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Evaluating The Impact of HPV Vaccination Programs on Reducing HPV Infections and Related Diseases Among Young Adults in Palm Beach County, Florida

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Abstract
Both men and women can contract the common virus known as human papillomavirus (HPV) through sexual intercourse. Infections with the human HPV have been connected to at least six specific cancer kinds. HPV vaccination programs are important in combating this virus. HPV vaccination prevents malignancies rather than treating infections. It reduces health risks in young adults, including genital warts and certain cancers. Preventing HPV exposure is crucial for reducing future health burdens. For vaccination to be as effective as possible, it should be received before to exposure to HPV, usually beginning in adolescence. Since HPV infections usually occur shortly after a person begins sexual activity, young adults are more at risk for them. This study aims to assess how effectively HPV vaccination campaigns in Palm Beach County, Florida, USA, have worked to lower the incidence of HPV infections and associated illnesses among young adults. This study evaluated the success of HPV vaccination campaigns, the risk of emerging HPV-associated diseases (e.g., cervical cancer), and young adults' participation in these campaigns and their involvement in the vaccination process in the Palm Beach area.

Keywords: HPV vaccine; human papillomavirus; vaccine effectiveness; vaccine impact.

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Human Papillomavirus is a common virus transmitted through sexual contact, affecting both men and women. While most infections are clear on their own, certain high-risk HPV types can cause genital warts and lead to cancers of the cervix, vulva, vagina, penis, anus, and throat. The term "Human Papillomavirus" refers to a group of related viruses, of which over 40 varieties are readily infectious when skin-to-skin contact occurs during vaginal, anal, or oral sexual contact, according to the World Health Organization (WHO, 2024).

The importance of HPV vaccination programs lies in their ability to prevent infections by targeting these high-risk strains. Vaccination is recommended before exposure to HPV, typically starting in adolescence, to maximize its effectiveness. By reducing HPV transmission, these programs contribute significantly to preventing HPV-related diseases and cancers, thereby improving public health outcomes globally. The vaccination cannot cause cancer or other HPV-related disorders because it does not include any live virus or virus DNA. The HPV vaccination is intended to stop the growth of malignancies rather than treat HPV infections or illnesses brought on by HPV (WHO, 2024).

In addition, among young adults, HPV (Human Papillomavirus) poses significant health risks primarily due to its ability to cause genital warts and certain types of cancers. These cancers include cervical, vaginal, vulvar, penile, anal, and some oropharyngeal cancers. Young adults are particularly vulnerable as HPV infections often occur soon after becoming sexually active. Prevention through vaccination before exposure is crucial in reducing the risk of HPV-related diseases and their

associated health burdens later in life. Regular screenings for cervical cancer in women and awareness of HPV-related risks are also essential for early detection and treatment.
The aim of this study is to evaluate the effectiveness of HPV vaccination programs in Palm Beach County, Florida, U.S., in reducing the prevalence of HPV infections and incidence rates of related diseases among young adults.

Literature Review
According to estimates, HPV caused 620.000 cancer cases in women and 70.000 cases in men in 2019 globally (De Martel et al., 2020). Sub-Saharan Africa has the highest prevalence of cervical HPV among women (24%), with Latin America and the Caribbean (16%), Eastern Europe (14%), and South-East Asia (14%) following closely behind. The prevalence varies greatly among men according to sexual tendencies (Bruni et al., 2010).

Low- and middle-income nations have the greatest incidence and mortality rates from cervical cancer. This reflects significant disparities caused by social and economic factors, as well as limited access to national HPV vaccination, cervical screening, and treatment facilities (WHO, 2024). Every year, 42 million U.S. individuals are infected with the common virus HPV, of which 36,000 become unwell. Although there is early screening for cervical cancer, there is no screening advised for other HPV-related cancers such as vulva, vaginal, throat, anus, or penis (CDC, 2021a). Cancers from HPV can be prevented with vaccines.

Mandates for vaccinations have long been recognized as a useful instrument for raising immunization rates and lowering the risk of disease outbreaks worldwide. The majority of Americans are in favor of vaccination mandates; support ranges from 68% for COVID-19 to 90% for DTaP, polio, chickenpox, and MMR. In this regard, the strongest support comes from people who live in urban areas, identify as ethnic minorities, think vaccinations are vital and safe, and have faith in medical facilities. In the United States, the public generally supports vaccination requirements (Header, 2023).

In the U.S., starting at age 9, the HPV vaccine is advised for children aged 11 to 12, as well as for all preteens, teenagers, and young adults up to age 26.

For kids aged 11 to 12, the CDC advises receiving two doses of the HPV vaccine, beginning at age 9. Merely two doses are required if administered before the age of fifteen. Children aged 9-14 require a third dose if given less than five months apart, while young adults aged 15–26 require three doses. Also, individuals aged 9 to 26 who have compromised immune systems ought to receive three doses (CDC, 2021b).

Routine vaccinations are usually covered by health insurance programs in the U.S.. Additionally, children 18 years and under who are Medicaid-eligible, American Indian or Alaska Native, under-insured, or without insurance can receive vaccinations under the Vaccines for Children (VFC) program (CDC, 2021b).

The U.S. Food and Drug Administration (FDA) has granted licenses for three HPV vaccines: the bivalent HPV vaccine (Cervarix, 2vHPV), the quadrivalent HPV vaccine (Gardasil, 4vHPV), and the 9-valent HPV vaccine (Gardasil 9, 9vHPV). Most HPV malignancies are caused by HPV types 16 and 18, which are protected against by all three HPV vaccinations (CDC, 2021b).

The vaccination that is being given out in the US is called Gardasil-9 (9vHPV). Nine HPV types are protected against by this vaccine: 6, 11, 16, 18, 31, 33, 45, 52, and 58. There has been a significant

change in HPV infections and cervical pre-cancers since 2006. There has been an 88% decrease in teen girls and an 81% reduction in young adult women since 2006. Common HPV kinds have resulted in a 40% decrease in cervical pre-cancers among vaccinated women (CDC, 2024).

As it's known, the U.S. healthcare system is a complex mix of private and public insurance, high costs, variable quality, and regulated by multiple federal and state entities, offering advanced medical care but facing significant access and cost challenges. In such a healthcare system, HPV vaccination programs in the US are implemented through various channels, including the Advisory Committee on Immunization Practices (ACIP) Recommendations, Vaccines for Children (VCF), school entry requirements, public health campaigns, healthcare provider initiatives, community-based programs, and insurance coverage. The ACIP recommends routine vaccination for boys and girls aged 11-12, while catch-up vaccination is recommended for those not adequately vaccinated. The VFC program provides free vaccines to Medicaid-eligible, uninsured, under-insured, or American Indian/Alaska Native children. The impact of this program can be seen from the high vaccination rates in the areas where these people mostly live.

Moreover, some states in the U.S. have school entry requirements for HPV vaccination, e.g. Virginia and Washington, D.C., while public health agencies and healthcare providers advocate for vaccination. Community-based programs also increase vaccine access.

To encourage HPV vaccination, public health organizations and agencies like the American Cancer Society and the CDC run education and awareness programs. The American Academy of Pediatrics and the American Academy of Family Physicians are two organizations that support HPV vaccination and offer tools to assist medical professionals in having conversations with patients and their families about the vaccine.

Initiatives to expand access to HPV vaccines are frequently carried out by community health centers, local health departments, and other community-based organizations. These initiatives could involve awareness campaigns, vaccination clinics, and collaborations with local institutions of higher learning. Many commercial health insurance policies and government health programs, such as Medicaid, provide free or reduced-cost HPV vaccinations, hence enhancing vaccine accessibility. Together, these initiatives aim to increase HPV vaccination rates and lower the frequency of illnesses linked to HPV, including cervical cancer and other HPV-related cancers.

Even though vaccination rates are lower in the United States, there has already been a noticeable decline in the prevalence of the vaccine strains. Although eight years following the beginning of the HPV vaccination in the United States, the prevalence of 4vHPV-type in cervicovaginal specimens lowered from the pre-vaccine era by 71% in females aged 14–19 and 61% in females aged 20–24 (Oliver et al., 2017). This is data that clearly shows the positive effect of the HPV vaccine on the outcomes.

HPV vaccination campaigns in Palm Beach County, Florida, which we chose as the region of this study, seek to lower HPV infections by making vaccines more widely available and encouraging awareness of the advantages of immunization. The HPV vaccine is available as part of the immunization programs provided by the Florida Department of Health in Palm Beach County. These initiatives, which target both adults and children, offer vaccinations through the Vaccines for Adults (VFA) program, which aims to protect people against diseases that can be prevented by vaccination, as well as in health department clinics.

To guarantee greater vaccination rates, initiatives include public awareness campaigns, partnerships with educational institutions, and community engagement. By stopping the first infection, these programs contribute to a reduction in the occurrence of malignancies and other illnesses linked to HPV.

In the state of Florida, these programs work together to promote HPV vaccination and reduce the prevalence of HPV-related diseases, notwithstanding there is no HPV vaccination requirement for admission to schools in Florida. Although some states and the District of Columbia have corresponding regulations, Florida does not require HPV vaccination to attend school. Instead, it promotes the vaccine (Florida Department of Health, 2024). As a result of the evaluation of the outcomes of vaccination studies conducted over many years, we believe that such practices, even if mandatory, will increase vaccination rates.

HPV vaccination is crucial for young adults for cancer prevention, prevention of other HPV-related diseases, herd immunity, stronger immune response in youth, sexual activity onset, and long-term health costs. It protects against cervical, anal, oropharyngeal, and other genital cancers, prevents genital warts and non-cancerous lesions, reduces herd immunity, and is more effective in preteens and teens. Vaccination also reduces long-term healthcare costs associated with treating these conditions, benefiting both individuals and the healthcare system.

It is very clear that vaccinating young adults before they become sexually active ensures they are protected before any potential exposure to HPV, which is primarily spread through sexual contact.

In Palm Beach County, Florida, HPV vaccination campaigns have had a major positive effect in lowering the prevalence of illnesses linked to HPV. Increased immunization efforts have led to improvements across the state, according to the Florida Department of Health. The main objective has been to lower the prevalence of HPV infections, which can result in several malignancies, including cancers of the throat, anal, and cervical regions. The Palm Beach County efforts are a component of larger programs that also involve more vaccine accessibility and educational campaigns.

As we stated before, vaccinating against HPV protects against cancer-causing infections, abnormal cells, and the lasting effects of testing and treatment. Starting at age 9, children aged 11-12 receive two doses, while those starting after 15 need three doses (CDC, 2024). Health department reports and surveys conducted at the federal, state, and local levels are usually utilized to monitor HPV prevalence rates in the states and the United States. We would like to present the data from our study scope in this section in the light of Florida Department of Health. However, before reviewing the status in Florida together with Palm Beach County, it would be appropriate to include the figures for all of U.S. in 2022.

In 2022, 38.6% of children aged 9 to 17 in the U.S. received at least one dose of the HPV vaccine, with 42.9% of girls receiving one or more. Vaccination rates increased with age, with older children (15-17 years) being more likely to receive the vaccine. Health insurance coverage, parental education, and geographic location all influenced vaccination rates, with greater rates among children with private health insurance and those living in metropolitan areas. Hispanic children have lower immunization coverage than their white counterparts. For children aged 9 to 12, a two-dose regimen is recommended, while those with compromised immune systems should receive three doses (Villarroel et al., 2024).

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The related data and the numbers of Florida Department of Health via public records is evaluated regarding HPV vaccine completion rates together with cervical cancer incidence and relevant deaths. In 2022, Palm Beach County had a higher percentage of people (females aged 9 to 17) with completed HPV vaccinations (37.2%) than Florida (34.4 %) across all age categories and modalities of exposure. Palm Beach County is in the third quartile for this measure, which indicates that, in comparison to other Florida counties, around half of the counties experience the condition less frequently, and approximately 25% of the counties experience it more frequently (Table 1).

Table 1: ***HPV Vaccine Completion, Ages 9-17, Percentage of Population (Count/Denom/Numbers, Rates)*** **(Florida Department of Health, 2024)**

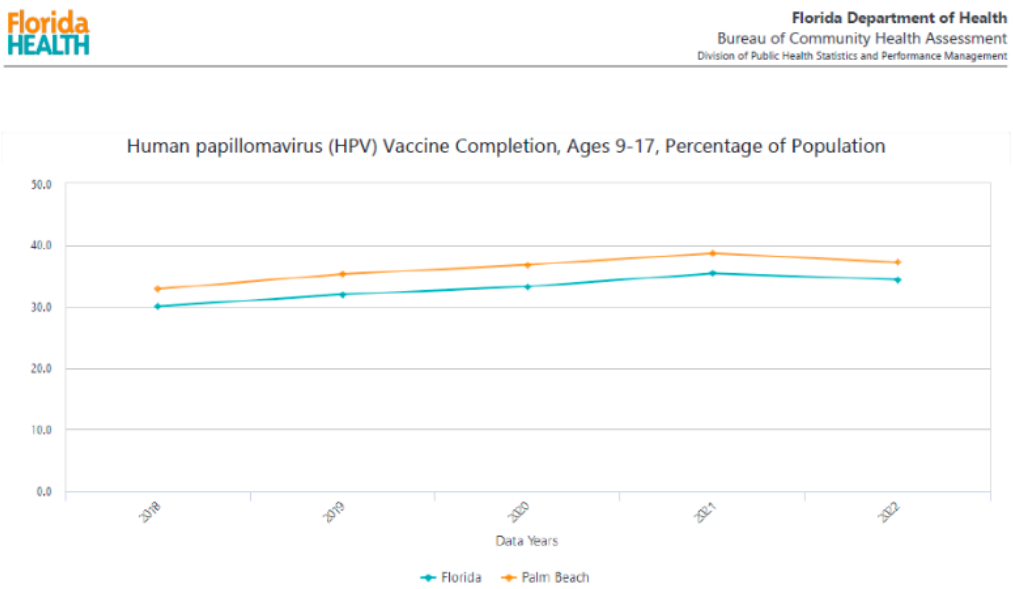
Florida Department of Health
Bureau of Community Health Assessment
Division of Public Health Statistics and Performance Management

Human papillomavirus (HPV) Vaccine Completion, Ages 9-17, Percentage of Population

	Palm Beach			Florida		
Data Year	Count	Denom	Rate	Count	Denom	Rate
2022	56,155	150,851	37.2	788,796	2,293,489	34.4
2021	56,070	144,710	38.7	782,372	2,209,301	35.4
2020	53,290	144,653	36.8	729,484	2,191,499	33.3
2019	51,292	145,128	35.3	695,510	2,172,501	32.0
2018	47,332	143,650	32.9	641,821	2,135,346	30.1

Year-by-year figures show that vaccination rates among young adults ages 9 to 17 are generally 2 to 3 percentage points higher in Palm Beach County than in Florida (Figure 1).

Figure 1.: ***HPV Vaccine Completion, Ages 9-17, Percentage of Population (Rates Only)*** **(Florida Department of Health, 2024)**



Across Florida counties, when we review the rates on the Florida map, the highest vaccination rate is in Hamilton County with 54.6, and the lowest is in Calhoun County with 16.7 (Figure 2).

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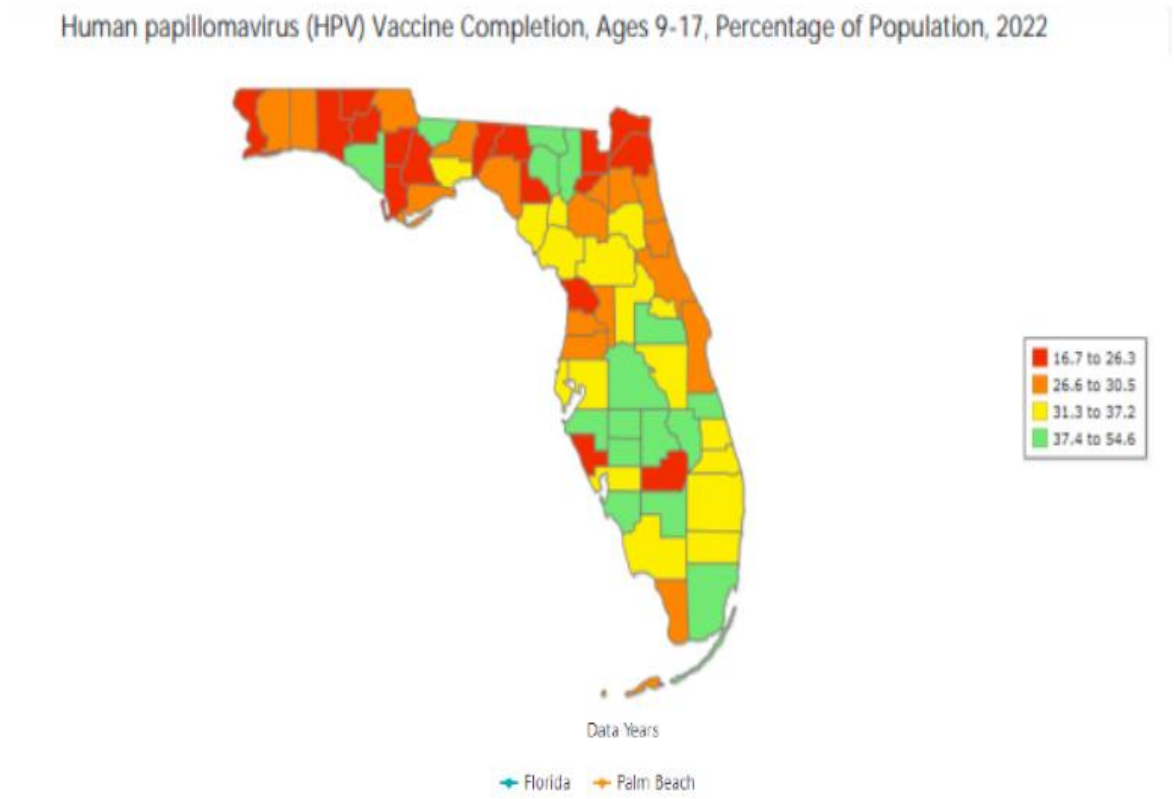
Figure 2.: ***Florida State County Based, HPV Vaccine Completion, Ages 9-17, Percentage of Population (Map Based Only)*** **(Florida Department of Health, 2024)**



One of the main causes of death in Florida and the United States is cancer.
One of the most frequent malignancies that threaten the health of women is cervical cancer, and many other cancers and cervical cancer share close pathogenesis with the ongoing infection of high-risk HPV. Cervical cancer, a malignant neoplasm, can be detected through pap smear screening, and treatment can prevent its development. In developed countries, screening programs have reduced invasive cervical cancer incidence by 50% or more.
Therefore, we will also examine the incidence rates, and deaths of cervical cancer, the most associated with HPV, in the state of Florida and Palm Beach. Thus, we will also evaluate the incidence and outcomes associated with HPV vaccination and this cancer in this section.
According to the records of Florida Department of Health, Palm Beach County's age-adjusted cervical cancer incidence rate per 100,000 people was 7.9 in 2021, compared to Florida's 9 (Figure 3). Palm Beach County's age-adjusted deaths from cervical cancer (All) per 100,000 people in 2022 was 1.6, while Florida's was 2.6 (Figure 4). Age-adjusted cervical cancer incidence of Florida states also shown as map as county based (Figure 5). When we review the numbers of Florida state average comparing with Palm Beach County, it is understood that the Palm Beach County has a best picture than Florida average numbers in terms of cervical cancer incidence rates and deaths from cervical cancer.

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Figure 3: ***Florida State County Based, Age-adjusted Cervical Cancer Incidence, Single Year*** **(Florida Department of Health, 2024)**

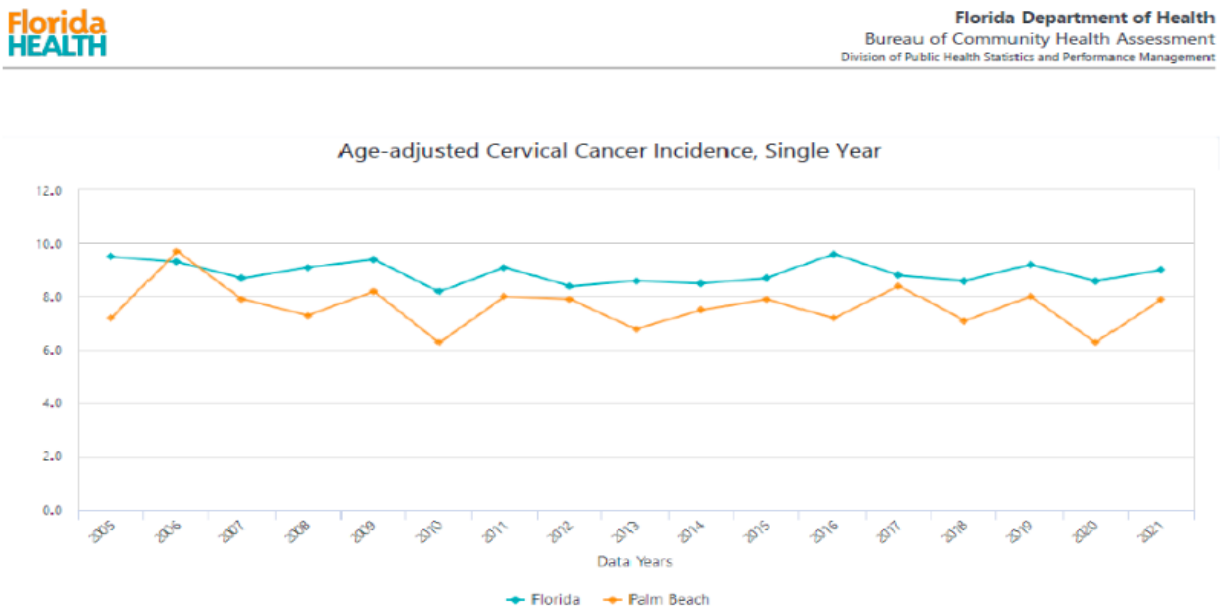

Figure 4.: ***Florida State, Age-adjusted Deaths From Cervical Cancer, Single Year*** **(Florida Department of Health, 2024)**

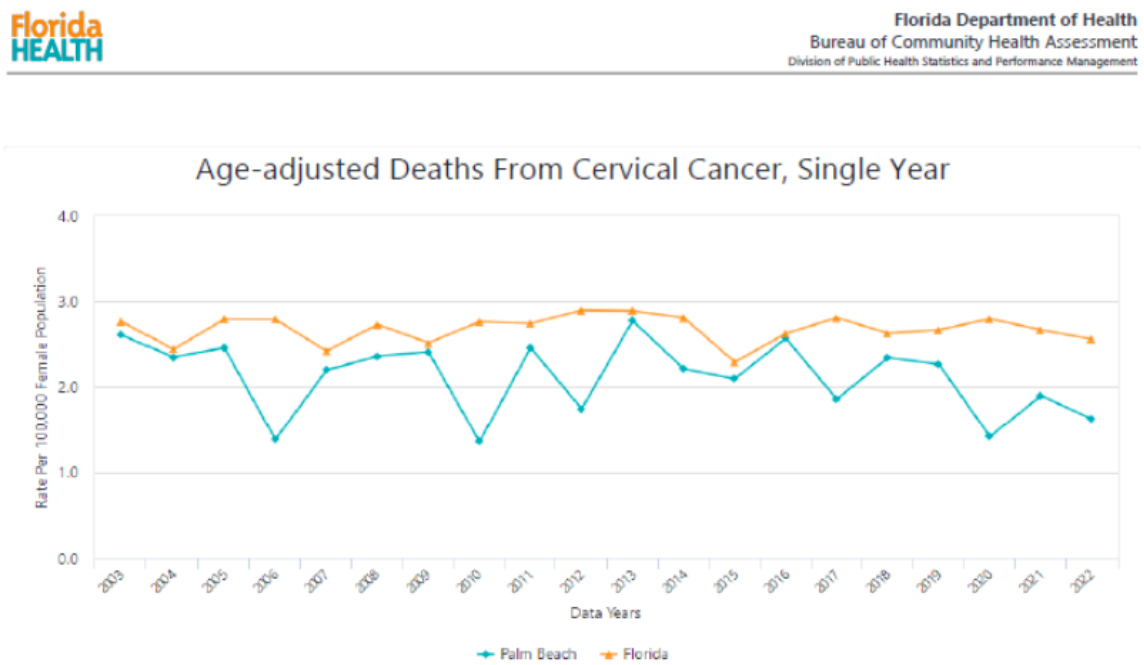

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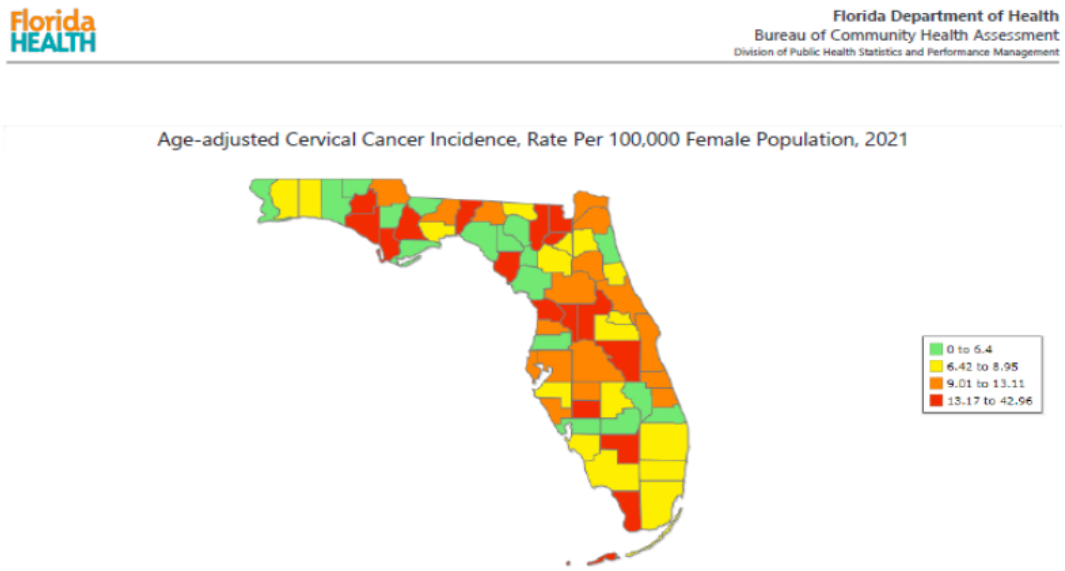
Figure 5.: ***Age-adjusted Cervical Cancer Incidence of Florida (Map, County Based)***



On the other hand, many vaccine processes, such as HPV, are also targets of vaccine bias worldwide. Misinformation and conspiracy theories about vaccines have led to global vaccine hesitancy by linking HPV vaccines to infertility and primary ovarian insufficiency. The COVID-19 pandemic has exacerbated these issues, with anti-vaccine activists promoting claims of irregular periods and primary ovarian insufficiency (Smith & Gorski, 2024).

For this reason, leaving aside anti-vaccine sentiment, it is necessary to protect against HPV-related diseases by vaccination. The best defense against HPV infection, cervical cancer, and other diseases linked to HPV is vaccination. Cervical pre-cancers can be identified by screening and treated before they progress to cancer. Before they engage in sexual activity, all females between the ages of 9 and 14 should have an HPV vaccination.

The World Health Assembly has adopted a global strategy to eradicate cervical cancer, aiming for 90% vaccination by age 15, 70% screening by age 35 and 45, and 90% treatment for affected women. This is part of the WHO's global health sector strategy for HIV, hepatitis, and sexually transmitted infections, and includes actions on oral health. The WHO and UN sister agencies work together to formulate policies, offer technical assistance, and improve care quality. We believe that this approach is valuable and that it is possible to protect against HPV-related diseases by adopting vaccination methods on a global scale.

Discussion

HPV, a common sexually transmitted virus, can cause genital warts and potentially lead to various cancers in both men and women. HPV vaccination programs focus on high-risk strains of HPV, reducing infections and improving public health outcomes. Vaccination is suggested before being exposed, beginning in young adulthood, and lowers transmission, reducing HPV-related disorders and malignancies without causing cancer.

Young adults are at high risk of HPV-related diseases, necessitating early vaccination, screenings, and awareness to prevent and treat these harmful infections. HPV infects 42 million people in the United States each year, with 36,000 of them becoming ill.

Vaccine mandates have long been regarded as an effective tool for increasing immunization rates and reducing the risk of disease outbreaks around the world. Many Americans support vaccine mandates.

The U.S. recommends the HPV vaccine for children aged 11-12, preteens, teenagers, and young adults up to age 26. The CDC recommends two doses for children, three for young adults, and three for those with compromised immune systems (CDC, 2021b).

Routine vaccinations are provided to American Indian and Alaska Native children under 18 years old, Medicaid-eligible, under-insured, or without insurance under the VFC program. The ACIP and VFC are key programs in the US healthcare system, addressing HPV vaccination challenges. In addition, in some states in the U.S., such as Virginia and Washington, D.C., HPV vaccination is a requirement for school enrollment, but there is no such requirement in Florida.

The Florida Department of Health in Palm Beach County, Florida, is implementing HPV vaccination campaigns to reduce infections. These campaigns, targeting both adults and children, are part of the VFA program and health department clinics.

Health department reports and surveys at the federal, state, and local levels are routinely used to track HPV prevalence rates among states and the United States. According to data from the Florida Department of Health on our study topic, the current situation is as follows:

- In 2022, Palm Beach County had a greater percentage of people (females aged 9 to 17) with completed HPV vaccinations (37.2%) than Florida (34.4%) across all age groups and modes of exposure,
- Every year, vaccination rates among young adults aged 9 to 17 are 2 to 3 percentage points higher in Palm Beach County than in the rest of Florida. When we look at the immunization rates throughout Florida counties, we can see that Hamilton County has the highest rate (54.6), while Calhoun County has the lowest (16.7). When looking at vaccination rates across Florida counties, Palm Beach County ranks in the middle,
- In 2021, Palm Beach County had an age-adjusted cervical cancer incidence rate of 7.9 per 100,000 individuals, while Florida had 9. throughout 2022, Palm Beach County had an age-adjusted death rate from cervical cancer (all) of 1.6 per 100,000 persons, compared to 2.6 throughout Florida. When the figures from the Florida state average are compared to those from Palm Beach County, Palm Beach County has more favorable outcomes than the Florida average in terms of cervical cancer incidence rates and mortality,
- Compared to the national figures for 2022, Palm Beach County was slightly behind in HPV vaccination rates.

Limitations of These Studies

In this paper, we examined some peer viewed articles as well as publications by the related U.S. agencies like as CDC, Florida Department of Health sharing data in HPV vaccination. When the topic of our study is HPV vaccination in Palm Beach County, Florida, the main source we evaluate for this paper was the records of Florida Department of Health. HPV vaccination is a common case globally. Therefore, we reached many studies regarding HPV released over the years. A significant number of articles have been reviewed concerning our study topic. In addition, it has been noticed that the data from Florida Department of Health is actual and up to date so it makes our study findings especially the numbers existent.

Conclusions and Future Study

The HPV vaccination offers long-lasting, reliable protection against the HPV infections that most frequently result in cancer. In the U.S., public health agencies, healthcare providers, local health departments, and community-based organizations work together to promote HPV vaccination and reduce the prevalence of HPV-related diseases like cervical cancer. Healthcare providers advocate for the vaccine, while local health departments and community health centers run programs to increase access. Private health insurance plans and public insurance programs also cover vaccine costs.

Many Americans support vaccination mandates, with support ranging from 68% for COVID-19 to 90% for DTaP, polio, chickenpox, and MMR. The strongest support comes from urban residents, ethnic minorities, and faith in medical facilities. Vaccination mandates have broad public support in the U.S. However, HPV and vaccines face global bias and opponents due to misinformation and conspiracy theories. Academic studies and vaccine-based criticism are necessary to prevent disruption of the useful vaccination process. Therefore, instead of objections based on anti-vaccination, ongoing vaccine-based measurement and evaluation processes should be valued. According to records, it is possible to say that the HPV vaccination rates in both the United States, Florida and Palm Beach County are approximately 35-40%. Considering that this rate can be over 50% in some regions, the need to increase the effectiveness of HPV vaccination studies and related programs and to increase vaccination rates is clearly seen.

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