Le papillomavirus humain décrypté : prévention, impact et politiques mondiales en matière de santé

[Human Papillomavirus Decoded: Prevention, Impact, and Global Health Policies]

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ABSTRACT: Human papillomavirus (HPV) is a widespread viral infection that poses a major challenge to global public health. Its high prevalence and close link to various types of cancer, particularly cervical cancer, make it a primary health concern. The impact of HPV extends beyond cervical cancer, also affecting the skin, anogenital areas, and upper respiratory tract. The seriousness of this infection is underscored by its role in over 90% of cervical cancer cases, one of the most common cancers among women worldwide. In response to this threat, prevention and control strategies have been implemented, yielding promising results. Cervical screening, especially when carried out systematically, has proven to be an effective tool in reducing the incidence and mortality associated with cervical cancer. Developing countries have made significant progress in recent years by combining coordinated cytological screening programs with vaccination campaigns. HPV vaccination has proven particularly effective in preventing infection and associated diseases in uninfected women. However, despite these advances, significant barriers remain in low-income regions, highlighting the need to continue efforts in prevention, screening, and treatment of HPV on a global scale.

KEYWORDS: Human papillomavirus (HPV); Cervical cancer; HPV vaccination; Cytological screening; Genital warts.

RESUME: Le papillomavirus humain (HPV) est une infection virale très répandue qui représente un défi majeur pour la santé publique mondiale. Sa prévalence élevée et son lien étroit avec divers types de cancer, en particulier le cancer du col de l'utérus, en font un problème de santé majeur. L'impact du HPV va au-delà du cancer du col de l'utérus, touchant également la peau, les zones anogénitales et les voies respiratoires supérieures. La gravité de cette infection est soulignée par son rôle dans plus de 90 % des cas de cancer du col de l'utérus, l'un des cancers les plus fréquents chez les femmes dans le monde. En réponse à cette menace, des stratégies de prévention et de contrôle ont été mises en œuvre, donnant des résultats prometteurs. Le dépistage du cancer du col de l'utérus, en particulier lorsqu'il est effectué de manière systématique, s'est avéré être un outil efficace pour réduire l'incidence et la mortalité associées à ce cancer. Les pays en développement ont réalisé des progrès significatifs ces dernières années en combinant des programmes coordonnés de dépistage cytologique et des campagnes de vaccination. La vaccination contre le HPV s'est avérée particulièrement efficace pour prévenir l'infection et les maladies associées chez les femmes non infectées. Cependant, malgré ces progrès, des obstacles importants subsistent dans les régions à faible revenu, soulignant la nécessité de poursuivre les efforts de prévention, de dépistage et de traitement du HPV à l'échelle mondiale.

MOTS-CLEFS: Papillomavirus humain (HPV) ; Cancer du col de l'utérus ; Vaccination contre le HPV ; Dépistage cytologique ; Verrues génitales.

1 INTRODUCTION

Human papillomavirus (HPV) is a common sexually transmitted infection that can affect the skin, genitals and throat [1]. Human papillomavirus (HPV) comprises 200 known viruses [2], [3]. Virtually all sexually active individuals will be infected at some point in their lives, mostly without showing symptoms [1]. In most cases, the immune system is able to expel HPV from the body. Persistent infections are significantly associated with a high risk of genital warts and cervical cancer [4]. Factors that increase the risk of this infection progressing to cancer include the oncogenic virulence of the HPV type, immune status , the existence of other sexually transmitted diseases, the number of births, young age at first childbirth, use of hormonal contraceptives and smoking [1], [5]. Cervical cancer is the fourth most common cancer among women worldwide, with around 660,000 new cases and around 350,000 deaths in 2022 [1]. Low- and middle-income countries have the highest incidence and mortality rates for this type of cancer.

This highlights the significant disparities associated with inadequate access to HPV vaccination, cervical cancer detection and treatment services, and socio-economic factors [3]. Cervical cancer prevention can be effectively achieved through prophylactic HPV vaccination, as well as screening and treatment of precancerous abnormalities, methods which are also proving highly economically viable [1]. Cervical cancer can be cured if diagnosed early and treated promptly [1].

2 IMPACT AND EVOLUTION OF HPV INFECTION

HPV infection remains a major public health challenge worldwide, with substantial regional variations in both prevalence and impact. A large number of HPV carriers show no signs of disease. In general, the immune system is able to clear HPV from the body within one to two years, without persistent consequences [3], [5]. Some HPV infections result in small, rough protuberances (condylomas) that can appear on the vagina, penis or anus, and exceptionally in the throat. They may cause pain, itching, bleeding or swollen lymph nodes [6].

Persistent HPV infection that does not heal on its own can cause changes in cervical cells, leading to early lesions that can develop into cervical cancer if left untreated [2], [3]. In general, the development of cervical cancer following HPV infection takes between 15 and 20 years [3]. Approximately 99.7% of cervical cancer cases are caused by persistent genital infection with high-risk HPV [7].

Initial damage to cervical cells and precancerous lesions generally do not lead to clinical signs. Cervical cancer may be manifested by intermenstrual or post-sex hemorrhage, or by foul-smelling vaginal secretions. These symptoms may be due to other conditions. Individuals showing these symptoms should see a health professional [3].

Data show that HPV was responsible for 620,000 cases of female cancer and 70,000 cases of male cancer in 2019 [8] worldwide. In 2022, cervical cancer ranked fourth among cancers and causes of cancer mortality in women, accounting for nearly 660,000 newly diagnosed cases and approximately 350,000 deaths worldwide [1]. Over 90% of HPV-associated cancers in women are cervical cancers [8].

Sub-Saharan Africa has the highest rate of cervical HPV in women (24%), followed by Latin America and the Caribbean (16%), Eastern Europe (14%) and Southeast Asia (14%) [2]. Frequency among men varies considerably according to sexual orientation [3].

HIV-positive women are particularly at risk, having a six-fold higher probability of contracting cervical cancer compared to the general population, and around 5% of all cervical cancer cases are specifically attributable to HIV [1]. These inequalities highlight the vital importance of implementing effective preventive strategies, such as HPV vaccination and regular screening, to mitigate the public health impact of cervical cancer in the areas most affected [5].

3 PREVENTIVE HEALTH POLICIES

The introduction of HPV vaccination programs in high-income countries has reduced the frequency of high-risk HPV types. The systematic review by Drolet et al. [9] found a notable decline in HPV 16 and 18 types in vaccinated populations, especially in areas where vaccination is highly prevalent.

The impact of HPV vaccines on cancer prevention is undeniable. However, to achieve the ultimate goal of eradicating oncogenic HPV types, a vaccination coverage rate of 75% among adolescents of both sexes is required [6]. In parallel, in 2020 the World Health Organization adopted the Global Strategy for Cervical Cancer Elimination, which includes the goal of fully vaccinating 90% of girls with the HPV vaccine by the age of 15. Unfortunately, few countries have achieved coverage of 70% or more [10].

However, obstacles remain in low- and middle-income countries, where limited access to vaccines continues to impede progress. Vaccine inequality manifests itself in consistently high HPV-associated morbidity in areas with limited health resources, highlighting the need for comprehensive initiatives to improve vaccine access and reach [5]. These disparities are generally linked to socio-economic factors, the availability of health services and varying degrees of awareness of the dangers of HPV and the benefits of vaccination [2].

According to the WHO, countries that have implemented screening programs have seen a significant drop in the incidence of cervical cancer, mainly thanks to structured screening programs that have employed HPV-based methods [3].

The cervical smear, long the cornerstone of cervical cancer prevention, has been supplemented and, in some cases, replaced by more sensitive HPV tests. HPV testing has improved detection of precancerous cervical lesions, enabling earlier intervention and reducing progression to invasive cancer [11].

The HPV test is recognized for its greater sensitivity than cytology (cervical smear), enabling screening to be spaced out without compromising safety. The implementation of HPV screening programs, particularly among women aged 30 and over, is associated with a significant reduction in new cases of cervical cancer. This switch to HPV testing is expected to reduce cervical cancer incidence by 70-80% when well-defined guidelines are followed [12].

According to Ronco et al [13] these programs have proven effective in detecting high-risk infections early, slowing their progression to invasive cancers. Switching from cytological screening to HPV testing has proven to be a valuable public health approach that can improve early detection and outcomes for women at risk [5].

Human papillomavirus (HPV) screening programs have proven to be significantly effective in reducing the incidence and mortality of cervical cancer.

Integrating HPV vaccination into screening further strengthens prevention efforts. HPV vaccines prevent infections caused by the types of HPV most frequently associated with cervical cancer, thereby significantly reducing the risk of developing

precancerous lesions. This combined approach of vaccination and screening could almost completely eradicate cervical cancer, minimizing the associated healthcare burdens [12].

However, challenges remain, particularly in resource-limited regions where access to screening and vaccination is inadequate. Innovations such as low-cost, high-sensitivity HPV tests and the development of next-generation sequencing technologies should improve the specificity and accessibility of screening in these settings [14], 15].

4 CHALLENGES AND OPPORTUNITIES

By 2030, the WHO aims to eradicate cervical cancer as a public health problem, relying on three interdependent pillarsand requiring increased coordination between governments, international institutions, and civil society to overcome persistent obstacles and ensure equitable implementation [1]. The major opportunity lies in the increasing availability of safe and effective HPV vaccines, capable of preventing the majority of new infections and significantly reducing future incidence, but access remains unequal, particularly in low- and middle-income countries [10]. Indeed, in these contexts, supply chains, sustainable financing, cold chain logistics, surveillance systems, and social acceptability can hinder progress. The lessons learned from the COVID-19 pandemic show that health systems, if under pressure, can delay vaccination and screening campaigns, but they also demonstrate resilience and the value of early planning, flexible funding, and enhanced intersectoral coordination [3]. To accelerate post-pandemically and preserve achievements, it is necessary to strengthen supply chains and screening capacities adapted to the local context (e.g., deployment of accessible HPV tests and integrated care pathways), ensure rapid and comprehensive treatment for women identified as positive (with rigorous follow-up, support services, and palliative care when necessary), secure sustainable funding and multi-level partnerships involving governments, international organizations, and the private sector, and implement equitable approaches that reduce geographical and socio-economic disparities in access to vaccination, screening, and treatment. Finally, robust monitoring and evaluation, based on quality data and clear indicators (vaccination coverage rates, effective screening rates, treatment timelines, and health outcomes), will allow for progress measurement, identification of gaps, and rapid adjustment of interventions to prevent goal drift and ensure a tangible reduction in morbidity and mortality associated with cervical cancer [5]; [7; [9].

5 CONCLUSIONS AND FUTURE PROSPECTS

One of the major breakthroughs in global public health is HPV prevention, mainly through vaccination, which significantly reduces the burden of HPV-related diseases such as cervical cancer. However, many significant obstacles remain to the widespread implementation of HPV vaccination programs, particularly in low- and middle-income countries, where the incidence and mortality rate of cervical cancer remain high. Closing vaccination coverage gaps, overcoming vaccine hesitancy and ensuring equitable access to healthcare and vaccination are essential to optimize overall HPV prevention outcomes.

Looking ahead, expanding HPV vaccination worldwide will require multi-faceted approaches that include not only improved access to care, but also community awareness and education. Public health programs should aim to overcome cultural and logistical barriers to vaccine uptake, particularly in communities where vaccination levels are historically low. In addition, introducing HPV vaccines into routine immunization programs and increasing the availability of low-cost or subsidized vaccines in low- and middle-income countries could be crucial to overcome the lack of vaccine coverage.

On the research front, the development of new-generation HPV vaccines, likely to offer broader coverage of HPV types or prolonged immunity with a reduced number of doses, is very promising [16]. The development of therapeutic HPV vaccines

also continues to evolve, presenting prospects for use in individuals already affected or with HPV -associated lesions. This could further reduce the long-term burden of HPV-related pathologies.

In addition, the study of genetic elements associated with individual vulnerability to HPV infection and its evolution could help to develop more tailored HPV prevention strategies in the future.

In sum, although significant advances have been made in the battle against HPV, a coordinated global response is imperative, focusing on accessibility, education and strengthening research to perfect vaccines and diagnostic tests. It will be crucial to intensify cooperation between governments, health experts and international entities to optimize the benefits of HPV vaccination for global health. In this way, HPV prevention methods could not only reduce the incidence of HPV-associated cancers worldwide, but also set an example for the prevention of other infectious pathologies with significant public health consequences.

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