sampling frame. The inclusion criteria for study participants were as follows: English speaking orthodontists, who graduated from a CODA accredited postgraduate orthodontic program, and who were actively practicing in the state of Florida at the time of this study in February 2017. Individuals, who did not meet the inclusion criteria, as well as, orthodontists that served as full-time faculty at the Nova Southeastern University, College of Dental Medicine, Department of Orthodontics

at the time of this study, were excluded. The resulting sample included 15 (3%) participants without and 459 (97%) with membership in the AAO (Figure 3). Each participant was assigned a unique six-character (three-letter and three-digit) identifier for anonymity and tracking purposes.

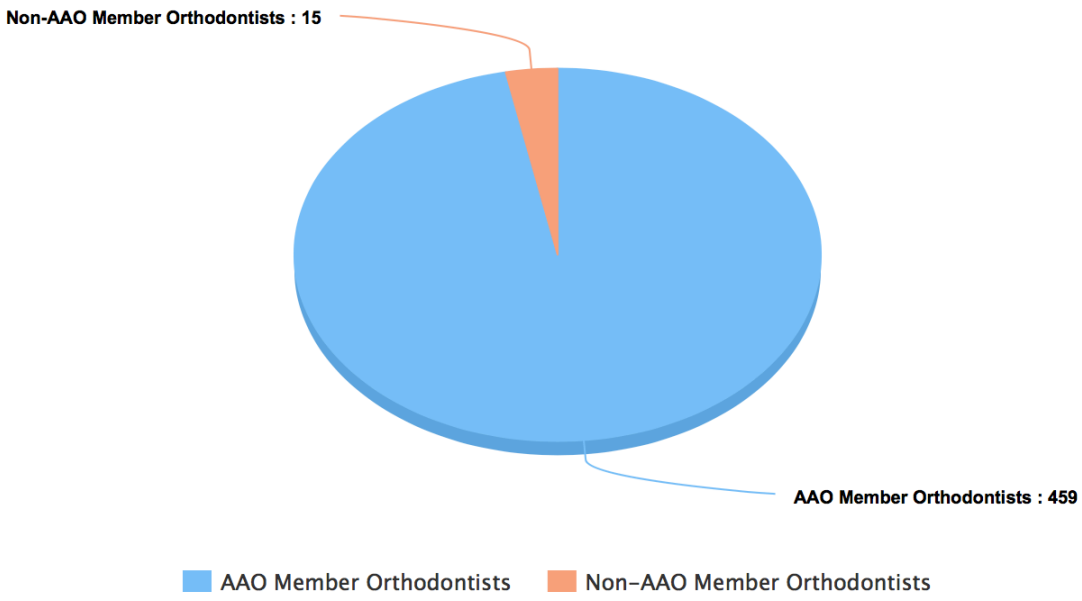

Figure 3: American Association of Orthodontists membership status within the study sample

2.3. Focus Group Procedures

Ten participants were selected and agreed to partake in focus group interviews during development of the survey instrument. Five of the ten participants were randomly selected from the sample of 474 orthodontists currently practicing in the state of Florida using a web-based random number generator. The remaining five were selected by convenience from among the Florida Orthodontists that currently serve as adjunct faculty members in the Department of Orthodontics within the College of Dental Medicine at Nova Southeastern University. Adjunct faculty members were not included in the original

sample of 474 orthodontists currently practicing in the state of Florida. Focus group participants were excluded from participating in the survey.

According to Fishbein,[43] the beliefs underlying a particular health behavior may be different for different populations. Therefore, an elicitation phase was a requirement for survey design to ensure that the survey was valid for the intended target population.[43] The elicitation phase for our study consisted of open-ended telephone interviews that identified beliefs of our sample population to permit appropriate measurement of constructs of the IBM within our survey instrument.[37] Specifically, interviews assessed attitudes towards performing and the outcome of performing an HPV educational intervention, the impact other individuals or groups may have on performing an HPV educational intervention, and certain facilitators or barriers to delivery of an HPV educational intervention.[37] This information helped to specify questionnaire content.[37] Focus group interviews were also used to confirm face validity by asking participants questions such as, "Do you understand what this item is asking you? Why or Why not?" and "Do you feel confident that the responses you gave accurately represent your views, beliefs, or opinions? Why or why not?"

2.3. Survey Instrument

The 29 item survey instrument used in this study was informed by the IBM.[37] Survey instrument design, with respect to content validity, item content, construction, and response scales, was based upon recommendations from experts and the literature regarding the use of the IBM.[37,44] Completion of the self-administered survey instrument

required ten to fifteen minutes of the participant's time and was completed in one sitting. Study participant responses were submitted by either return of the mailed hardcopy survey instrument or by electronic submission on the REDCap website, an online application for construction, administration, and management of digital survey instruments. Hardcopy responses were entered manually into a Microsoft Excel spreadsheet individually, by both the principal investigator and a research assistant, and the data was later compared for accuracy. Electronic submissions were automatically recorded in REDCap and exported as an Excel spreadsheet. Finally, hardcopy and electronic response spreadsheets were merged and used for data analysis. Participant email addresses and contact information were disassociated from survey response data and stored in a file on a separate password protected university server.

2.5. Solicitation and Recruitment

Dillman's Total Design Method (TDM) informed the survey administration for the current study.[45] The TDM includes a prescribed series of contact communications with prospective participants in order to maximize survey response rates.[45] The initial contact prescribed by the TDM, is a mailed cover letter outlining the purpose of the study along with the survey instrument.[45] One-week later, a reminder postcard is sent, followed by an additional questionnaire booklet three weeks and seven weeks after the initial mailing to non-respondents.[45] Survey administration in our study followed a modification of the TDM, both in contact modalities and communications timing.

Communication with prospective participants utilized a series of structured

mailings and emails administered by REDCap. Postal and email addresses were acquired from the AAO membership directory and the Yellow Page listings. An initial hardcopy mailing contained an introductory letter, informed consent statements, and hardcopy of the survey instrument with a pre-addressed, stamped envelope to return the survey. Subsequent REDCap emails included an invitation to participate with an explanation of the study and its purpose, as well as an embedded hyperlink to the electronic informed consent and survey instrument that was housed on the REDCap website. A 4"x 6" reminder postcard included an invitation to participate with an explanation of the study and its purpose, as well as a REDCap web address to permit informed consent and completion and submission of the survey instrument. Following acceptance of the informed consent, respondents were provided the self-administered survey instrument. Individuals wishing to decline participation in the study could withdraw at study initiation or opt-out from the study at any time without consequences. Incomplete survey instruments were included in the study. All communications with prospective participants included the primary investigator's contact information so that participants could ask questions if necessary at any time during the study.

Contact communications were staged to allow ample participant response time but amended from those communications prescribed by the TDM. At each step in the communication process, prospective participants were thanked for their time and effort to participate, and contribution to furthering an important research effort. In addition, participant identifiers were used at each stage of communication only to ensure that those who had previously submitted survey responses were excluded from all further

communications. Two weeks following the initial mailing, the principal investigator sent a solicitation email, followed by two additional solicitation emails, each at two-week intervals, to non-respondents via the REDCap website. One week following the final email, a postcard was sent to non-respondents to encourage participation. A final telephone call to non-respondents was placed two weeks following the postcard mailing to request submission of either the hardcopy or emailed survey.

To encourage participation and to acknowledge and thank individuals for their time and effort in advancing our research endeavors, opportunities to enter a drawing were provided as incentives. Incentives were offered to those who participated in the focus group elicitation phase and to participants who completed the survey. The incentives offered were entries into a drawing for a 42mm Apple iWatch at the completion of the study. The number of drawing entries granted depended upon the solicitation stage when each participant submitted a completed survey. Each participant's random 6-character alphanumeric identifier was used to track survey submission in relation to the stage of solicitation in order to appropriately assign drawing entries. Each drawing entry for each participant was recorded by saving the participant's alphanumeric identifier to a single row, in the first column of a Microsoft Excel spreadsheet. Multiple drawing entries were recorded by saving the participants' alphanumeric identifier on multiple rows in the same column of the spreadsheet.

The method of awarding drawing entries for each solicitation stage was as follows. One entry was provided for those who participated in the focus group elicitation

interviews. Participants received a single entry into the incentive drawing after completing the hardcopy survey or first emailed survey. Two drawing entries were awarded for completion of the second and third emailed surveys. Following the dissemination of the third solicitation email, fewer responses were received from study participants than anticipated. The principle investigator and research assistants subsequently placed telephone calls to non-respondents in order to confirm email addresses and encourage participation. A fourth and final solicitation email was then sent one week following the third email. Three drawing entries were awarded for completed surveys received following the final solicitation email. One week following this final email, a postcard was sent to non-respondents to again encourage participation. Five drawing entries were awarded for completed surveys received following the reminder postcard. The principal investigator and research assistants placed a final telephone call to non-respondents, two weeks following the postcard mailing, to request submission of either the hardcopy or emailed survey. Ten drawing entries were awarded for completed surveys received after the final telephone solicitation. Following the study, one identifier was randomly selected from this column using a web-based random number generator, the study participant was contacted and the Apple iWatch incentive was awarded. The institutional review board of Nova Southeastern University approved our study design, methods, and protocols.

2.6. Dependent Variables

For Specific Aim 1, prevalence was measured by a survey item response to whether orthodontists would be willing to provide an HPV educational intervention

and/or administer the HPV vaccine to their patients, based on a 4-point Likert scale dichotomized to “willing” vs. “un-willing”. The dependent variable for Specific Aims 2 and 3 was also the dichotomized “willingness” Likert response to the survey item that assessed whether orthodontists would be willing to provide patients with an HPV educational intervention. For Specific Aim 4, the dependent variable was measured by a survey item response to whether orthodontists agreed HPV was out of the scope of orthodontic practice, based on a 4-point Likert scale dichotomized to “agree” or “disagree”. For ease of interpretation, this variable was then recoded to assess agreement that HPV was *within* the scope of orthodontic practice.

2.7. Independent variables

For Specific Aim 2, the primary independent variables of interest were measured by survey item responses to orthodontists’ self-rated knowledge of HPV and the HPV vaccine based upon a 4-point Likert scale dichotomized to “none or limited” vs. “moderate”, “good”, or “excellent”. The primary independent variable of interest for Specific Aim 3, was a response to whether orthodontists agree HPV was out of the scope of orthodontic practice, measured by a Likert scale, dichotomized to agree or disagree. For ease of interpretation, this variable was then recoded to assess agreement that HPV was *within* the scope of orthodontic practice. For Specific Aim 4, the primary independent variable of interest was measured by a survey item response to assess Florida Orthodontists’ encouragement during their professional education to either discuss HPV with their patients or recommend the HPV vaccine dichotomized to “yes” or “no”.

Additional independent variables included respondents' sociodemographic characteristics (age, sex, race/ethnicity), characteristics of respondents' orthodontic practices (years in practice, practice setting, number of patients treated daily, and the number of patients treated that are ≤17 years or ≥18 years of age), and responses to survey items informed by the domains of the IBM. The IBM domains used included *Perceived Norm (Injunctive Norm), Knowledge, Personal Agency* (*Self-Efficacy and Perceived Control*)*, Salience, and Environmental Constraints*.

2.8. Statistical Analysis

The study included univariate, bivariate, principle component, and multivariable logistic regression analyses. The univariate analysis described the socio-demographic and background characteristics of our sample by reporting the means and standard deviations of the continuous variables and frequencies and proportions of categorical variables. The bivariate analyses evaluated the unadjusted associations between the two dependent variables and each of the independent variables. Principle component analysis was employed to identify if groups of seemingly correlated observed variables (survey items) could be transformed into linear combinations of optimally weighted observed variables creating artificial variables, known as principal components, that explain most of the variance of the observed variables. Factor scoring was used to weight the contribution each observed variable made to the constructs and then the resulting principal components were assessed to determine if they could be identified as constructs of the IBM. The multivariate logistic regression analyses examined associations between

dependent variables and the independent variables of interest and covariates (including principal components) as outlined in the specific aims. Multivariable model building began by initially including independent variables demonstrating an unadjusted bivariate association with the dependent variable with a p-value ≤ 0.25. Each of the models were further reduced in a stepwise fashion, resulting in the most parsimonious model with best model fit and explanation of variance in the dependent variable, following the method outlined by Hosmer and Lemeshow.[46] Sociodemographic and practice characteristic variables were forced into the regression models to control for potential confounders, independent of p-values. Robust standard errors were utilized in the process in order to accommodate problems of normality, heteroscedasity, and observations that exhibited large residuals, leverage, or influence.

Multivariable logistic regression (MLR) analysis was used to examine all dichotomous outcomes. Pass 14 software (NCSS, LLC, Kaysville, Utah) that employs Hsieh's power estimation method[47] was used for our power analysis. The power calculation assumed a sample size of 450 participants and an unadjusted baseline proportion of orthodontists' willingness to provide an HPV educational intervention of at least $P_0 = 0.50$, demonstrated by a similar study.[42] We estimated the smallest effect size (i.e., odds ratio), detectable as a function of power for one dichotomous dependent variable and as many as 10 covariates (Figure 4). The MLR analyses are estimated to detect OR's from 1.71 to 1.79, comparable to Cohen's "d" small effect size[48] with a power of 80%, and larger effect size detection is estimated with power greater than 80%.

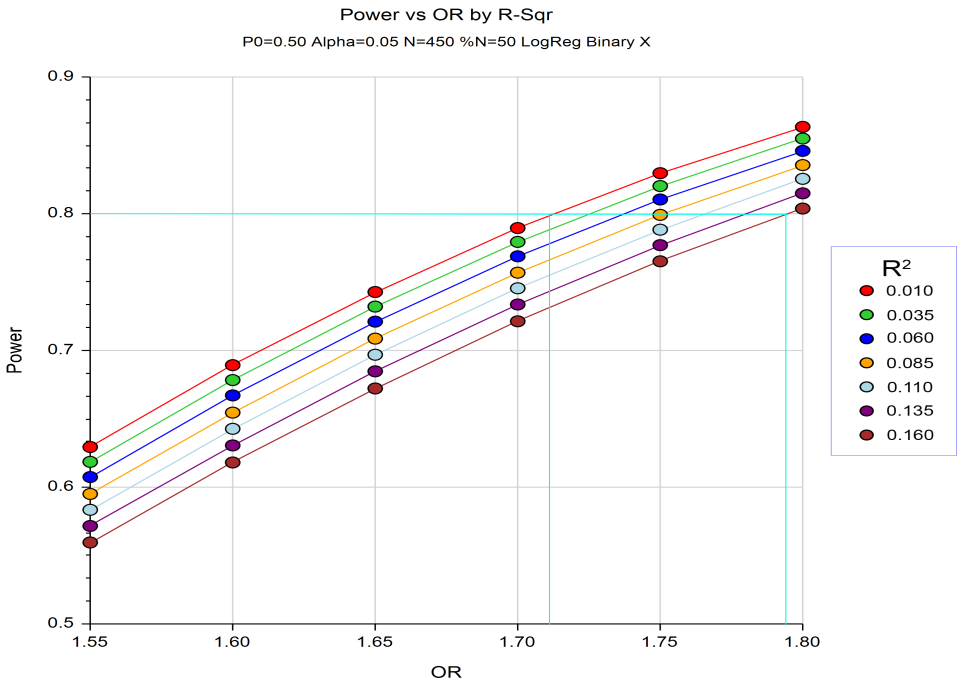

Figure 4: Power calculation for multiple logistic regression analysis. Odds ratio (OR) = 1.71 -1.79 detectable with 80% power (for R_2 = 0.01 – 0.16, respectively).

Chapter 3: Results

3.1. Participation Summary

Among the 469 Florida Orthodontists recruited to complete a survey instrument, 119 responded with completed surveys, resulting in a 25.4% response rate. The majority of participants completed the hardcopy survey (64%) while the remainder completed the web-based version (36%). The incentive offered upon response submission was an entry or entries into a drawing for a 42mm Apple iWatch at the conclusion of the study. As described above, the number of entries was dependent upon the stage of solicitation at which the completed survey was received. Accordingly, 72% of respondents received one entry, 19% of respondents received two entries, 4% of respondents received three entries, 1% received five entries, and 3% of respondents were awarded ten entries into the lottery in appreciation of their participation.

3.2. Descriptive Statistics

Descriptive statistics provide a summary of the participants in our study and are presented in Table 1. The majority of these participants were male (63%) with an average age of 48.6 years. Whites were the most represented racial group (86%) followed by Other (7%), Asian (4%), and Black (3%) and regarding ethnicity, 16% were Hispanic/Latino.

The participants in our study had practiced an average of 18-years, and more than half (54%) graduated from their residencies after the year 2000. Nearly three-fourths of respondents were in solo practices (74%), almost all reported working in a private

practice setting (96%) and in urban areas (92%). More than a third of participants (37%) reported daily patient volume between 51-75, followed by 30% who reported between 26-50 patients per day, while 17% reported practices, with more that 75 patients per day. Additionally, participants reported that the majority of patients in their practices (72%) were 17 years of age or younger.

Less than 11% of respondents reported having none/limited self-rated knowledge of HPV and its modes of transmission. Evidence of our participants' baseline knowledge was observed by the high percent of participants who recognized that HPV causes cancer in females (95%) and males (80%), is sexually transmitted (93%), and is preventable (97%). While 68% of respondents reported learning about HPV during their education, only 11% were encouraged to either discuss HPV with, or recommend the HPV vaccine to their patients during professional training. Additionally, more participants reported a moderate, good or excellent level of self-rated knowledge of routine childhood vaccinations (88%) compared to that of the HPV vaccines (73%).

Most participants reported that they needed additional knowledge about HPV prevention (86%) and information about vaccine administration (79%), as well as information on how to effectively discuss HPV with their patients (86%). Almost 90% of the participants reported that patients were most often referred to their primary care providers for follow-up of medical conditions, and two-thirds of participants stated that they knew where to refer their patients for HPV vaccination, however only a little more than half (57%) knew where they could refer patients for HPV information.

While 93% of participants agreed they were not only responsible for their patients' oral health, but also, patients' overall health, less than half the respondents (46%) agreed that HPV was within the scope of orthodontic practice. Moreover, although 64% of participants believed communication with patients and their parents about HPV is important, none reported providing patients informational pamphlets or educational videos regarding HPV and only 3% reported ever discussing HPV with patients and their parents. Regarding future behaviors, 55% and 66% of respondents, respectively, were unwilling to either discuss HPV with their patients or present an HPV informational video. Yet, 68% of the respondents reported a willingness to offer HPV informational pamphlets within the next year. Moreover, only 32% of participants considered it their responsibility to personally deliver HPV educational intervention, and more than half agreed delivering HPV educational interventions could be delegated to a chairside assistant, or treatment coordinator/office manager, 53% and 52%, respectively. The majority of respondents (64%) reported they would offer HPV educational intervention regardless of third-party reimbursement and few participants (19%) expected reimbursement in return for such a service; however, nearly three-fourths (74%) were willing to devote only two minutes or less to providing an HPV educational intervention.

More than three-quarters of respondents (82%) agreed that they would feel that they were acting in the patients' best interest by providing HPV educational interventions, however, only 40% reported that they would feel comfortable doing so. Three-fourths of participants agreed that patients and their parents would be

uncomfortable if they offered HPV educational intervention and more than half (52%) were afraid that patients would be offended if they did. Similarly, only 31% respondents agreed patients and their parents were amenable to HPV educational interventions in the orthodontic setting. In addition, only 30% of participants agreed that their colleagues' perception of them as orthodontists would improve and 36% agreed that their patients' perception of them as orthodontists would improve if they offered HPV educational intervention.

Notably, 81% of participants reported that it was important to vaccinate children between the ages of 11 and 12 years for HPV, but 74% were not willing to deliver the vaccine, even if administration of vaccines were considered to be within the scope of dental practice. Similar to responses regarding discussing HPV with patients and parents, 72% of respondents felt if they offered the HPV vaccine they would be acting in their patients' best interest, only 26% agreed their colleagues' perception of them as orthodontists would improve and 27% agreed that their patients' perception of them as orthodontists would improve, if they did so. Finally, 62% of participants agreed that they would be concerned about negative reactions from patients if they offered the HPV vaccine.

3.3. Principle Component Analysis – Factor Loading

Table 2 presents the results of the principle component analysis (PCA). Factor loading occurs when seemingly correlated observed variables (survey items) are transformed into linear combinations of optimally weighted observed variables, creating

principal components that independently account for the maximum amount of variance in the data set not accounted for by previous components and are uncorrelated with other components. According to Clark and Watson,[49] meaningful principal components must have three or more variables loading. In our study, seven components were identified and six retained from the PCA. The six components described conceptual constructs of the IBM that included, *Perceived Norm (Injunctive Norm), Knowledge, Personal Agency* (*Self-Efficacy and Perceived Control*)*, Salience, and Environmental Constraints*. One of the seven identified components was uninterpretable and consequently not used. The IBM constructs of *Attitude* and *Habit* were not identified as principal components within our response data.

The variables that loaded on the component representing *Injunctive Norm* examined respondents' agreement that their colleagues' and patients' perception of them would improve if they offered HPV educational intervention and the HPV vaccine, agreement they would make patients and their parents uncomfortable if they discussed HPV, and their willingness to discuss HPV with patients and parents. Self-rated knowledge of HPV and the HPV vaccine, routine childhood vaccines and modes of disease transmission, as well as agreement that additional knowledge regarding HPV prevention is required, were variables which reflected the conceptual construct of *Knowledge*. The *Self-Efficacy* construct was composed of variables that assessed whether respondents knew where to refer patients for HPV information and vaccination. Variables that loaded under *Salience* examined whether orthodontists were encouraged to discuss HPV and recommend the vaccine to patients during their education, agreement they

would be afraid of offending patients if they offered HPV educational intervention, agreement they would be concerned about negative reactions from patients if they offered the HPV vaccine, where they most often refer for follow-up of medical conditions, and agreement that HPV educational intervention can be delegated to a treatment coordinator or office manager. Importance of HPV communication, agreement that additional HPV discussion skills and vaccination information are required, willingness to give an HPV informational pamphlet, and agreement that orthodontists are responsible for overall patient health were variables that loaded on the construct identified as *Perceived Control*. Finally, variables that loaded on the IBM construct identified as *Environmental Constraints* questioned whether participants learned about HPV during their professional training, agreement that HPV is a preventable disease, reimbursement expectation for HPV educational intervention, and agreement to provide educational intervention without reimbursement.

3.4. Multivariable Logistic Regression

Multivariable logistic regression was used to examine the determinants of orthodontists' willingness to provide an HPV educational intervention (Table 3) and orthodontists' agreement that HPV is within the scope of orthodontic practice (Table 4) by computing adjusted odds ratios (AOR). Model building began with those variables forced into the model (sociodemographic and practice characteristic variables), independent variables outlined in Specific Aims 2-4, the six constructs of the IBM identified by the PCA, and all remaining covariates with a p-value ≤ 0.25. Model building then proceeded with stepwise deletion of non-significant variables, resulting in

the most parsimonious and explanatory model following method of Hosmer and Lemeshow.[46]

3.4.1. Willingness to provide patients with an HPV educational intervention.

As presented in Specific Aims 2 and 3, we examined associations between Florida Orthodontists' self-rated knowledge and agreement that HPV is within the scope of orthodontic practice, and their willingness to provide patients with an HPV educational intervention. Neither self-rated knowledge nor agreement that HPV is within the scope of orthodontic practice, were significant determinants of orthodontists' willingness to provide an HPV educational intervention. However, for each year that participants' aged, the adjusted odds of willingness increased 12% (AOR = 1.12, 95% CI 1.02, 1.23). Additionally, for those participants who agreed that HPV causes cancer in females, they were four times more willing to provide an HPV educational intervention than those who disagreed that HPV causes cancer in females (AOR = 4.07, 95% CI 1.51, 10.94). Of the six components identified from the PCA and included in the regression model, two were statistically significant determinants of orthodontists' willingness to provide an HPV educational intervention to patients, namely, *Perceived Control* and *Salience*. After controlling for Gender, Age, Race, Hispanic/Latino ethnicity, and other covariates, for each 1-unit increase in *Perceived Control*, the odds of orthodontists' willingness were two times greater than their unwillingness to provide an HPV educational intervention (AOR = 2.03, 95% CI 1.06, 3.90). In addition, orthodontists' adjusted odds of willing vs. unwilling to provide an HPV educational intervention was three times greater for every 1-unit increase in *Salience* (AOR = 3.09, 95% CI 1.35, 7.09), after controlling for

sociodemographic variables and other covariates. However, *Self-Efficacy* (AOR = 5.40, 95% CI 0.94, 31.2), agreement that delivering educational intervention can be delegated to a chairside assistant (AOR = 1.42, 95% CI 0.86, 2.34), and the amount of office time respondents were willing to spend to provide an HPV educational intervention to their patients (AOR = 9.72, 95% CI 0.72, 130.94), were not statistically significant determinants of orthodontists' willingness to provide an educational intervention.

3.4.2. Agreement that HPV is within the scope of orthodontic practice.

Specific Aim 4 examined the association between Florida Orthodontists' encouragement to either discuss HPV with their patients and/or recommend the HPV vaccine during their professional education and their agreement that HPV is within the scope of orthodontic practice. Model building followed the methods used in Specific Aims 2 and 3. After controlling for sociodemographic and practice characteristics, neither of the primary independent variables of interest, namely, encouragement to discuss HPV with their patients and/or recommend the HPV vaccine during their professional education, were statistically significant determinants of Florida Orthodontists' agreement that HPV is within the scope of orthodontic practice. The only significant determinant of participant orthodontists' agreement that HPV is within the scope of orthodontic practice was the amount of office time that respondents were willing to allocate to HPV educational interventions within their practices. The more office time respondents could provide to deliver HPV information to patients, the adjusted odds of agreement were greater. For respondents willing to spend less than 1 minute providing HPV information, the adjusted odds of agreement was over seven times greater than their disagreement (AOR = 7.55, 95% CI 1.09, 52.33), for 1-2 minutes over twenty-one times greater (AOR

= 21.20, 95% CI 3.44, 130.52), and for 3-4 minutes over forty-one times greater (AOR = 41.05, 95% CI 6.04, 279.12). Neither *Perceived Control* (AOR = 1.53, 95% CI 0.82, 2.85) nor *Salience* (AOR = 0.72, 95% CI 0.46, 1.13) were statistically significant determinants of orthodontists' agreement that HPV is within the scope of orthodontic practice.

Chapter 4: Discussion

HPV is the most common sexually transmitted virus and while most infections resolve through normal immunogenic processes, HPV can cause a number of health sequelae that range from benign warts to invasive cancers.[1,2] HPV has been identified as an etiologic agent for oropharyngeal cancers, making HPV particularly relevant to dentists and dental specialists.[5,6,9,31] While few long-term studies have considered the efficacy of three FDA-approved vaccines in the prevention of oropharyngeal cancers, current evidence is promising. One study examined the efficacy of *Cervarix* in 5,840 Costa Rican women as part of a double-blind controlled trial.[50] Four years after vaccination, there were fifteen prevalent oral HPV16/18 infections in the control group and only one in the vaccine group, with an estimated vaccine efficacy of 93.3%.[50] Despite such encouraging data, dentists and dental specialists remain surprisingly underutilized in addressing the low HPV vaccination rates in this country.

In 2014, 83% of children aged 2-17 years, visited a dentist (including specialists such as orthodontists) in the previous year.[34] Because patients visit orthodontists frequently and for prolonged periods, orthodontists have multiple, continuing opportunities to offer patients and their parents important educational information regarding HPV and the need to vaccinate, that has been previously overlooked. Orthodontic specialists are particularly well positioned for this role given the majority of their patients are within the target ages for the vaccine.[26] According to the AAO, nearly three-quarters of patients treated by orthodontists in 2014 were 17 years of age or

younger.[35,36] This is consistent with our findings that a majority of patients (72%) in the practices of our study participants were 17 years of age or younger.

The role of dentists and dental specialists in the prevention of HPV-related malignancies remains a subject of limited research.[32,33] Few studies have examined barriers or facilitators associated with provider-driven HPV educational intervention in the dental setting and, to our knowledge, none in the orthodontic setting. One fact is clear, despite the opportunities of frequent, long-term patient contact provided by orthodontists to deliver an HPV educational intervention, our study revealed the orthodontic venue is underutilized for this important and timely interaction between orthodontists, patients and their parents. Daley et al.,[32] found that more than 52% of Florida dentists reported no intention to discuss the HPV vaccine with their female patients. Daley et al.,[32] concluded that lack of intent was due to discomfort discussing sexual health related topics, absence of guidelines or oversight from dental professional organizations, and an interaction viewed as outside the scope of dental practice. Such findings are consistent with our study that indicated the majority of participant orthodontists were uncomfortable discussing HPV with patients and their parents and if they did so, were afraid they would offend their patients. In spite of expressed concern of parents' reactions by our participants, there is evidence that suggests that parents would not only be amenable to the receipt of HPV information in the orthodontic care setting, but also, willing to allow their children to receive the HPV vaccination, if only the orthodontist would recommend vaccination.[33] Shapiro[33] examined parents' willingness to allow their child to receive the HPV vaccine and reported that the strongest predictor of

parents' willingness to receive the HPV vaccine was if parents considered vaccination salient. Shapiro[33] found that a critical factor contributing to parents' perception of salience was receipt of a recommendation to vaccinate from an orthodontist. This suggests that orthodontists are important parental influencers with respect to overall health and furthermore, that a recommendation from an orthodontist regarding HPV immunization predicts a parent's decision to vaccinate.[33] Apparently, orthodontists' influence over their patients' health behaviors is greater than orthodontists realize. Shapiro's[33] findings suggest that orthodontists may have a critical impact on parents' willingness to allow their children to receive the HPV vaccine. Perhaps, dissemination of Shapiro's findings could positively influence orthodontists and orthodontic leadership of this important missed opportunity to positively impact patient health.

Our study is among the first to assess orthodontists' attitudes and beliefs regarding HPV educational intervention in the orthodontic care setting. We examined participant orthodontists' agreement that HPV is within the scope of orthodontic practice and their willingness to provide an HPV educational intervention to patients. Furthermore, our study sought to identify barriers or facilitators associated with offering an HPV educational intervention, and to understand what mode of intervention orthodontists' would be willing to deliver.

We hypothesized that orthodontists' agreement that HPV was within the scope of orthodontic practice would increase with encouragement during professional education to either discuss HPV with, or recommend the HPV vaccine to their patients. Neither

encouragement to discuss HPV nor recommend the HPV vaccine during professional education were significant determinants of orthodontists' agreement that HPV was within the scope of orthodontic practice. In fact, 54% of our participants disagreed that HPV is within the scope of orthodontic practice, similar to Daley et al.,[32] who found that Florida dentists responded that HPV was not within the scope of dental practice. However, the amount of office time respondents would be willing to provide to deliver HPV information to patients was a significant predictor of agreement that HPV was within the scope of orthodontic practice (AOR = 2.13, 95% CI 1.17, 3.86). Indeed, 70% of participant orthodontists in our study reported they could provide some amount of office time to deliver HPV information. It is not difficult to infer that the more time respondents were willing to dedicate to the delivery of HPV information, the more likely they were to agree that HPV was within the scope of orthodontic practice. Our participants overwhelmingly reported a need for additional knowledge regarding skills for effectively communicating about HPV and HPV prevention with patients and their parents. Perhaps this highlights an opportunity for the AAO to provide proactive guidance that could support orthodontists' need for knowledge and promote an understanding that HPV *is* within their purview.

We also hypothesized that orthodontists' willingness to provide patients with an HPV educational intervention would increase with greater self-rated knowledge of HPV and the HPV vaccine and with agreement that HPV is within the scope of orthodontic practice. Neither self-rated knowledge nor agreement that HPV is within the scope of orthodontic practice, were significant determinants of orthodontists' willingness to

provide an HPV educational intervention. These findings also are consistent with those of Daley et al.,[32] in that HPV-related knowledge was also not a predictor of dentists' readiness to discuss HPV with their patients. However, agreement that HPV causes cancer in females was a significant predictor of willingness to provide an HPV educational intervention in our study, suggesting a rudimentary understanding of the virus does indeed play a role in willingness. To help understand this inconsistency, it is important to note that the majority of our sample (73%) completed their postgraduate orthodontic residency programs before 2010, the year the American Dental Association (ADA) acknowledged HPV as a risk factor for oropharyngeal cancers.[51] Furthermore, it was only in 2006 that one of the largest U.S. pharmaceutical companies, Merck and Company, obtained approval for the first HPV vaccine.[18] Therefore, it is possible that many of our participants are unfamiliar with the most current scientific evidence pertaining to virus sequelae and the strain-specific vaccines that prevent HPV infections. Perhaps this unfamiliarity minimized the role of self-rated knowledge in participants' willingness to provide an HPV educational intervention. In fact, two studies have assessed dentists' knowledge regarding HPV and its relationship to oropharyngeal cancers.[52,53] Daley et al.,[52] reported deficits in dental professionals' knowledge of the pathogenesis of HPV and the impact of HPV on overall health. Vázquez-Otero et al.,[53] found confusion among dentists regarding differences between low and high risk strains of the HPV virus and the implications in the development of certain cancers.[53] Data suggests dentists may need additional knowledge to provide patients with the most up-to-date information regarding HPV and the HPV vaccine.[52,53] Consistent with these findings, participant orthodontists in our study reported a need for additional knowledge

regarding HPV prevention (86%). This not only highlights the importance of professional school education in preparing clinicians to effectively discuss HPV and the HPV vaccine with patients and their parents, but also of continuing education and a professional's role and responsibility to be a life-long learner and seeker of knowledge.

We found that *Perceived Control* and *Salience,* were significant determinants of orthodontists' willingness to provide an HPV educational intervention. The IBM construct, *Perceived Control,* was composed of survey items assessing agreement that in order for our participants to contribute to a public health effort aimed at increasing HPV vaccination rates among their adolescent patients, additional information about discussing HPV effectively (79%) and about vaccine administration (86%) were needed. Clearly, our respondents perceived that they lacked sufficient skills to effectively communicate with their patients about HPV and the HPV vaccine. It may be that these insecurities result from most respondents (89%) report of a lack of encouragement to either discuss HPV or the HPV vaccine during their education. Furthermore, such insecurities may be the reason that more than half of our participants (55%) were unwilling to have a direct conversation with patients and their parents regarding HPV. Encouragingly, 68% of respondents reported a willingness to provide patients with an HPV informational pamphlet within the next 12-months. These findings suggest an obvious opportunity for the AAO to support orthodontists in impacting HPV vaccination rates among their patients by development and provision of educational pamphlets. It may be that such pamphlets are a reasonable solution to the dichotomy between perceived insufficient skills, reluctance to have direct conversations, and the importance of HPV.

Salience was one of the most impactful determinants of participants' willingness to provide an HPV educational intervention. Variables that loaded on the construct of *Salience* included encouragement to discuss HPV or recommend the vaccine during professional education. Our findings suggest that few participants were encouraged to discuss HPV or recommend the vaccine during professional education. Promisingly, Poelman et al.,[54] found that current pre-doctoral and post-doctoral students placed value in HPV vaccine discussions with patients and desired more education in oral cancer detection. Such findings are corroborated by a recent editorial entitled "Could Your Next Doctor Be Your Dentist", by Nisarg Patel,[55] a senior Harvard Dental School student. Patel[55] suggested a broader scope of dental practice that includes preventive primary healthcare to address the shortage of affordable healthcare in the United States. To accomplish this, Patel[55] explained that more dental schools need to adopt a comprehensive medical education model. Encouragement to discuss HPV and recommend the HPV vaccine during dental education may provide a first step in beginning to change orthodontist's attitudes about the appropriateness of discussing HPV and habituate orthodontists to such discussions with patients.

The majority of participant orthodontists reported the importance of communication with patients and parents about HPV despite their unwillingness to do so. Perhaps the time is ripe for orthodontists to exercise their professional responsibilities and act on their beliefs related to overall patient health and the importance of childhood vaccinations and communication about HPV. Indeed, orthodontists have a unique

opportunity with repeated long-term contact with adolescents, the population most at risk to HPV. Adolescents are also the target age group for the HPV vaccine. As such, orthodontists are in the driver's seat of what may be considered the "ground zero" venue for delivering effective HPV prevention efforts. Mobilizing orthodontists in such efforts requires a collaborative approach, emphasizing their unique position in healthcare. It seems reasonable to suggest that the AAO may play a pivotal role given that both the ADA and the ADA Council on Scientific Affairs encourage dentists to educate themselves and their patients about the relationship between HPV and oropharyngeal cancer.[56] After all, Daley et al.,[32] found that dentists seek approval and guidance from their professional organizations. Orthodontists may turn to the AAO for support and guidelines in fulfilling their reported responsibility to overall patient health, and in doing so, aid in the development of effective means to implement educational interventions in the orthodontic practice setting.

Because *Salience* was a statistically significant predictor of orthodontists' willingness to provide an HPV educational intervention in our study, a paradigm shift is necessary, whereby the importance of orthodontists' role in the prevention of HPV is communicated by the AAO to its member orthodontists. As health professionals, orthodontists can no longer sit idly by and accept the rising incidence of HPV-related cancers as anything other than preventable. Our study reveals specific opportunities for orthodontists' to fulfill their self-reported obligation to overall patient health, by contributing to a necessary public health effort to increase the low HPV vaccination rates in this country. It is time for orthodontists, with the support of their professional

organizations and the institutions that educate them, to mobilize and collectively halt the spread of HPV infections.

Chapter 5: Conclusions

Orthodontists have an ethical responsibility to address low HPV vaccination rates, a critical public health issue. However, a clear disconnect exists between how respondents view their roles and responsibilities as healthcare providers, and their actions. This disparity highlights the need for targeted interventions to mobilize orthodontists to fulfill their self-reported obligation to overall patient health. Our findings suggest an opportunity to impact orthodontists' willingness to provide an HPV educational intervention by encouraging and preparing clinicians to discuss HPV and the HPV vaccine effectively in professional school and continuing education, the availability and dissemination of informational pamphlets, and support and guidance from the American Association of Orthodontists (AAO). Such support and guidance from the AAO is necessary to promote orthodontists' understanding that HPV *is* within the scope of orthodontic practice. This study provides a foundation for future public health efforts aimed at addressing low HPV vaccination rates by outlining approaches to mobilize a potentially potent, but previously overlooked, venue for HPV prevention.

5.1. Strengths and Limitations

A strength of our study is that it is among the first to examine orthodontists' willingness to provide an HPV educational intervention by representative sampling of Florida Orthodontists. Moreover, our study was informed by the Integrated Behavior Model (IBM); a valid measurement of behavioral intent appropriate to our specific aims. Our study was further strengthened by use of focus group elicitations that identified beliefs of our sample population in order to permit accurate measurement of IBM

constructs within our survey instrument.[37] The low survey response rate (25.4%) was a limitation of this study despite fidelity to accepted methods of survey administration. Given that only a quarter of our sample responded, the threat to validity is that there may be systematic differences between respondents and non-respondents, and as such, our results may not be representative of the population studied. In fact, the low response rate may be an important finding in itself, as an indicator of the magnitude of effort required to communicate the importance of HPV vaccination to orthodontists. Nonetheless, the findings of this study will help inform future public health interventions using a potent, yet underutilized, healthcare venue targeted towards increasing orthodontic patients' and their parents' awareness and knowledge of HPV and the HPV vaccines with the intent of increasing HPV vaccination rates among adolescents.

5.2. Future Studies

Because so little has been published regarding the role of the dental profession, and orthodontists in particular, in positively contributing to an increase in HPV vaccination rates among adolescents, there are many topic areas for future research. For example, future research may examine the impact of HPV educational intervention (i.e., delivering informational pamphlets) on HPV vaccination rates in the orthodontic care setting. Furthermore, there is need to examine the association between official guidelines released by the AAO regarding HPV, and prevalence of orthodontists providing HPV information to their patients, whether the current mode of information dissemination is effective, or if there may be more effective means to disseminate such information. Future research may also evaluate the impact of a pilot pre-doctoral dental curriculum

that emphasizes the impact of oral health on overall systemic health, and focuses on HPV by pinpointing the development of doctor-patient communication skills beyond the academic setting. In addition, there is a need to gather information from dental school and orthodontic residency administrators regarding their willingness to include HPV in respective curricula, and to provide a directive for them to do so. An opportunity exists to contribute to public health efforts to increase HPV vaccination rates and decrease HPV-related oropharyngeal cancers; an opportunity that must not be missed through targeted public health interventions informed by future studies.

Appendix A

Table 1

Table 1. Characteristics of orthodontist participants currently practicing in the state of Florida (N=119), 2017

Characteristic	Overall		Willing to Provide HPV Educational Intervention		Agree HPV is Within the Scope of Orthodontic Practice	
	Frequency (Mean)	Percent (SE)	Column % [Mean (SE)]	P-Value	Column % [Mean (SE)]	P-Value
Gender						
Female	43	36.75	25.6	0.81	15.5	0.53
Male	74	63.25	42.7		30.2	
Age (years)	(48.64)	(1.19)	[48.6 (49.7)]	< 0.01	[48.6 (48.9)]	< 0.01
Race						
White	100	85.47	59.0	0.54	38.8	0.98
Black or African American	4	3.42	1.7		1.7	
Asian	5	4.27	2.6		1.7	
Other	8	6.84	6.0		3.5	
Hispanic / Latino						
No	99	83.9	55.9	0.29	37.6	0.84
Yes	19	16.1	12.7		7.7	
Graduation Year						
< 1970	1	0.85	0.9	0.83	0.9	0.85
1970 - 1979	11	9.4	6.8		4.3	
1980 - 1989	20	17.09	13.7		6.0	
1990 - 1999	22	18.8	12.0		9.5	
2000 - 2010	32	27.35	18.0		12.9	
> 2010	31	26.5	18.0		12.1	
Years in Practice	(18.01)	(1.23)	[18.0 (18.8)]	< 0.01	[17.9 (17.8)]	< 0.01
Patients treated daily						
0-25	20	17.39	13.9	< 0.01	11.4	0.11
26-50	35	30.43	20.9		14.9	
51-75	42	36.52	27.8		14.9	
76-100	15	13.04	3.5		2.6	
100+	3	2.61	2.6		1.8	
Patients						
≤ 17 years of age	(72.06)	(1.25)	[72.1 (71.2)]	< 0.01	[72.0 (70.8)]	< 0.01
≥ 18 years of age	(28.47)	(1.36)	[28.5 (28.7)]		[28.5 (29.3)]	

Table 1 (Continued)

Characteristic	Overall		Willing to Provide HPV Educational Intervention		Agree HPV is Within the Scope of Orthodontic Practice	
	Frequency (Mean)	Percent (SE)	Column % [Mean (SE)]	P-Value	Column % [Mean (SE)]	P-Value
Practice Setting						
Private practice	112	95.73	64.1	0.30	41.4	0.04
University-based practice	4	3.42	3.4		3.5	
Public Health practice	1	0.85	0.9		0.9	
Practice Type						
Solo practice	87	74.36	48.7	0.26	34.5	0.76
Group practice	30	25.64	19.7		11.2	
Practice Location						
Urban	106	92.17	64.4	0.38	41.7	0.96
Rural	9	7.83	4.4		3.5	
HPV content during education						
Received instruction						
No	38	31.93	24.4	0.23	15.3	0.67
Yes	81	68.07	44.5		30.5	
Encouraged to discuss/recommend vaccine						
No	106	89.08	58.8	0.05	39.8	0.54
Yes	13	10.92	10.1		5.9	
HPV knowledge						
Self-rated knowledge						
None/limited	12	10.26	6.0	0.65	4.3	0.92
Moderate	67	57.26	40.2		25.9	
Good	31	26.5	18.0		12.9	
Excellent	7	5.98	5.1		3.5	
Causes cancer in females						
Disagree	6	5.08	2.5	0.31	1.7	0.55
Agree	112	94.92	66.1		43.6	
Causes cancer in males						
Disagree	24	20.34	11.0	0.09	6.0	0.07
Agree	94	79.66	57.6		39.3	
Knowledge of disease transmission modes						
None/limited	12	10.08	8.4	0.43	3.4	0.77
Moderate	58	48.74	31.1		22.0	
Good	38	31.93	21.9		16.1	
Excellent	11	9.24	7.6		4.2	

Table 1 (Continued)

Characteristic	Overall		Willing to Provide HPV Educational Intervention		Agree HPV is Within the Scope of Orthodontic Practice	
	Frequency (Mean)	Percent (SE)	Column % [Mean (SE)]	P-Value	Column % [Mean (SE)]	P-Value
Sexually transmitted disease						
Disagree	8	6.84	6.8	0.05	4.3	0.30
Agree	109	93.16	61.5		40.5	
Preventable disease						
Disagree	3	2.56	0.9	0.19	1.7	0.44
Agree	114	97.44	67.5		43.1	
Self-rated knowledge of HPV vaccine						
None/Limited	14	11.76	9.2	0.58	5.1	0.76
Moderate	51	42.86	26.9		20.3	
Good	41	34.45	24.4		14.4	
Excellent	13	10.92	8.4		5.9	
Self-rated knowledge of HPV vaccine						
None/limited	32	26.89	17.7	0.48	11.9	0.51
Moderate	63	52.94	39.5		26.3	
Good	21	17.65	10.1		5.9	
Excellent	3	2.52	1.7		1.7	
Self-assessment regarding HPV-related material						
Additional knowledge needed about HPV prevention						
Disagree	17	14.41	5.9	0.01	5.1	0.33
Agree	101	85.59	63.6		41.0	
Information on discussion skills needed						
Disagree	16	13.68	4.3	< 0.01	2.6	0.02
Agree	101	86.32	65.8		44.0	
Information on vaccination administration needed						
Disagree	25	21.37	10.3	0.01	8.6	0.52
Agree	92	78.63	58.1		37.1	
Patient referrals						
Know where to refer for HPV information						
No	51	42.86	32.8	0.12	19.5	0.96
Yes	68	57.14	36.1		26.3	

Table 1 (Continued)

Characteristic	Overall		Willing to Provide HPV Educational Intervention		Agree HPV is Within the Scope of Orthodontic Practice	
	Frequency (Mean)	Percent (SE)	Column % [Mean (SE)]	P-Value	Column % [Mean (SE)]	P-Value
Know where to refer for HPV vaccination						
No	40	33.61	25.2	0.31	15.3	0.95
Yes	79	66.39	43.7		30.5	
Don't know where to refer for HPV vaccine						
Disagree	84	71.19	47.5	0.47	33.3	0.70
Agree	34	28.81	21.2		12.0	
Medical referrals						
Physician's in my own referral network	1	0.84	0.0	0.08	0.0	0.17
Refer patients to their primary care provider	107	89.92	63.9		44.1	
I do not usually refer for medical conditions	9	7.56	5.0		1.7	
Other	2	1.68	0.0		0.0	
Orthodontists responsible for patient health						
Disagree	8	6.72	1.7	0.01	0.9	0.05
Agree	111	93.28	67.2		44.9	
HPV is within the scope of practice						
Disagree	64	54.24	28.0	< 0.01		
Agree	54	45.76	40.7			
HPV information currently provided						
Discussion						
No	114	96.61	66.1	0.18	42.7	0.03
Yes	4	3.39	3.4		3.4	
Informational pamphlets						
No	119	100	68.9		45.8	
Educational video						
No	118	100	69.5		46.2	
Willing to discuss HPV with patients/parents						
Not willing	65	54.62	23.5	< 0.01	11.0	< 0.01
Willing	54	45.38	45.4		34.8	
Willing to offer HPV informational pamphlet						
Not willing	38	31.93	0.8	< 0.01	5.1	< 0.01
Willing	81	68.07	68.1		40.7	
Willing to offer HPV educational video						
Not willing	79	66.39	35.3	< 0.01	20.3	< 0.01
Willing	40	33.61	33.6		25.4	

Table 1 (Continued)

Characteristic	Overall		Willing to Provide HPV Educational Intervention		Agree HPV is Within the Scope of Orthodontic Practice	
	Frequency (Mean)	Percent (SE)	Column % [Mean (SE)]	P-Value	Column % [Mean (SE)]	P-Value
Willingness to offer an educational intervention (discussion, pamphlets, video)						
Not willing	37	31.09			5.1	< 0.01
Willing	82	68.91			40.7	
Importance of HPV communication						
Unimportant	42	35.59	17.0	< 0.01	6.0	< 0.01
Important	76	64.41	51.7		39.3	
Orthodontists' comfort discussing HPV						
Disagree	71	60.17	35.6	0.01	16.2	< 0.01
Agree	47	39.83	33.1		29.1	
Colleagues' perception of orthodontist improved						
Disagree	83	70.34	42.4	< 0.01	23.9	< 0.01
Agree	35	29.66	26.3		21.4	
Acting in best interest of patient						
Disagree	21	17.65	5.9	< 0.01	2.5	< 0.01
Agree	98	82.35	63.0		43.2	
Patients/parents amenable to HPV information						
Disagree	79	68.7	41.7	0.01	21.1	< 0.01
Agree	36	31.3	27.0		23.7	
Patients' perception of orthodontist would improve						
Disagree	76	64.41	36.4	< 0.01	18.0	< 0.01
Agree	42	35.59	32.2		27.4	
Patients/parents would be uncomfortable discussing HPV						
Disagree	29	25	23.3	< 0.01	21.7	< 0.01
Agree	87	75	45.7		23.5	
Afraid of offending patients						
Disagree	57	48.31	37.3	0.05	29.1	< 0.01
Agree	61	51.69	31.4		16.2	

Table 1 (Continued)

Characteristic	Overall		Willing to Provide HPV Educational Intervention		Agree HPV is Within the Scope of Orthodontic Practice	
	Frequency (Mean)	Percent (SE)	Column % [Mean (SE)]	P-Value	Column % [Mean (SE)]	P-Value
Providing HPV information Is orthodontist's responsibility						
Disagree	80	68.38	41.9	0.01	21.6	< 0.01
Agree	37	31.62	26.5		23.3	
May be delegated to chairside assistant						
Disagree	55	47.41	28.5	0.08	20.0	0.60
Agree	61	52.59	39.7		24.4	
May be delegated to treatment coordinator/office manager						
Disagree	56	48.28	27.6	0.01	18.3	0.20
Agree	60	51.72	40.5		26.1	
Time willing to spend providing HPV information						
Not willing	35	29.91	7.7	< 0.01	3.5	< 0.01
Less than 1 minute	22	18.8	13.7		6.0	
1-2 minutes	29	24.79	22.2		13.8	
3-4 minutes	22	18.8	17.1		14.7	
5 minutes or more	9	7.69	7.7		6.9	
Orthodontists' responses about HPV vaccine						
Vaccination of children at 11-12 years old						
Unimportant	22	18.64	9.3	0.03	4.3	0.01
Important	96	81.36	60.2		41.9	
Willing to deliver HPV vaccine to patients*						
Not willing	88	73.95	46.2	0.01	29.7	0.03
Willing	31	26.05	22.7		16.1	
Colleagues' perception of orthodontist improved						
Disagree	86	74.14	45.7	0.01	25.2	< 0.01
Agree	30	25.86	22.4		19.1	
Patients' perception of orthodontist improved						
Disagree	83	72.81	43.0	< 0.01	23.9	< 0.01
Agree	31	27.19	25.4		20.4	

Table 1 (Continued)

Characteristic	Overall		Willing to Provide HPV Educational Intervention		Agree HPV is Within the Scope of Orthodontic Practice	
	Frequency (Mean)	Percent (SE)	Column % [Mean (SE)]	P-Value	Column % [Mean (SE)]	P-Value
Acting in best interest of patient						
Disagree	33	28.45	15.5	0.05	6.1	< 0.01
Agree	83	71.55	52.6		38.3	
Negative reactions from patients						
Disagree	44	38.26	30.4	0.03	21.9	0.03
Agree	71	61.74	37.4		21.9	
Acting in best interest of patient						
Disagree	33	28.45	15.5	0.05	6.1	< 0.01
Agree	83	71.55	52.6		38.3	
Expect reimbursement for educational intervention						
Disagree	96	80.67	56.3	0.67	38.1	0.48
Agree	23	19.33	12.6		7.6	
Would provide educational intervention without reimbursement						
Disagree	42	35.59	18.6	< 0.01	9.4	< 0.01
Agree	76	64.41	50.9		36.8	
Survey response by:						
Hard Copy Survey response	76	63.87	42.9	0.57	25.4	0.07
Web-based Survey Response	43	36.13	26.1		20.3	
Integrated Behavior Model (IBM) Constructs						
Perceived Norm (Injunctive Norm)	0.00	0.19	[0.58, (0.24)]	<0.01	[1.18, (0.32)]	<0.01
Self-Rated Knowledge	0.00	0.16	[-0.02, (0.19)]	1.0	[0.03, (0.23)]	0.47
Personal Agency (Self-Efficacy)	0.00	0.15	[-0.11, (0.18)]	0.27	[0.05, (0.21)]	0.91
Salience	0.00	0.13	[-0.16, (0.16)]	0.03	[-0.39, (0.18)]	0.01
Personal Agency (Perceived Control)	0.00	0.14	[0.62, (0.09)]	<0.01	[0.58, (0.13)]	<0.01
Environmental Constraints	0.00	0.13	[0.25, (0.15)]	0.01	[0.44, (0.18)]	0.01

This item was prefaced by the hypothetical: "If administration of vaccines were considered within the scope of dental practice…"

Appendix B

Table 2

Table 2 – Principal Component Analysis (N=119)

Variables	Components					
	Injunctive Norm*	Self-rated Knowledge	Self-Efficacy†	Salience	Perceived Control†	Environmental Constraints
Colleagues' perception of orthodontist improved (HPV)	0.28					
Colleagues' perception of orthodontist improved (vaccine)	0.28					
Discuss HPV with patients/parents (willing)	0.25					
Patients' perception of orthodontist improved (vaccine)	0.30					
Patients' perception of orthodontist improved (HPV)	0.30					
Patients/parents uncomfortable discussing HPV	-0.27					
Self-rated knowledge of routine childhood vaccines		0.30				
Self-rated knowledge of HPV vaccine		0.32				
Additional knowledge required		-0.28				
Modes of disease transmission		0.37				
Self-rated knowledge (HPV)		0.34				
Where to refer for HPV information			-0.43			
Where to refer for HPV vaccination			-0.42			
Don't know where to refer for HPV vaccine			0.36			
Encouraged to discuss/recommend vaccine				0.37		
Afraid of offending patients				0.31		
Negative reactions from patients (vaccine)				0.33		
Medical referrals				0.35		
May be Delegated to treatment coordinator/office manager (HPV)				-0.25		
Importance of HPV communication					0.27	
Additional discussion skills required (HPV)					0.28	
Additional vaccination information required					0.26	
Willing to give HPV informational pamphlet					0.27	
Orthodontists responsible for patient health					0.25	
Received instruction						0.26
Preventable disease						0.28
Expect reimbursement for educational intervention						0.47
Would provide educational intervention without reimbursement						-0.37

* A subcategory of Perceived Norm

† A subcategory of Personal Agency

Appendix C

Table 3

Table 3 – Logistic regression results for the dependent variable "Willing to provide HPV educational intervention" (N=119), 2017

	Willing vs. unwilling to provide HPV educational intervention		
	Model Effect p-value	**AOR[a] (95% CI)**	**p-value**
Gender	0.111		
Female		1.00	…
Male		4.29 (0.72, 25.71)	0.111
Age	0.021	1.12 (1.02, 1.23)	0.021
Race	0.287		
White		1.00	…
Black or African American		1.07 (0.06, 18.09)	0.960
Asian		0.30 (0.027, 3.29)	0.322
Other		0.21 (0.01, 8.34)	0.406
Hispanic / Latino	0.413		
No		1.00	…
Yes		4.84 (0.11, 210.78)	0.413
Practice Location	0.329		
Urban		1.00	…
Rural		2.52 (0.39, 16.19)	0.329
Practice Type	0.481		
Solo practice		1.00	…
Group practice		2.26 (0.23, 21.91)	0.481
Time willing to spend providing HPV information	0.087		
Not willing		1.00	…
Less than 1 minute		131.40 (6.66, 2592.76)	0.001
1-2 minutes		371.81 (6.28, 22011.95)	0.004
3-4 minutes		175.57 (6.86, 4495.87)	0.002
5 minutes or more		…	…
Providing HPV information may be delegated to chairside assistant	0.172		
Disagree		1.00	…
Agree		1.42 (0.86, 2.34)	0.172
HPV causes cancer in females	0.005		
Disagree		1.00	…
Agree		4.07 (1.51, 10.94)	0.005
Personal Agency			
Perceived Control	0.033	2.03 (1.06, 3.90)	0.033
Self-Efficacy	0.059	5.40 (0.94, 31.16)	0.059
Salience	0.008	3.09 (1.35, 7.09)	0.008

a. AOR – Adjusted Odds Ratio

b. Sociodemographic variables forced into the model as covariates: Gender, Age, Race, Hispanic/Latino, Practice Location, and Practice Type

Appendix D

Table 4

Table 4 – Logistic regression results for the dependent variable "HPV is Within Scope of Orthodontic Practice" (N=119), 2017

	Agree vs. disagree that HPV is Within Scope of Orthodontic Practice		
	Model Effect p-value	**AOR[a] (95% CI)**	**p-value**
Gender	0.242		
Female		1.00	…
Male		0.49 (0.15, 1.63)	0.242
Age	0.114	0.96 (0.92, 1.01)	0.114
Race	0.464		
White		1.00	…
Black or African American		0.53 (0.06, 4.42)	0.554
Asian		1.60 (0.09, 29.48)	0.751
Other		0.41 (0.05, 3.69)	0.423
Hispanic / Latino	0.764		
No		1.00	…
Yes		0.77 (0.14, 4.22)	0.764
Practice Location	0.183		
Urban		1.00	…
Rural		3.82 (0.53, 27.38)	0.183
Practice Type	0.286		
Solo practice		1.00	…
Group practice		0.50 (0.14, 1.78)	0.286
Time willing to spend providing HPV information	0.013		
Not willing		1.00	…
Less than 1 minute		7.55 (1.09, 52.33)	0.041
1-2 minutes		21.20 (3.44, 130.52)	0.001
3-4 minutes		41.05 (6.04, 279.12)	0.000
5 minutes or more		18.92 (0.95, 378.13)	0.054
Personal Agency			
Perceived Control	0.182	1.53 (0.82, 2.85)	0.182
Salience	0.151	0.72 (0.46, 1.13)	0.151

a. AOR – Adjusted Odds Ratio

b. Sociodemographic variables forced into the model as covariates: Gender, Age, Race, Hispanic/Latino, Practice Location, Practice Type

Appendix E

Focus Group Interview Questionnaire

FOCUS GROUP QUESTIONS

Experiential Attitude

How do you feel about the idea of providing HPV educational intervention to your patients and their parents?

What do you like/dislike about the idea of providing HPV educational intervention to your patients and their parents?

What would you enjoy/hate about providing HPV educational intervention to your patients and their parents?

Instrumental Attitude

What are some of the advantages of providing HPV educational intervention to your patients and their parents?

What are some of the benefits that might result from providing HPV educational intervention to your patients and their parents?

What are some of the disadvantages of providing HPV educational intervention to your patients and their parents?

What are the negative effects that might result from providing HPV educational intervention to your patients and their parents?

Normative Influence

Who would support your decision to provide HPV educational intervention to your patients and their parents?

Who would be against your decision to provide HPV educational intervention to your patients and their parents?

If you were to consider providing an HPV educational intervention for your patients and their parents, is there someone who's opinion would be instrumental to you in your decision?

Perceived Control

What things would make it easy for you to provide HPV educational intervention to your patients and their parents?

What things would make it hard for you to provide educational intervention to your patients and their parents?

Self-Efficacy

If you want to provide HPV educational intervention to your patients and their parents, how certain are you that you can?

What kinds of things would help you overcome any barriers to providing HPV educational intervention to your patients and their parents?

Appendix F

Informed Consent

Participation Letter

Title of Study: Florida Orthodontists' willingness to provide Human Papilloma Virus (HPV) Educational Intervention

Principal investigator
Marc Weber, D.D.S.
901 SE 2nd Court #2
Fort Lauderdale, FL 33301
(704) 491-8918

Co-investigator
Richard Singer, D.M.D., M.S.
3301 College Avenue
Fort Lauderdale, FL 33314
(954) 262-1610

For questions/concerns about your research rights, contact:
Human Research Oversight Board (Institutional Review Board or IRB)
Nova Southeastern University
(954) 262-5369 / Toll Free: 866-499-0790
IRB@nsu.nova.edu

Description of Study: You are invited to participate in a research study. The purpose of this study will focus on identifying the determinants of Florida Orthodontists' willingness to provide information regarding the Human Papilloma Virus (HPV) and/or HPV vaccinations to adolescent patients and their parents.

We are inviting you to participate because you are an orthodontist currently practicing in the state of Florida. Participants include American Association of Orthodontists (AAO) members recruited from the AAO member directory and non-AAO member orthodontists recruited from the Florida Yellow Pages. The results of this study may be used to inform possible future public health interventions aimed towards increasing acceptance of the HPV vaccination and thereby reducing the prevalence of both HPV infections and associated cancers. There will be between 400 to 450 participants in this research study.

You are asked to complete a self-administered 10 to 15-minute electronic survey housed on the secure, HIPAA-compliant NSU REDCap web site. The survey includes multiple choice and fill in the blank (drop-down list) items, including demographic information. After you complete the survey instrument, your responses will be de-identified and analyzed.

Risks/Benefits to the Participant: There is minimal risk to you as a participant. The greatest potential risk may be compromised confidentiality and anonymity. However, every reasonable attempt has been designed into the study administration protocols to protect your confidentiality and anonymity, including use of a secure HIPAA-complaint server for data acquisition and storage. If you have any questions about the research, your research rights, or have a research-related injury, please contact Dr. Marc Weber or Dr. Richard Singer at the phone numbers indicated above. You may also contact the IRB at the numbers indicated above with questions as to your research rights. There are no direct benefits for your participation in this study.

Cost and Payments to the Participant: There are no costs to you and no monetary compensation for participating in this study, however, participants who complete the survey will be provided entry into a drawing for an Apple iWatch in appreciation of their time and contribution to our research.

Confidentiality: All information obtained in this study is strictly confidential, unless disclosure is required by law. Data collected using the secured web site, REDCap, will be automatically de-identified to ensure anonymity and confidentiality of participants. All participant email addresses and contact information will be disassociated from survey response data and stored on a separate password protected university server. All data acquired during this research will be deleted after 36 months from the conclusion of the study as required by the IRB. The IRB, regulatory agencies, and Dr. Weber or Dr. Singer may review research records.

Participant's Right to Withdraw from the Study: Your participation is voluntary; you are free to refuse to participate in or withdraw from this study at any time without penalty. If you do not want to continue, you can simply leave this website. If you do not click on the submit button at the end of the survey, your answers and participation will not be recorded. If you choose to withdraw after completion of the survey, any information collected from you before the date you leave the study will be kept in the research records for 36 months from the conclusion of the study, but you may request that it not be used by contacting the principal investigator in a timely manner.

I have read this letter and I fully understand the contents of this document and voluntarily consent to participate. All of my questions concerning this research have been answered. If I have any questions in the future about this study, the investigator listed above or his staff will answer them.

I understand that the completion of this questionnaire implies my consent to participate in this study.

I have read and understand the informed consent above: YES ☐ NO ☐

Appendix G

Survey Instrument

ID:

HPV and the Orthodontic Care Setting

This survey explores your viewes regarding educational and informational activities regarding the Human Papilloma Virus (HPV) and HPV vaccination and prevention that are now or could be provided in the orthodontic care setting. As you may know, national HPV vaccination rates among adolescents are significantly below those of vaccination rates for routine childhood vaccines. We are especially interested in determining effective means of communicating HPV facts to patients and their parents, in order to increase the national HPV vaccination rate among adolescents, as recommended by the Centers for Disease Control and Prevention (CDC).

We appreiate your assistance in this important emerging research.

1. Are you a currently practicing dental specialist in orthodontics practicing in the State of Florida?

☐ Yes → Please continue and complete and return your questionnaire in the envelope provided.

☐ No → Please stop and return your questionnaire in the envelope provided.

NOVA SOUTHEASTERN UNIVERSITY
Health Professions Division
College of Dental Medicine

HPV SURVEY INSTRUMENT

1. Study ID ☐

2. I understand that the completion of this questionnaire implies my consent to participate in this study.

0☐ I understand

3. Do you currently offer any of the following Human Papilloma Virus (HPV) educational interventions to your patients?

		1**Yes**	0**No**
a	HPV informational pamphlets		
b	Discuss HPV with parents/patients		
c	HPV educational video		

4. If you do not currently offer these interventions, how willing would you be to offer it as part of your practice within the next year?

		Willingness to Offer			
		0 **not willing**	1 **somewhat unwilling**	2 **somewhat willing**	3 **very willing**
a	HPV informational pamphlets				
b	Discuss HPV with parents/patients				
c	HPV educational video				

5. If administration of vaccinations were considered to be within the scope of dental practice…

		Willingness to Administer the HPV vaccine			
		0 **not willing**	1 **somewhat unwilling**	2 **somewhat willing**	3 **very willing**
a	How willing would you be to deliver the HPV vaccine to your patients?				

6. The following concern HPV knowledge acquired during your professional education.

		1 **Yes**	0 **No**
a	Did you learn about HPV during your professional education?		
b	Were you encouraged to discuss HPV with your patients during your professional education?		
c	Were you encouraged to recommend the HPV vaccine during your professional education?		

7. How would you rate your clinical knowledge of the following?

		0 **none/limited**	1 **moderate**	2 **good**	3 **excellent**
a	Human Papilloma Virus (HPV)				
b	HPV vaccinations (efficacy, associated risks, availability)				
c	HPV modes of transmission				
d	Routine childhood vaccines (eg., MMR, DTaP, Polio)				

8. Where is the *one* place where you most often refer patients for follow-up of medical conditions? (please select one response)

0 ☐ Physician's in my own referral network

1 ☐ Refer patients back to their own primary care provider

2 ☐ I do not routinely make referrals for medical conditions

3 ☐ Other

9. Do you know a place where you can refer a patient for the following?

		1 **Yes**	0 **No**
a	HPV educational information		
b	HPV vaccination		

10. How much do you agree or disagree with the following statements?

		0 **strongly disagree**	1 **disagree**	2 **agree**	3 **strongly agree**
a	HPV is a sexually transmitted disease (STD)				
b	HPV is preventable				
c	HPV causes cancer in females				
d	HPV causes cancer in males				

11. Please indicate how much you agree or disagree with each of the following statements: If I offered HPV educational intervention to my patients…

		0 **strongly disagree**	1 **disagree**	2 **agree**	3 **strongly agree**
a	I would feel that I am acting in the best interest of the patient				
b	My colleagues' perception of me as an orthodontist would improve				
c	My patients' perception of me as an orthodontist would improve				
d	I would be afraid I would offend my patients				

12. If you were to contribute to a public health effort aimed at increasing the HPV vaccination rates among adolescent patients, please answer how much you agree or disagree with the following statements.

		0 **strongly disagree**	1 **disagree**	2 **agree**	3 **strongly agree**
a	I need additional knowledge about HPV prevention				
b	I don't know where to refer patients for the HPV vaccine				
c	I need information about HPV vaccine administration				
d	I would offer HPV educational intervention even if third party reimbursement was not available				
e	I need information on how to discuss HPV effectively with my patients				
f	Orthodontists, as dentists, have responsibilities for overall patient health and not just health of the oral cavity				

13. Regarding the possibility of offering HPV educational intervention in your practice, how much do you agree or disagree with the following statements?

		0 **strongly disagree**	1 **disagree**	2 **agree**	3 **strongly agree**
a	My patients and/or their parents are amenable to HPV educational intervention in the orthodontic setting				
b	It would make my patients and/or their parents uncomfortable if I discussed HPV				
c	I would feel comfortable talking with my patients and/or their parents about HPV				
d	HPV is out of the scope of practice for an orthodontist				
e	I expect reimbursement for my HPV educational intervention				

14. How important do you regard each of the following?

		0 **not important at all**	1 **somewhat unimportant**	2 **somewhat important**	3 **very important**
a	Communication with your patients and their parents regarding HPV				
b	Vaccination of children between the ages of 11 and 12 years for HPV				

15. Please indicate how much you agree or disagree with each of the following statements. If I offered the HPV vaccine to my patients…

		0 **strongly disagree**	1 **disagree**	2 **agree**	3 **strongly agree**
a	I would feel that I am acting in the best interest of the patient				
b	My colleagues' perception of me as an orthodontist would improve				
c	My patients' perception of me as an orthodontist would improve				
d	I would be concerned about negative reactions from my patients				

16. Are you Hispanic / Latino?

1☐ Yes
0☐ No

17. What is your gender?

0☐ Male
1☐ Female
2☐ Other

18. What is your race?

0☐ White
1☐ Black or African American
2☐ Asian
3☐ American Indian or Alaska Native
4☐ Native Hawaiian or Pacific Islander
5☐ Other

19. What is your age (years)?

☐☐

20. What year did you graduate from your Postgraduate Orthodontic Residency Program?

☐☐☐☐

21. How many years have you practiced Orthodontics exclusively?

☐☐

22. Which ONE of the following geographic descriptors best describes your PRIMARY current practice?

0 ☐ Urban
1 ☐ Rural

23. Which ONE of the following structural descriptors best describes your *PRIMARY* current practice?

0 ☐ Solo practice
1 ☐ Group practice

24. Which ONE of the following settings best describes your PRIMARY current practice?

0 ☐ Private practice
1 ☐ University-based practice
2 ☐ Public health practice

25. Please approximate the percent of the patients in your office that fall within the following age categories (Please respond by entering percentages between: 0 – 100%).

	Ages	Percent (%)		
a	17 years of age or younger			
b	18 years of age or older			

26. Which *one response* best describes the number of patients you see in your office daily?

0 ☐ 0-25
1 ☐ 26-50
2 ☐ 51-75
3 ☐ 76-100
4 ☐ 100+

27. How much office time are you willing to spend to provide an HPV educational intervention to your patients?

0 ☐ not willing
1 ☐ less than 1 minute
2 ☐ 1-2 minutes
3 ☐ 3-4 minutes
4 ☐ 5 minutes or more

28. Please indicate how much you agree or disagree with the following statements regarding the delivery of HPV educational intervention to your patients?

		0 **strongly disagree**	1 **disagree**	2 **agree**	3 **strongly agree**
a	It is the responsibility of the orthodontist to deliver the educational intervention personally				
b	Delivering educational intervention can be delegated to a chairside assistant				
c	Delivering educational intervention can be delegated to a treatment coordinator and/or office manager				

29. Do you have any comments on providing patients with HPV education, HPV vaccination referrals, availability of training materials, and/or other chairside medical screenings in the orthodontic care setting? Please let us know below.

_____
_____
_____
_____
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