Sexual Orientation Identity and Gender Disparities in Human Papilloma Virus (HPV) Vaccination Among U.S. Adults

By

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Introduction

Every day the United States population evolves, what makes up each unique identity is always changing from person to person. One part of this population that is consistently a focus of modern politics and media is the LGBTQ+ community. A 2021 Gallup poll showed a near doubling of the U.S. LGBTQ+ population with 7.1% of adults identifying as anything but heterosexual, compared to 3.5% in 2012 (Jones, 2022). With this population so rapidly increasing, it is important to ensure this group of people receives proper, inclusive healthcare, regardless of the type of care needed. Moreover, the LGBTQ+ population is an inherently at-risk population that faces greater adversity and discrimination both in and outside of medicine (Gruberg et al., 2020). As a result, they require unique considerations in their care. Reproductive care especially requires a great deal of mindfulness for LGBTQ+ patients as it often significantly more physically and emotionally invasive, leading people to avoid seeking care (Mirza & Rooney, 2018)

Human papillomavirus (HPV) is a group of approximately 200 virus strains, and nearly all sexually active people become infected with HPV (NCI, 2023). While HPV is the most common sexually transmitted disease (STD), most frequently spread through vaginal, oral and anal sex, it can be transmitted through close skin-to-skin contact and contracted even if someone is not sexually active (NCI, 2023; Petca et al., 2020). Most HPV infections are considered low-risk and are easily managed by the immune system, so most people do not even know that they have HPV unless tested for it, or if they develop genital warts. There are, however, approximately 14 strains considered to be high-risk (NCI, 2023). These high-risk strains cause multiple types of cancer including cervical, oropharyngeal (throat), anal, penile, vaginal and vulvar cancers (Senkomago et al., 2019). In the United States, over 30,000 of these cancer

diagnoses each year result from HPV infection (Senkomago et al., 2019; NCI, 2023). In 2014, a vaccine was released to help reduce infection of two low-risk strains that cause genital warts and the seven high-risk strains that cause most cancers – an upgrade from the 2006 version that protected against fewer strains (CDC, 2022). It is recommended that people receive the first of the two to three-shot series between the ages of 11 and 12, although it can be given as early as age nine and new research is showing significant protection with just one dose (NCI, 2022). Early vaccination ensures protection against all HPV strains in the vaccine – if received later in life it is more likely that someone has already contracted any of the strains of HPV and therefore the vaccine does not offer the same amount of protection from future cancer development (CDC, 2022).

Given the many routes of HPV transmission, people of all sexualities are equally likely to contract HPV. However, studies show that LGBTQ+ people often have difficulty accessing care due to direct discrimination or other systemic barriers that queer people disproportionately face (Mirza & Rooney, 2018). The Center for American Progress conducted a survey revealing just how pervasive anti-LGBTQ+ attitudes are within healthcare, further altering how LGBTQ+ people navigate the medical system. Within the year prior to the survey, eight percent of LGBQ respondents and 29% of transgender respondents reported that a doctor or other healthcare worker refused to see them because of their actual or perceived sexuality (Ahmed, Mirza & Rooney, 2018). This hostility transcends medical specialties and given the extremely vulnerable space of reproductive medicine, LGBTQ+ populations deserve an inclusive and non-traumatizing healthcare experience.

Discrimination paired with the fact that many providers are unsure of the proper reproductive care and screenings to provide their LGBTQ+ patients, this raises the question of if

LGBTQ+ people receive the HPV vaccine proportionally to straight people, and if these groups are in accordance with the recommended age range (Rowe et al., 2017). Investigating this is not merely about understanding vaccination trends but gives information into lifesaving healthcare. By persistently examining HPV vaccination trends, public health efforts can continue to be expanded or refined where necessary to reach as many people as possible, not only those who are seemingly at highest risk.

Literature Review

Literature that covers reproductive health and care for LGTBQ+ people as well as routine, primary care standards and practices that also monitor reproductive health, is growing each year. Historically, research regarding non-heterosexual and cisgender experiences is minimal in existence, as LGBTQ+ identities were characterized as deviant and clinically pathologized. The American Psychiatry Association, classified homosexuality as a mental illness within their standard diagnostic criteria, the DSM, until just 50 years ago in 1973 (Drescher, 2015). To this day, people undergo traumatizing conversion therapies – although no longer part of medical care – because of the pervasive history of pathologizing queerness (Blakemore, 2019; Mayer et al., 2008). Although LGBTQ+ identities are becoming more accepted in U.S. society, this community is continually discriminated against personally and systematically which has significant consequences on their health (Mirza & Rooney, 2018; McNamara & Ng, 2016). Current research is often extremely limited in the size of LGBTQ+ participants and consequentially many studies include only lesbian or gay, bisexual and heterosexual participants, or they only examine differences of sexual orientation while still operating withing a cisgender binary. For this reason, throughout this work there are varying acronyms other than LGBTQ+, such as LGB or LGBQ, and this use is intentional. Variations in this acronym indicate the limitations behind a study which exist even in my own data analysis.

When it comes to reproductive health, it is not standard practice in the U.S. for young people to be educated on sexual and reproductive care, much less on anything other than outside of heterosexual, cisgender relationships (Rubinsky & Cooke-Jackson, 2021). As a result, one in five (20%) lesbians and 12% of bisexual women over the age of 18 have never seen a provider for a gynecologic exam which is much higher than non-LGBTQ women at 6% (Dawson et al.,

2021). Additionally, many LGBTQ women express wishes for more inclusive education during their childhood, whether it be from family or in school (Rubinsky & Cooke-Jackson, 2021).

Because of the disproportionate impact of cervical cancer due to HPV infection, relative to the other types of HPV-related cancers, this project focuses on reproductive care for those who identify as LGBTQ+ women in the United States, including the perspectives of LGBTQ+ people and physicians. This review identifies existing reproductive healthcare practices, patient experiences, healthcare provider knowledge and potential changes in practice for LGBTQ+ patients assigned female at birth (AFAB). In choosing resources, I cover works regarding multiple queer identities for people AFAB and focus more on general reproductive system health, as opposed to research that focuses exclusively on HPV or cervical cancer, in order to provide a broader picture of gynecological care for the LGBTQ+ community.

Perspectives of LGBTQ+ Patients

Studies that put the perspectives of LGBTQ+ people into the spotlight are increasing in number as lived experiences are becoming more valued more within medical research. The beginnings of queer research focused on health disparities but did not address discrepancies of the care queer people understand themselves to need. When it comes to patient perspectives, researchers began by investigating LGBTQ+ people's basic knowledge of health conditions. In 2010, Polek and Hardie studied the correlations between lesbians' knowledge of HPV and age, education, and openness with healthcare providers. Emphasis was placed on quantitatively measuring how much knowledge participants had, but newer literature not only describes sexual and reproductive health literacy of queer women, it also shifts focus to the appraisal and application of such information (Paschen-Wolff et al., 2020). Paschen-Wolff et al. (2020)

conducted a qualitative study of 22 sexual minority women to further investigate how women go about formulating their knowledge about their health. Primary sources of sexual and reproductive health information included family, health care providers, and school, although none of the participants learned about sexual minority-specific information in the school setting. The details of participants' knowledge was also largely dependent on where participants gained their sexual and reproductive health knowledge and their perception of risk.

While helpful in gaining perspective of education of LGBTQ+ women, the aforementioned studies are limited in inclusivity to cisgender women only. As research on the LGBTQ+ community expands, there is a need for greater attention to gender-diverse people including non-binary and transgender (TGNB) people AFAB. Transgender people face unique challenges specific to their transitional identity that cisgender women do not. Many TGNB individuals find reproductive care that does not align with their gender identity to cause dysphoria, often increasing emotional distress at healthcare visits (McNamara & Ng, 2016; Montoya et al., 2021; Tishelman et al., 2019).

Wingo et al. (2018) provide space for the experiences, and further, reproductive priorities among both cisgender and gender-diverse people AFAB in medical literature. Wingo et al.'s survey was open-ended and permitted participants to also say what topics they feel reproductive researchers should pursue. Patients expressed treatment needs for a range of conditions that apply to both LGBTQ+ and non-LGBTQ+ identities. Participants also reported health care professionals had a lack of knowledge of LGTBQ-specific reproductive care like the impact of hormone therapy on fertility and safe same-sex practices, mirroring the findings of Polek and Hardie (2010) and Paschen-Wolff (2020). Johnson et al. (2020) examined the nuance of why transgender men undergo gynecological cancer screening at a reduced rate compared to

cisgender women. Johnson et al. identify eight overarching socio-ecological factors: societal stigma, Legislative policy barriers, non-inclusive paperwork or documentation, unwelcoming physical environments at healthcare locations, gender-affirmative and welcoming healthcare professionals, past negative experiences, the development of their gender identity, and socioeconomic status. These factors open the scope of Wingo et al.'s findings to include non-provider-related influences on reproductive care while also providing insight into the unique barriers transgender people AFAB face.

Carpenter (2021) then shifted the conversation to the strategies AFAB people use to navigate the healthcare system to meet the reproductive needs described by Wingo et al. (2018), despite the barriers found by Johnson et al. (2020). Strategies included participants becoming experts in their own care by creating a close community, seeking alternative or de-medicalized care like that from midwives, and managing their gender identity and sexual orientation disclosure to providers (Carpenter, 2021). These three strategies were largely variable based on participants' systemic barriers like socioeconomic status, geography, local political climate, and race (Carpenter, 2021).

These articles provide a picture of the issues that LGBTQ+ people find most important while addressing what prevents them from receiving reproductive care. However, while these works all have a similar aspiration of representation, they are vastly different in their research questions. Pashcen-Wolff (2020) sought to understand reproductive health literacy levels, Carpenter (2021) to understand the navigation of reproductive care settings, Wingo et al. (2018) gives voice to reproductive priorities and experiences and Johnson (2020) investigated causes of disparity in cervical cancer screenings. Centering the experiences of queer people AFAB is crucial in this conversation, but there are pieces missing from this conversation because this

patient-centered research has differing goals. Each of these studies are also limited in that they are small in sample size, limiting their applicability to the whole population of LGBTQ+ people AFAB. Future qualitative projects that gather input from LGBTQ+ people should increase the representation of various identities while also increasing the number of participants so a more complete picture is made, and greater conclusions can be drawn.

Healthcare Provider Perceptions

Official recommendations on reproductive care for LGBTQ+ people AFAB are continuously shifting based on new literature. The American College of Obstetricians and Gynecology (ACOG) is one of the most significant licensing organizations for Obstetric and Gynecological physicians (OBGYNs) or primary care physicians that provide reproductive gynecologic care. In 2012, the ACOG Committee on Health Care for Underserved Women released an article outlining various discriminatory and structural barriers to care for sexual minority women while also suggesting providers follow the same routine screenings (like STI testing and pap smears) as straight women. This article reaffirmed support for queer cisgender women in medicine, however, it left gender-diverse people out and may be outdated in actionable items given the 11-year span since publication. Additionally, it largely assumed that care priorities would be the same for all cisgender women regardless of their sexuality.

With ACOG's recommendations in mind, researchers further investigated how healthcare providers shape the reproductive care LGBTQ+ AFAB people receive, especially because of their comfort with treating such patients. Hayes et al. (2015) found through questionnaires that medical students and residents were significantly less confident in history taking and sexual health management of LGBTQ patients. Rowe et al. (2017) also conducted a survey of

community-based outpatient clinics in which 85% of physicians in the study had not received any training focused on caring for LGBT patients. Additionally, Rowe et al. found that only a little over half of the providers surveyed even felt they were competent in providing care to LGBT patients.

In 2015, Unger surveyed OBGYNs about their knowledge and interactions with transgender or other gender minority people. Unger found a clear lack of education and even willingness to provide anatomy-appropriate care, such as Pap smears for transmen. Tishelman et al. (2019) investigate providers' comfort also when treating transgender patients, but instead emphasize the importance of patient mental health and supportive care during dysphoric aspects of this care. Tishelmen et al. ultimately provide a more complete picture of gynecologic care for transgender patients relative to Unger as they highlight reproductive care as a potential peak of gender dysphoria while also studying provider education and comfort.

Studies focusing on patient perceptions coincide with the above studies on provider comfort and knowledge. Rowe et al. (2017) recommend additional LGBT-focused training during job orientation with a required 80% passing score on a subsequent evaluation as well as further inclusion of LGBT care in educational curriculums. Paschen-Wolff (2020) asserts the need for better training and education of providers regarding queer women’s needs and risk levels. Paschen-Wolff also suggests that organizations like the CDC or ACOG make sexual and reproductive health information more accessible and understandable to the public. Wingo et al. also call for further research into what constitutes comprehensive LGTBQ-specific reproductive care as well as investigation into what makes up more affirmative healthcare settings. A common thread throughout this research is that providers' uncertainty in treating queer AFAB people is reflected in the experiences of their patients. These works show a necessity for clearer

recommendations from organizations like ACOG and a need for more inclusive health care curriculums.

Initiatives for Improved Health Outcomes

To reduce health disparities for LGBTQ+ people, McNamara and Ng (2016) use quantitative data to inform best practices for general practitioners treating LGBTQ+ patients, creating a standard model of care. McNamara and Ng (2016) stress the importance of proper screening services including HPV and other sexually transmitted infections (STI) as well as anatomically appropriate cancer screenings. Personalized screenings are especially important in monitoring life-changing diseases and cancer, so the authors coined the phrase "screen what you have" regarding a patient's anatomy, as an easy way to guide what procedures to offer patients (McNamara & Ng, 2016, p. 535). McNamara and Ng provided foundational guidelines for physicians to tailor reproductive care to LGBTQ+ patients based on their physiology, social identity and the health disparities they face. Montoya et al. (2021) use more recent clinical research to provide an extensive guide on the multitude of aspects and procedures of reproductive care alone that are not addressed by McNamara and Ng. This includes contraceptives, fertility treatments and family planning, adoption, fertility preservation, childbirth, and hysterectomies. Montoya et al. went significantly further in detailing exactly how various procedures should be performed or altered based on patients' sexual orientation or gender identity.

Furness et al. 's (2020) research also builds on the foundation of McNamara and Ng (2016), serving as a quality improvement initiative for the primary care of LGBT patients. They present a blended model of care for LGBT patients that involves educating health practitioners

on creating inclusive environments, correct sexual orientation and gender identity (SOGI) screening, history taking, and STI screenings. Furness et al.'s program was enacted for one year and involved direct coaching of healthcare providers and results included pre- and post-intervention evaluations. This initiative involved more direct evaluation of providers and put the recommendations McNamara and Ng outlined into practice.

To further improve initiatives like that of Furness et al., Owens et al. (2022) call for implementing universally practiced trauma-informed reproductive care. In 2021, the ACOG (2021) Committee on Health Care for Underserved Women published a recommendation to approach all healthcare interactions with a trauma-informed method, especially considering the invasive nature of gynecologic care. Owens et al. (2022) provide further evidence supporting this recommendation and identify how physicians can perpetuate harm if recommendations are not followed. First, Owens et al. identify the various types of traumas that people can encounter, emphasizing the potential for physicians to produce medical trauma. Owens et al. also describe actionable items including verbal screening mechanisms, displays of physical and verbal signals of safety and alteration of physical exams. Ultimately, this paper clearly outlines and reaffirms the mechanisms that create trauma – as described by ACOG (2021) – while advancing care by creating appropriate alterations of reproductive care for OBGYNs and primary care physicians.

Collectively, these publications build upon one another to formulate better practices of reproductive care for people AFAB. Furthermore, literature that offers models for future reproductive care is scarce but continues to become more nuanced and inclusive of all queer identities. Additionally, given that the LGTBQ+ population suffers from significantly higher rates of abuse and trauma, building dialogue about trauma-informed care is essential to

improving these initiatives and marks a significant change in this conversation (Owens, 2022; McNamara & Ng, 2016).

HPV Vaccination and Cancer

It's important to know that HPV can cause six different types of cancer: cervical, vaginal, vulvar, anal, penile, and oropharyngeal (Senkomago et al., 2019; NCI, 2023). Between 2012 and 2016, an average of 34,800 cancer diagnoses annually were related to HPV. Furthermore, about 92% of these diagnoses resulted from HPV strains targeted within the current 9-strain HPV vaccine (Senkomago et al., 2019). The leading HPV-related cancer in the U.S. is cervical cancer; however, in the last three decades, there has been a 225% increase, on a population level, in oropharyngeal cancers related to HPV, putting it on track to surpass the rates of HPV-related cervical cancer (Chaturvedi et al., 2011). The HPV vaccine is a crucial tool in preventing tens of thousands of potentially life ending cancer diagnoses for all types of individuals.

One of the key components of routine reproductive care for people AFAB is Papanicolaou (Pap) tests to screen for cervical cancer. Within medicine, HPV is often emphasized in relation to cervical cancer given that it is nearly the sole cause for this life-threatening diagnosis. Pap tests can be lifesaving, as the 5-year survival for early stages of cervical cancer are over 90% when treated, but they require an incredibly invasive procedure, contributing to why many LGBTQ+ people, especially transgender and gender nonconforming individuals, actively avoid reproductive care (Johnson et al., 2020). Gynecologic care, especially this procedure, is overwhelmingly cisnormative, furthering discrimination and stigmatization in healthcare settings against TGNC patients. Sexual minority individuals AFAB were found to be 46% less likely to have ever had a Pap in 2018 (Stenzel et al., 2022). This is an improvement since 2010 when lesbian women were at a 60% reduced probability of getting a Pap test,

however this gap reflects potential long-term and life-threatening consequences for LGBTQ+ people AFAB (Agénor et al., 2014). Furthermore, Pap tests can also be used to screen for anal cancer for any individual that engages in anal sex, however, this use form of Pap test is less known by the public. Anal Pap screening is especially important for men with HIV that engage in anal sex with men because they have the highest incidents of anal cancers, but it is also important for other groups such as women who have history of HPV-associated genital cancers and any other immunocompromised people who engage in anal sex (Barroso et al., 2022). Social disparities also relate to the survivability of HPV-related cancers, including gender, race, and insurance status (Osauwa-Peters et al., 2021).

Despite these disparities, HPV vaccination is a significant protective measure against all types of HPV-related cancers, but especially important for cervical cancer given its overall 67% 5-year survival (NCI, 2023). In a study of over 1.6 million women and girls, those who had initiated HPV vaccination before the age of 17 were at an 88% lower risk of developing cervical cancer compared to those who were unvaccinated (Lei et al., 2020). There are studies that have examined HPV vaccination among sexual minorities, however, many of them use older data. Furthermore, some of the national surveys used in these papers use age cutoffs that may miss significant information about HPV vaccination among the US population. A study of the 2013-2014 NHIS found that among all women, bisexual women had higher odds of starting and completing the HPV vaccine series compared to heterosexual women, but there was no difference for lesbian women (Agénor et al., 2014). In this study, gay men also had higher odds of initiation and completing the series compared to heterosexual men, with vaccination very low among men in general (Agénor et al.., 2014). In 2019, Gerend et al. found that there was a common misconception among sexual minority men that HPV vaccination was only for women

and girls, despite being at risk of developing HPV-related cancers themselves. Additionally, healthcare provider recommendations were a strong influence on vaccination rate, among men who have sex with men those who were explicitly recommended the vaccine were 40 times more likely to be vaccinated (Gerend et al., 2016). This literature showed a clear need to continue to advocate for vaccination and track progression of such public health measures.

Moving Beyond the Clinic

Reproductive health for LGBTQ+ people is inherently interdisciplinary, exemplified in the fact that the investigators discussed above consider many societal factors and social identities and how these interact with the medical field. Some researchers shifted this conversation to include the theoretical frameworks of reproductive justice and cultural competency. Baker and Beagan (2014) provide an anthropological critique of "culturally competent" care of LGBTQ+ patients. Their study also differs in the presentation of interviews via anthropological block quotations, allowing readers to be more interpretive of their data. While informative, this work targets readers more familiar with anthropology and is written in a way that makes it more challenging to understand its applicability to health professionals' daily interactions. Also, given the new knowledge and recommendations within the literature that have developed since Baker and Beagan's work in 2014, there may be a vastly different finding if this study were repeated today. Finally, Agénor (2019) also provides a critique of studies about contraception for sexual minority women, noting the necessity of a reproductive justice lens which allows researchers to consider the impacts of racism and economic oppression, in addition to heterosexism. Therefore, it may be beneficial for readers and writers to keep some basic aspects of this theory in mind.

The largest gap in this subject is a general lack of comprehensive research, as studies like those included in this review may be limited in scope or generalizability due to various limitations, such as non-inclusive surveying methods or small sample size. While each article provides a significant information in studying reproductive care for LGBTQ+ people, more research needs to be done to connect and mesh these works together, especially regarding practical solutions to health disparities. Moreover, much of this investigation is sparked or driven by organizations like the Guttmacher Institute and the Center for American Progress which act as voices for the LGBTQ+ community on a nationwide scale. Organizations such as these are also the entities gathering the most extensive population-wide data on LGBTQ+ people's health and care – providing information about the differences for people of different sexual and gender minorities that are difficult to distinguish in governmental surreys. Continuing this conversation on LGBTQ+ identities is crucial to reach a greater status of health equity and increase the health of the U.S. population.

Data & Methods

Datasets and Reorganization

The surveys used for this study were the National Health Interview Survey (NHIS) and National Survey of Family Growth (NSFG), both of which are conducted by the Centers for Disease Control and Prevention (CDC) throughout the United States. This data is collected for the goal of being a nationally representative survey of the health of civilian and noninstitutionalized citizens. The data used for this project was gathered in 2017-2019. The NHIS is composed of adults ages 18 and older and the NSFG includes those 15-49, although not all questions were asked for every participant in both surveys. Nationally representative samples of LGBTQ+ populations are extremely limited in the sector of quantitative projects. Surveys conducted through national agencies such as the CDC are beneficial as they give insight into the national population, however, they are often limited in scope in determining one's sexuality or gender identity. Neither the NHIS nor NSFG ask participants about their gender identity, but only ask participants' sex, assuming that all participants are cisgender. The NSFG even goes so far as to have entirely different surveys for men and women. Therefore, for the purposes of this project, the assumption was made that participants' gender identity aligns with their listed sex in the surveys and is not inclusive of transgender or gender-nonconforming individuals. Stata 17.0 was used for all data analysis, both Stata 17.0 and Microsoft Excel 16.75 were used for figure generation.

The primary variables of focus in this analysis are sexual orientation, HPV vaccine status and at what age participants received their first HPV vaccine if it was given. Sexual orientation categories for the NHIS data include: heterosexual, lesbian or gay, bisexual, something else, or unsure. The category of “something else” likely includes individuals who identify as a sexual

orientation outside of the three categories of gay/lesbian, straight, or bisexual – such as pansexual or asexual. Those who responded as "I don't know" were relabeled "Don't Know" for brevity and included those who do not fit into the four other categories and who are likely questioning their sexuality, including possible LGBQ+ identities. The NSFG data, however, is limited to only the categories of heterosexual, lesbian and bisexual.

Initially, I planned to combine 2017 through 2019 NHIS datasets to create a more comparable analysis to NSFG data because NSFG data is only accessible with these years pooled together; however, due to extensive remodeling of NHIS surveying methods, the 2019 NHIS was analyzed separately while the 2017 and 2018 NHIS were combined into one dataset. Because all variables of interest were originally titled the same in these two surveys, I did not need to rename the variables prior to combining them. After pooling the two together with the *append* command, I generated a new variable by combining the "asisim" and "asisif" variables, the sexual orientation variables for men and women correspondingly, and renamed this new variable "orient_a" to match the variable name in the 2019 NHIS. I also cloned and relabeled the variable called "shthpv2" to match the 2019 "shthpv_a" variable, which is whether or not an individual has received the HPV vaccine. Finally, the "ahpvage," "age_p," and "sex" variables were cloned and renamed "shthpvagep_a," "agep_a," and "sex_a" to match the 2019 NHIS. This was done for ease of coding and moving between datasets. In the 2019 NHIS, I cloned the "orient_a" variable and named it "orient_aredo" in order to renumber the categories so that 1=heterosexual, 2=lesbian/gay, 3=bisexual, 4=Something Else and 5=Don't know to create consistency with the 2017-2018 years and to have heterosexual individuals as the default reference group for any statistical tests.

The NSFG data on sexual orientation was present in two separate variables labeled "ORIENT_A" and "ORIENT_B" with each consisting of a random half of the sample and with differing numerical codes. So, I generated a new variable, "comboORIENT," which combined the two into the same numerically coded categories: 1=heterosexual, 2=lesbian, 3=bisexual.

A binary variable, "everhpvvacc" was also created in all datasets to include only those who answered "yes" or "no" when asked if they had received the HPV vaccine. All analyses were conducted with appropriate corresponding survey weighting. Because the 2017 and 2018 NHIS's were combined using the *append* command, the weight variable was divided in half to appropriately adjust for the of two surveys. Any observations in any of the datasets classified as "refused" or "not ascertained" were dropped during analysis as meaningful conclusions could not be made from those groups.

To generate more statistically relevant and robust sample size, a new variable was created for race in the NHIS surveys comprised of the categories "White," "Black/African American," "Asian" and "Other." These categories were made from each survey's original race variable that did not include the category of Hispanic. If participants were not asked their race, they were assigned missing in this new variable labeled "race."

Statistical Methods

To evaluate the impact of surveying methods, each statistical test using the NHIS was conducted three times with different parameters. The first set of conditions included only women under age 26 to create a comparable analysis to the NSFG survey, as the 2017-2019 NSFG women's survey only asked participants under the age of 26 about HPV vaccination and did it ask men about HPV vaccination. The second restriction was created to include only those for

whom the HPV vaccine was recommended in their lifetime, in accordance with the Food and Drug Administration (FDA). Because the HPV vaccine was recommended for girls aged 11-26 beginning in 2006, I included all women under the age of 40 in this second analysis to account for those who were 26 when the vaccine was first introduced who would be 39 years old in 2019. This helped provide insight as to what findings could be missed within the limited age range of the NSFG survey. Finally, analyses were also conducted on all participants in the NHIS surveys, regardless of age or gender. This final category was used to distinguish differences in HPV vaccination between genders as well as to account for evolving HPV vaccination recommendations. As of 2018, the vaccine has been FDA approved to administer up to age 45 spending on individual health risks.

To examine the strength of the association between sexual orientation and whether participants had received their first HPV vaccine, weighted multivariate logistic regressions were run to examine differences in the probability of receiving the vaccine based on sexuality or gender. In both the 2017-18 NHIS and 2019 NHIS, three logistic regressions were run controlling for gender, age, geographic region, and race. Participants whose gender was not available in the 2019 NHIS were excluded from analysis (n = 7). The first test included respondents of all genders and sexual orientations. The logistic regression is most appropriate because both variables are nominal categorical variables. Furthermore, the logistic regression helps predict if participants' sexual orientation influences their probability of receiving the vaccine. To assess the relationship between the age at which people receive their first HPV vaccine depending on their sexual orientation, weighted regressions were run under the three different age and gender conditions in the 2018-18 and 2019 NHIS datasets. One single regression was then run using 2017-2019 NSFG data. These regressions also controlled for

gender, age, geographic region, and race. The *margins* command was used for the sexual orientation by gender and a subsequent *marginsplot* was generated.

To examine the influence of race on the relationship between vaccination status and sexual orientation, a multivariate regression was used. First, a binary variable was created to categorize participants as either heterosexual or LGBQ+, those considered LGBQ+ were participants who answered, “lesbian or gay,” “bisexual,” “something else,” or “unsure” when asked how they thought of themselves. The regression assessing vaccination status and race, also controlled for gender, age and geographic region, was run twice in both the 2017-18 NHIS and 2019 NHIS, once for the heterosexual participants and the other for LGBQ+ participants. The same regression was run using NSFG data.

To examine the probability of vaccination over time in only the NHIS, the same recoding and new variables were generated in each year’s dataset. To keep variable names consistent, this required generating the same new sexual orientation vaccination status variables in the 2017 and 2018 datasets as well as the same variable labeled “race” in all three years. A multivariate logistic regression assessing the relationship between vaccination status and sexual orientation was then run, controlling for age, race, gender, and geographic region. The *margins* command was then used for the orientation variable only to gather the probability of vaccination for each category of sexuality independently. These margins were then entered into an Excel sheet for each NHIS year and then graphed using a non-stacked line graph.

Results

HPV Vaccine Status & Sexual Orientation

To understand the general distribution of the magnitude of people that have received an HPV vaccine relative to their sexual orientation, Tables A-C break down how many people fall into each category within each survey. There are many more straight identifying people included in this sample than other sexual orientations. From the total column on the right, we can see that only 14% of people surveyed in the 2019 NHIS have received at least one HPV vaccine, an increase from 11% in the combined 2017-2018 NHIS. The NFSG female responses differ greatly in that 50.5% of those asked had received the vaccine, which likely relates to the fact that only participants aged 25 and under were asked this question. When examining vaccination status in relation to sexual orientation, more people have not received the HPV vaccine than those that have for every category of sexual orientation in all surveys, although the NSFG this difference is, again, close to 50%.

To further examine the relationship between receiving an HPV vaccine and sexual orientation, a multivariate logistic regression, including individuals' sexual orientation, race, geographic region, age and gender was used. In this model of the 2017-2018 NHIS, gay or lesbian people were 1.63 times more likely to receive the vaccine ($p < 0.005$), bisexual people were 1.66 times more likely ($p = 0.001$). Those unsure of their sexuality or identify as some other non-heterosexual identities did not differ significantly from straight people in their likelihood to receive the HPV vaccine ($p = 0.50$; $p = 0.80$) (Figure 1). Figure 1 also displays that both straight men and straight women had the lowest probability of having received at least one dose of the vaccine relative to people of any other sexual orientation of the same gender. Overall, women were 3.9 times more likely ($p < 0.001$) to receive the HPV vaccine than men, which is reflected

in the red line being higher at all points in Figure 1. Furthermore, for every year older a participant was, they were 13% less like to be vaccinated. Furthermore, those in the south were also 35% less like to be vaccinated relative to those form the Northeast, while those from the West and Midwest did not differ.

The 2019 NHIS displays a closing gap between sexual minority populations and straight individuals in vaccination rates (Figure 2); however, women were still 2.6 times more likely to receive the vaccine than men ($p < 0.001$). Vaccination in relation to region and age were similar in 2019. For every year older a participant was, they were 11% less like to be vaccinated. Furthermore, those in the South were also 27% less like to be vaccinated relative to those form the Northeast, while those from the West and Midwest did not differ.

Stata input: svy: logit everhpvvacc i.orient_a i.sex_a agep_a i.race i.region if orient_a<6, or
margins orient_a, by(sex)
marginsplot

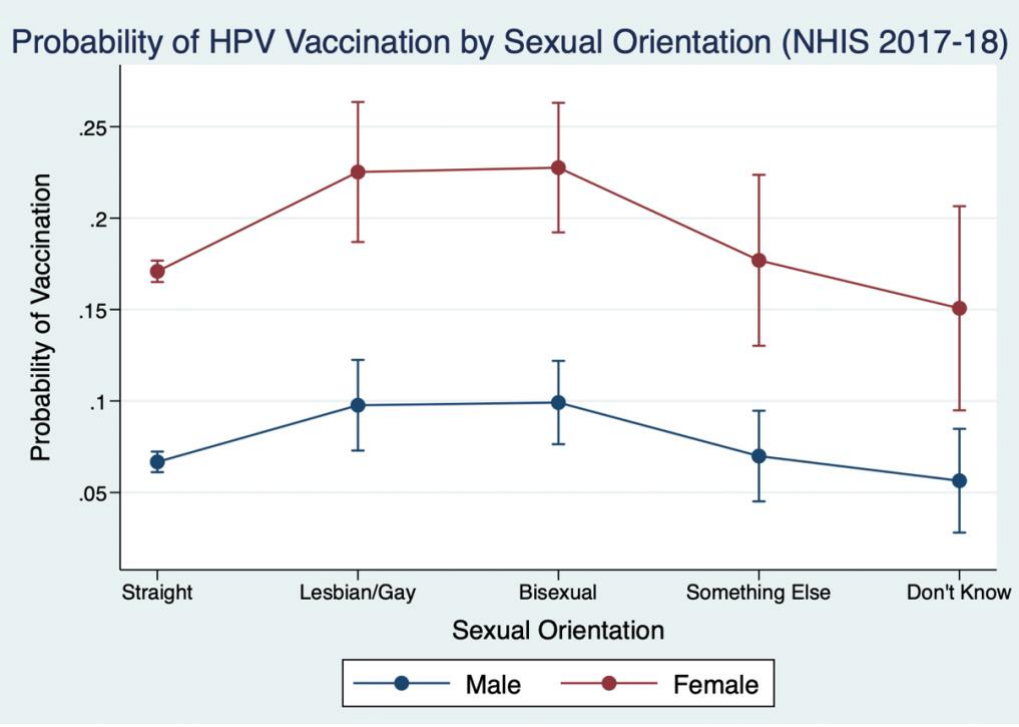

Figure 1. *The probability of receiving an HPV vaccine by sexual orientation for men and women (NHIS 2017-18)*

Stata input: svy: logit everhpvvacc i.orient_aredo i.sex i.race agep_a i.region if sex<3, or
margins orient_aredo, by(sex)
marginsplot

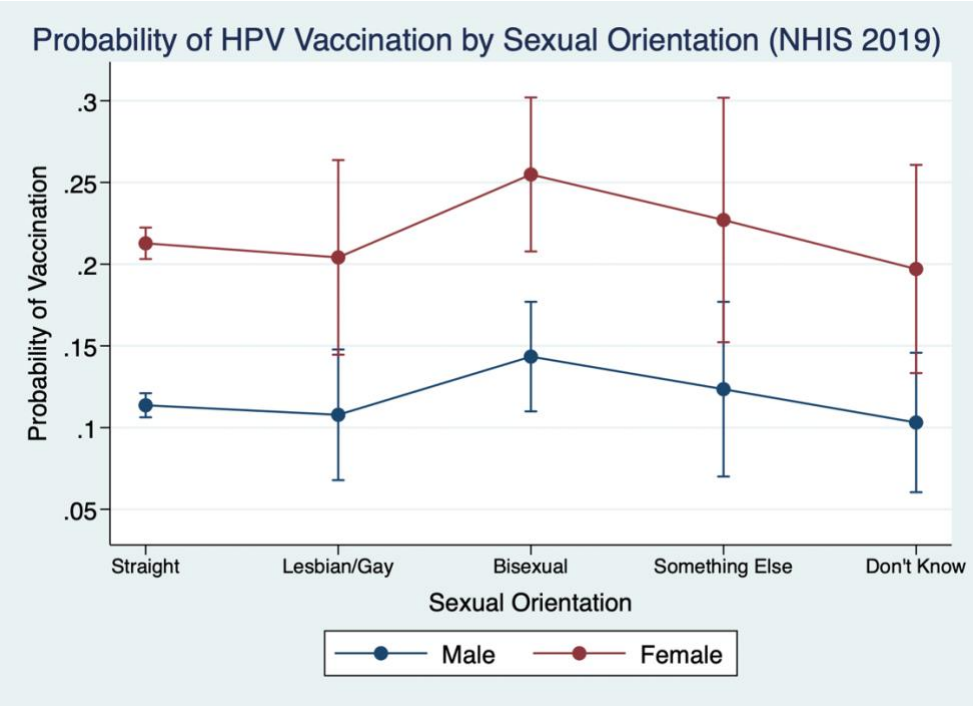

Figure 2. *The probability of receiving an HPV vaccine for various sexualities for men and women (NHIS 2019)*

To address the difference in sampling methods between the NSFG and NHIS, I reran analyses of the NHIS under the same age and gender restrictions as the NSFG survey – including only women aged 25 and under. Comparing the NSFG findings with equivalent NHIS data sets, there were differing results in the likelihood of women receiving the HPV vaccine. This age restriction led to clear differences in findings. In the 2017-2019 NSFG, there were no significant differences for bisexual or lesbian women compared to their heterosexual counterparts in HPV vaccination uptake. In the NHIS 2017-18 data, women under 26 were 2.2 times more likely ($p = 0.003$) to receive the vaccine if they were bisexual and 2.3 times more likely ($p = 0.014$) to receive the vaccine if they identified as something else compared to women under 26 who identified as straight. This gap, however, closed in the 2019 NHIS with women under age 26

having no significant difference in the likelihood of receiving the vaccine based on their sexual orientation.

When the conditions were expanded to include all women who have been eligible for the vaccine since it's approval (those approximately 39 or younger) similar results are found. In the 2017-18 NHIS, bisexual women under 40 were 1.4 times more likely than straight women to receive the shot ($p < 0.05$). This difference does not persist in the 2019 NHIS survey, however, that may be attributed to geographic region or age of vaccination, as eliminating these controls lead to a finding that bisexual women under age 40 were still 1.7 times more likely to receive the vaccine compared to heterosexual women ($p = 0.005$). With all controls, though, those who identity as some other non-specified sexuality were 2 times more likely to be vaccinated in 2019 ($p = 0.05$). Lesbian women under 40, as well as those who were unsure of their sexuality, did not differ in their probability of receiving the HPV vaccine in the 2017-2019 NHIS data.

Figure 3 displays the increasing trend in HPV vaccination overall, as well as how bisexual respondents are highest vaccinated in both 2017 and 2019. However, in 2018 there is a spike in vaccination among gay and lesbian respondents, which then decreases in 2019. All other groups consistently increase their probability of vaccination as time progresses.

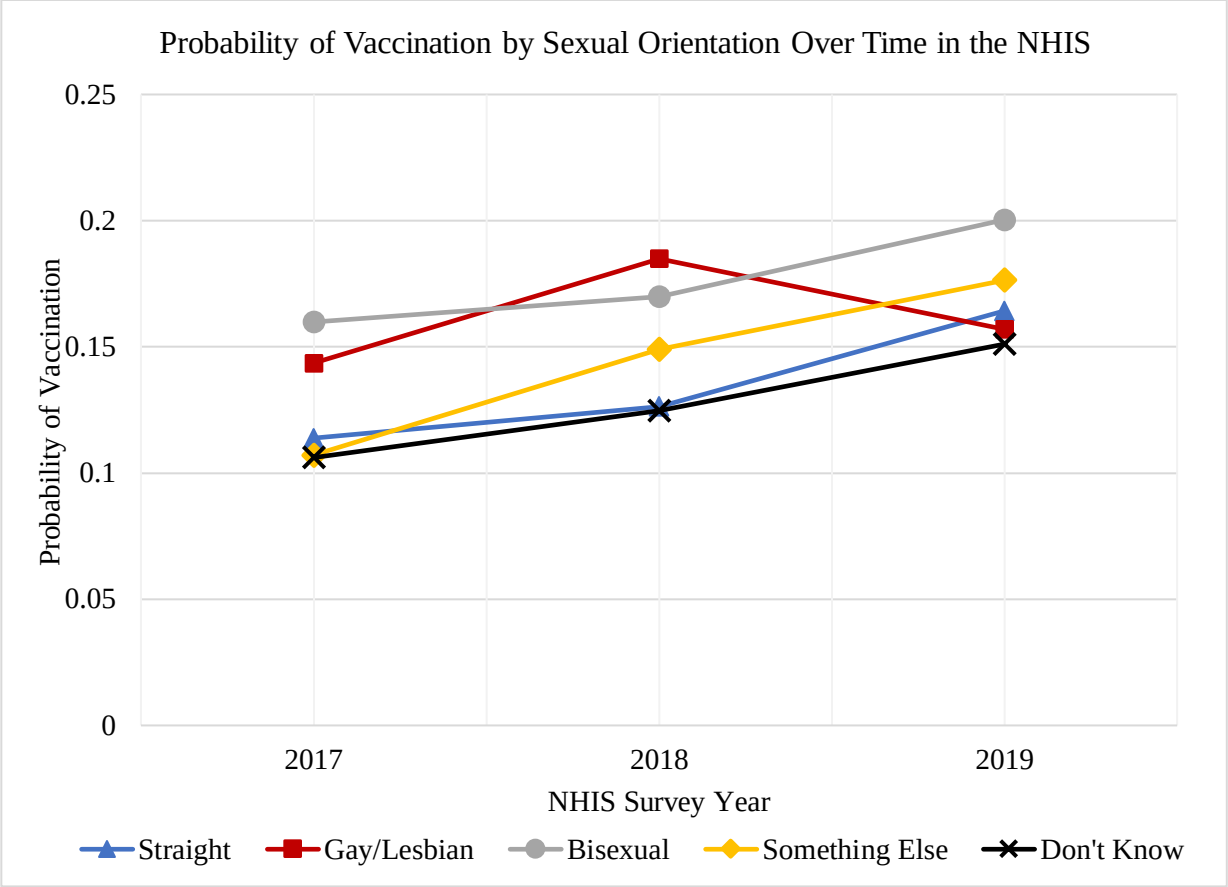

Figure 3. *Trend in HPV vaccination uptake in the NHIS from 2017 to 2019 by sexual orientation*

Age at First HPV Vaccination

Given differences in overall likelihood of vaccination by sexual orientation, additional analyses were conducted to evaluate if there were distinctions in age at first vaccination among these groups as well. There is an inherent difference in the age range of vaccination between NHIS surveys and the NSFG survey, seen in Figures 4-6, due to dissimilar methodologies between the NHIS and NSFG. Using a weighted regression of the data, I found that neither the 2017-2018 combined data nor the 2019 NHIS data showed any significant difference in age of vaccination based on sexual orientation when controlling for age, race, and geographic region. These regressions also showed that women were 1.7 years younger when they received their first

vaccine in 2017-2018 NHIS data and 1.5 years younger in 2019. Furthermore, geographic region was not significantly related to age at first HPV vaccination.

Among the women surveyed in the NSFG from 2017 to 2019, there was no difference in age at first HPV vaccination. When the NHIS datasets were subsequently restricted to women only younger than 26, mirroring the population in the NSFG, the 2017-2018 NHIS surveys showed bisexual women are 1 year older when they receive their first vaccine compared with straight participants ($p < 0.05$). Lesbian women as well as those unsure of their sexuality and those identifying as other sexualities did not differ from straight women. When I expanded the age restriction to include women younger than 40 – all women for which the vaccine was recommended in their lifetime – there was no difference in age of first HPV vaccine based on sexual orientation in the 2017-2018 NHIS. The 2019 NHIS showed no significant difference in age of first vaccination regardless of gender and age restriction (Table 2).

Table 1. *Median age of vaccination by sexual orientation of all survey participants*

	Straight	**Lesbian/Gay**	**Bisexual**	**Something Else**	**Unsure**
NHIS 17-18	17	18	17	15	17
NHIS 2019	17	17	16	19	15
NSFG 17-19	14	14	14	NA	NA

Table 2. *Regression coefficients of age at vaccination for each sexual orientation relative to heterosexual individuals by data source and with varying age cutoffs*

	NSFG 2017-19	**NHIS 2017-18** (women<26)	**NHIS 2019** (women<26)	**NHIS 2017-18** (women<40)	**NHIS 2019** (women<40)	**NHIS 2017-18** (all)	**NHIS 2019** (all)
Lesbian and/or Gay	0.038	-0.199	0.958	-0.752	-0.653	0.315	-0.002
Bisexual	0.131	**0.976***	-0.034	-0.205	-1.23	0.802	-0.065
Something Else	NA	-0.774	1.91	0.072	0.671	-0.021	1.17
Unsure	NA	0.862	-0.463	0.473	-0.123	0.982	0.134

*Bolded values are significant

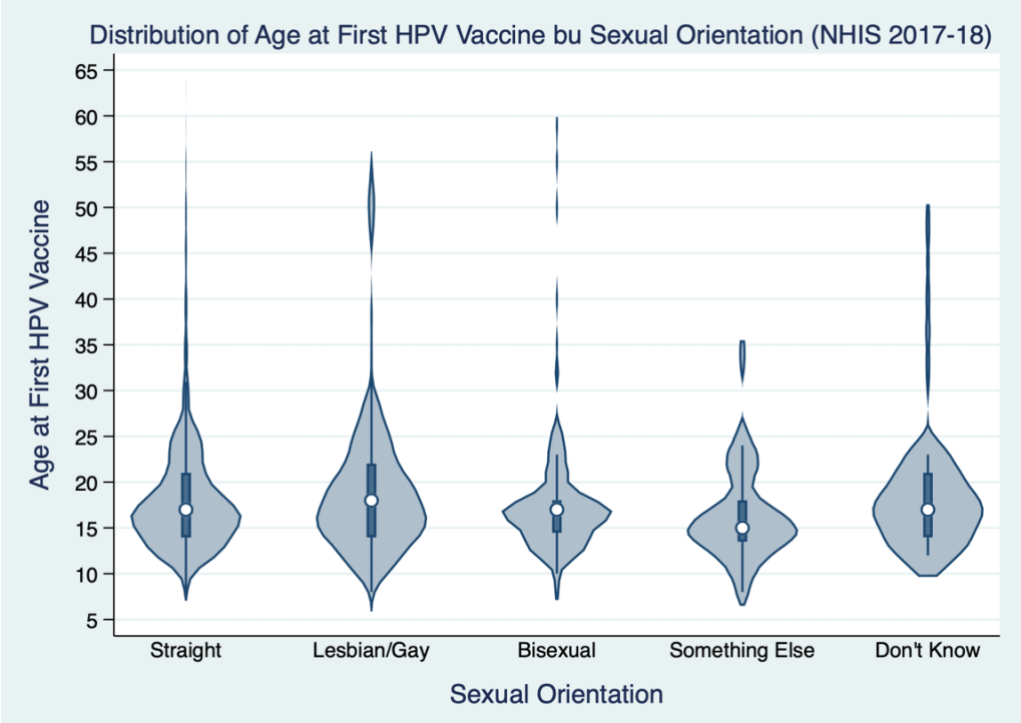

Figure 4*. Age distribution of first vaccination for all individuals by sexual orientation in NHIS 2017-2018, displaying both median age and the range*

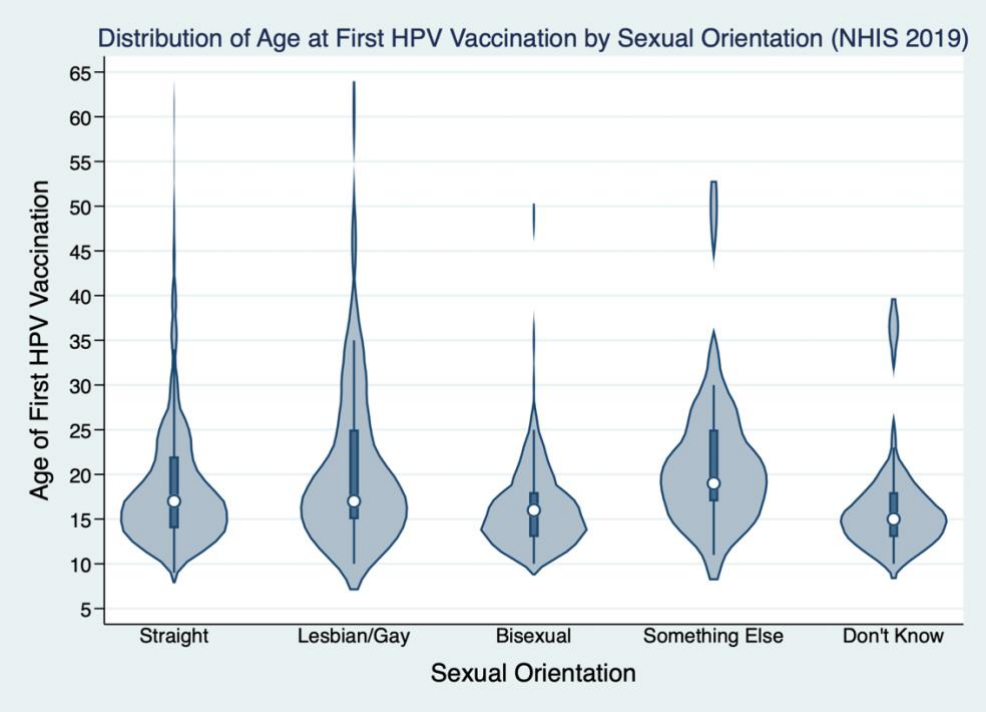

Figure 5. *Age distribution of first vaccination for all individuals by sexual orientation in NHIS 2019, displaying both median age and the range*

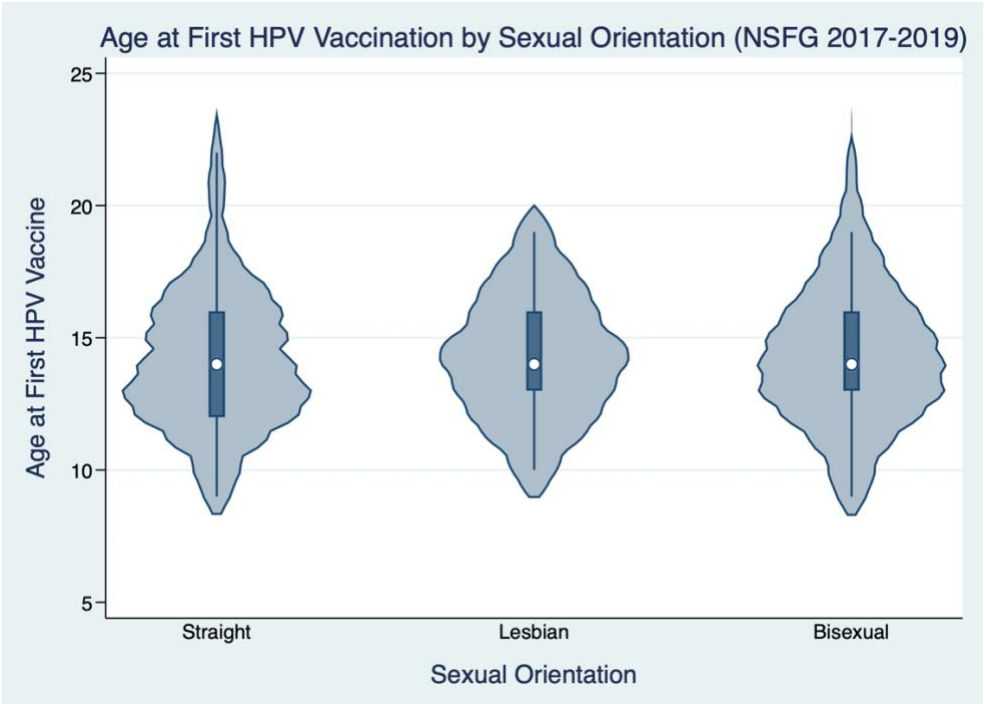

Figure 6. *Age distribution displaying both median age and the range of first vaccination for all individuals by sexual orientation in NSFG 2017-2019*

Vaccination Status Considering Both Race & Sexual Orientation

In a multivariate regression of the 2017-2018 NHIS data, while controlling for gender, age, and geographic region, there were no differences in vaccination status among all heterosexual people due to their race. This finding held true for LGBQ+ participants well. In the regression of all participants, those that identify as a race other than Black or African American or Asian were 1.3 times more likely to be vaccinated compared to White participants ($p < 0.05$).

In the 2019 NHIS, no racial minority group of LGBQ+ individuals were significantly different than those who are White. Among all heterosexual respondents though, Black or African Americans were 1.3 times more likely ($p < 0.05$), and people of a race other than Black or African American or Asian were 1.4 times more likely ($p < 0.05$) than White respondents to receive the vaccine. When including all participants, Black or African American individuals were 1.2 times more likely to be vaccinated than White individuals ($p < 0.05$), while those who are Asian or any other race did not differ. Due to limited sample sizes, analysis of the NHIS surveys was not repeated with restricted age categories; however, there was no influence of race on probability of being vaccinated for any sexuality group in the 2017-2019 NSFG data.

Discussion

HPV Vaccination & Sexual Orientation

Historically, LGBTQ+ identities were characterized as pathological deviance from cisgenderness or heterosexuality in medicine (Mayer et al., 2008; Drescher, 2015). As a result of continued stigma and discrimination, many that are part of the LGBTQ+ community deeply fear being their true selves while seeking care or avoid care altogether, contributing to health disparities for sexual minorities (Mirza & Rooney, 2018). While these findings show the probability of receiving the HPV vaccine is higher for sexual minorities, this may point to differences in perceptions of risk that are related to stigma. There is progress in this disparity as gay and lesbian and bisexual individuals are no longer significantly different from their heterosexual counterparts; however, in each of these models, regardless of restriction by age or race, bisexual individuals consistently have the highest probability of vaccination, aside from gay and lesbian individuals in 2018 (Figure 1-3). Additionally, among all women that have been eligible to receive the vaccine – age 26 or younger in 2006, or those born after 2006 – those who identity with another non-specified sexuality were 2 times more likely to be vaccinated in 2019 ($p = 0.05$). It is also of note that straight individuals are among those least likely to receive the vaccine, regardless of gender or sexuality, given that they are a much larger portion of the United States population. These findings point to a potential difference in the perceived sexual riskiness.

Many studies have found that bisexual individuals are at an increased risk of poorer health outcomes. In a review of literature on this specific disparity, Feinstein and Dyar (2017) find that these poorer health outcomes are primarily a result of stigma. They associate this stigma to the minority stress model which states that those with minority identities face additional, unique, stressors because of stigma and discrimination. In addition to being a sexual minority in

general, bisexual individuals face hostility or negative attitudes from both heterosexual and lesbian/gay people questioning the validity of their identity (Feinstein & Dyar, 2017; Brewster & Moradi, 2010). This further connects to a stereotype that associates bisexual people to sexually risky behaviors or promiscuity (Feinstein & Dyar, 2017; Brewster & Moradi, 2010). This perception may then permeate into the medical care of bisexual people, leading healthcare professionals to believe bisexual patients are at a greater risk of contracting HPV – or multiple strains – contributing to their higher rates of HPV vaccination. Because there is little research on sexual orientation identities that are not lesbian, gay or bisexual, it is difficult to understand why they were still 2 times more likely to be vaccinated in 2019. Given that other identities like, pansexuality or polysexuality, are minorities within the LGBTQ+ community, this stigma may also extend to them.

When it comes to the general trend of HPV vaccination, it is encouraging to see that, although small, it is increasing for most sexual orientations throughout these three years. As more data is captured, whether the drop in vaccination for gay and lesbian individuals persists is something to continue to monitor. This was just one year of change and a recent study shows promising increasing awareness of the importance of the HPV vaccine among gay and bisexual men, especially younger individuals (Chidobem et al., 2022).

Furthermore, it is also alarming that men are consistently significantly less likely to receive the vaccine, regardless of sexuality, given that they are half of the population of the United States. In 2017-2018, women were nearly 4 times more likely to receive the vaccine and in 2019 this remained high at 2.6 times more likely (Figure 1-2). While the differing timeline in vaccine approval – 2006 for girls/women and 2009 for boys/men – may contribute to this

disparity, given that in a ten-year span since its approval for boys the gap is still so large this reflects the strong influence of societal norms.

There is also socially constructed norm in the U.S. that places responsibility for protective measures during sexual or romantic interactions more so on women than men, especially in heterosexual contexts. This is evident in contraceptive usage, for example. There is a more normalized use of female birth control, especially during young adulthood, and a simultaneous societal shame and pushback regarding condom use. According to the CDC, about 20% of 15–19 year old girls and 21.6% of 20-29 year old women used birth control pills while only 5.1% and 10.4%, correspondingly, used male condoms as contraceptives (Daniels & Abma, 2020). Regardless of one's gender or natal sex there must be equal and high HPV vaccination rates as each person is just as likely to contract or transmit HPV to their partner(s).

Given the nondiscriminatory routes of transmission of HPV, targeting a specific gender or sexuality is detrimental in the long term as it furthers a social norm that HPV vaccination is more important for girls and continues to place responsibility of sexual risk on them. Yet, public health initiatives, like that of the World Health Organization, continue to focus on girls and women for this vaccination (WHO, 2022). In these public health efforts, the HPV vaccine is primarily discussed in relation to cervical cancer, which is a health risk for any person AFAB. This is a larger public health emphasis because HPV causes upwards of 90% — potentially up to 99% — of cervical cancer cases which are more prevalent than all other HPV-related cancers, with about 570,000 women world-wide getting an HPV-related cancer compared to about 60,000 men (NCI, 2023). However, continuing this exclusive messaging only perpetuates a public perception that those without a uterus should not be concerned about cancers resulting from HPV. All people can contract and spread HPV or develop an HPV-related cancer. Excluding

boys and men out of this advocacy leaves them more vulnerable to contracting high-risk strains of HPV and therefore developing penile, anal, or oropharyngeal cancers. Only by achieving widespread vaccination for the whole population will all HPV-related cancer rates decline.

When comparing findings in the NSFG vs NHIS, the impact of survey methods is clear. In the 2017-2019 NSFG, there were no significant findings about the probability of vaccination between bisexual, lesbian and heterosexual women. When the same age restriction was also applied to the NHIS surveys, there was a difference for bisexual women and women who identify as a different sexual orientation in 2017-2018, but this was no longer the case in the 2019 NHIS. When this age range was expanded to include all women who have ever been in the recommended age range of vaccination from 2006 onward (those under 40), bisexual women remain more likely to be vaccinated in 2017-2018 and women who identify as something else also remain more likely to be vaccinated in the 2019 NHIS. This may be attributable to the larger sample size within the NHIS data, but also indicates the importance of surveying all participants to understand all factors involved in HPV vaccination.

Age at First HPV Vaccination

By age 18, 55% of male and female teenagers have had sexual intercourse (Abma & Martinez, 2017). This information paired with the median age of first HPV vaccination for all sexualities in the NHIS data being between 15 and 18 indicates that approximately half of adolescents are not receiving the vaccine until after they become sexually active. Thus, they are potentially already exposed to HPV. The age of vaccination also impacts the dosage necessary for protection. If the first dose is given on or after the 15th birthday, three injections are required while only 2 are needed for those under age 15. The requirement of an additional dose in this

older age group has the potential to reduce the probability of someone completing the series, reducing the efficacy of the vaccination (CDC, 2021). Studies also suggest that the earlier two-dose series, even off schedule, is as good and possibly even better protection than the first injection later in adolescence or adulthood, and there is larger efficacy in the completion of the whole series prior to exposure (CDC, 2021). Although, any degree of protection via vaccine is better than none.

Figures 5 and 6 show us that the overall median age of HPV vaccine uptake is even lower in the NSFG. This is likely due to the limited age of participants as there is a significantly larger distribution in the NHIS surveys. Nevertheless, it is beneficial that all people, regardless of sexuality, are receiving the vaccine at younger ages in this data. The analyses of the NHIS are influenced by the outliers of the age ranges, visible in Figures 3-5. While the vaccine is ideal for ages 9-12 and recommended for those under 26, it is also approved up to the age of 45 for those who may can benefit from its protections as well (CDC, 2021). This protection for those over age 26 has been found in recent studies that show that even for those who have a confirmed HPV infection and have tested positive for precancerous cervical cell types, vaccination reduces their risk of recurrence of precancers (Bartels, 2020). Certainly, this older age group is not the primary target of this vaccine, but it is important to see how vaccine prevalence changes given its addition to treatment plans for those with precancers who that were initially ineligible to receive the shot. This accounts for some of the large age range in this data, however, it is also important to note that data points over the age of 45 may also be due to inaccurate reporting.

There is an interesting significance in age of vaccination within of bisexual and those who are another non-heterosexual identity in the NHIS surveys. The finding that young bisexual women under 40 receive the vaccine a year earlier than straight women in the 2017-18 NHIS

may result from previously discussed differences in perceived risk associated with sexual activity. However, it may also speak to potential gender or class differences within this sexuality as 29.4% of cisgender bisexual women face poverty compared to 17.9% of cisgender lesbians (Badgett et al., 2019). Given that those in poverty have greater challenges accessing care, healthcare providers may push for greater preemptive protective measures, like the HPV vaccine. Further investigation should examine other possible contributing factors to the age of receiving the first dose as this analysis is extremely limited in this capacity.

Vaccination Status Considering Race & Sexual Orientation

In the 2017-2018 NHIS data, there were no differences in vaccination status among all heterosexual or LGBQ+ participants due to race. When looking at the 2019 NHIS, among all heterosexual respondents, Black or African Americans were 1.3 times more likely and people of a race other than Black or African American or Asian were 1.4 times more likely than White people to receive the vaccine. There was, however, no difference probability of vaccination by race for LGBQ+ respondents. When including all participants, in 2017-2018, those that identify as a race other than Black or African American or Asian were more likely to be vaccinated compared to White participants. In 2019 though, Black or African American individuals were more likely to be vaccinated than White individuals. The greater differences found in the 2019 NHIS suggests that vaccine disparity by race may be worsening.

These findings are somewhat surprising. When considering the group of heterosexual respondents, the category of "other" included those who were multiracial, Alaska Indian, or American Native or other non-specified identities. One factor that influences this finding is that these individuals may be targeted more for preventative healthcare measures as continued,

annual access to care is limited in Alaska and Indigenous Reservations (Davy et al., 2016). Indigenous Reservations often have more restricted access to services and face greater healthcare discrimination than white populations, so they may be a target of the HPV vaccine given it's protective nature (Baciu et al., 2017). These findings may also speak to pervasive discriminatory beliefs in United States medical system. Historically, racism within the medicine led to the belief that communities of color have been associated with higher rates of STDs and unsafe sexual practices (Boutin & Williams, 2021)**.** Although empiric research shows people of color have had higher rates of STDs, there are a multitude of interweaving social factors that influence this trend, yet the cause is still often boiled down to individual sexually risky actions – continuing racist assumptions today (Boutin & Williams, 2021). This underlying assumption of increased exposure risk may then lead healthcare providers to encourage vaccination for their patients of color more so than for their white patients.

Conclusion

This study was limited in the ability to control for other various factors such as health insurance status, economic class, or parental vaccination beliefs due to incongruence across datasets. Overall, from these results we can see that limiting the age at which we survey individuals about the HPV vaccine – such as in the NSFG – eliminates the ability to study those who have received it within the recommended age range but are now older than it. Furthermore, new evidence indicates the ability for the HPV vaccine to prevent cervical cancer in those who have already had atypical cell development (Bartels et al., 2020), so the need to continue research on vaccination in correspondence with cancer rates is crucial to continue to understand long-term impact on population health. These findings also show that nearly all groups, except for bisexual women in the NHIS 2019, had less than a 50% probability of being vaccinated, showing a clear need to spread greater awareness about the safety and efficacy of the HPV vaccine to the United States public. While most other routine vaccinations protect against potentially fatal childhood illnesses, and thus are mandated in most schools, one should not delay HPV vaccination merely because the threat of cancer lies far into adulthood; nor should it be focused on only one gender, sexual orientation, or racial group.

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Appendix A

Table A. *Frequency distribution of participants HPV vaccination status by sexual orientation, including count and column percentage of each group in NHIS 2017-2018.*

tab everhpvvacc orient_a if orient_a<6
tab racerpi2 orient_a if racerpi2!=5 & orient_a<6, col

Demographic

Ever had an HPV shot	**Gay/ Lesbian**	**Straight**	**Bisexual**	**Something Else**	**Unsure**	**Total**
Yes	110 14.27	3,475 10.52	175 31.25	38 20.54	34 11.85	**3,832** **11.0**
No	661 85.73	29,563 89.48	385 68.75	147 79.46	253 88.15	**31,009** **89.0**
Total	**771** **100.00**	**33,038** **100.00**	**560** **100.00**	**185** **100.00**	**253** **100.00**	**34,841** **100.00**
Race						
White	767 82..47	38,864 80.19	505 80.41	185 75.20	339 73.54	**40,660** **8.15**
Black/African American	92 9.89	5501 11.35	67 10.67	37 15.04	55 11.93	**5,752** **11.34**
Asian	31 3.33	2569 5.30	16 2.55	6 2.44	43 9.33	**2,665** **5.25**
AIAN	12 1.29	556 1.15	6 0.96	4 1.63	10 2.17	**588** **1.16**
Other or Multiracial	28 3.01	972 2.01	34 5.41	14 5.69	14 3.04	**1,062** **2.09**
Total	**930** **100.00**	**48462** **100**	**628** **10**	**246** **100**	**461** **100**	**50,727** **100**

Key
Frequency (N) Column percentage

Appendix B

Table B. *Frequency distribution of participants HPV vaccination status by sexual orientation, including count and column percentage of each group in NHIS 2019.*

Stata input: tab everhpvvacc orient_a if orient_a<6
Tab raceallp_a oreint_a if raceallp_a<8 & orient_a<6, col

Demographic information

Ever had an HPV shot	**Gay & Lesbian**	**Straight**	**Bisexual**	**Something Else**	**Unsure**	**Total**
Yes	68 18.48	2,641 13.43	132 35.39	27 29.67	35 18.52	**2,903** **14.03**
No	300 81.52	17,030 86.57	241 64.61	64 70.33	154 81.48	**17,789** **85.97**
Total	**368** **100.00**	**19,671** **100.00**	**373** **100.00**	**91** **100.00**	**189** **100.00**	**20,692** **100.00**
Race						
White	334 77.86	22,731 80.06	304 77.75	89 76.07	177 71.37	**23,635** **79.91**
Black or African American	61 14.22	3,279 11.55	43 11.0	13 11.11	38 15.32	**3,434** **11.61**
Asian	19 4.43	1,540 5.42	14 3.58	7 5.98	25 10.08	**1,605** **5.43**
AIAN	3 0.7	254 0.89	4 1.02	0 0.00	2 0.81	**263** **0.89**
AIAN and any other group	5 1.17	258 0.91	9 2.30	5 4.27	2 0.81	**279** **0.94**
Other single and multiple races	7 1.63	329 1.16	17 4.35	3 2.56	4 1.61	**360** **1.22**
Total	**429**	**28,391**	**391**	**117**	**248**	**29,576** **100.00**

Appendix C

Table C. *Frequency distribution of participants HPV vaccination status by sexual orientation, including count and column percentage of each group in 2017-2018 NSFG.*

tab evervacc comboORIENT if evervacc<7, col
tab rrscrrace comboORIENT, col

Demographic information

Ever had an HPV shot	**Lesbian**	**Straight**	**Bisexual**	**Total**
Yes	25 47.17	655 49.66	159 55.03	**839** **50.51**
No	28 52.83	664 50.34	130 44.98	**822** **49.49**
Total	**53** **100.00**	**1,319** **100.00**	**289** **100.00**	**1,661** **100.00**
Race				
White	83 52.2	2436 47.49	312 50.24	**2831** **47.91**
Black or African American	39 24.53	1089 21.23	145 23.35	**1273** **21.54**
Hispanic	34 21.38	1368 26.67	137 22.06	**1539** **26.05**
Other	**159** **100.00**	**5,129** **100.0**	**621** **100.00**	**5,909** **100.00**