

## Original Article

## Vaccination's Role in Prevention of Human Papillomavirus (HPV) Infection and the Contribution of Community Nurses

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### Abstract

**Background:** Human papillomavirus (HPV) is one of the most common sexually transmitted infections worldwide. HPV vaccination constitutes a key prevention strategy.

**Aim:** Investigation of vaccination programs as a measure to prevent HPV and the role of the nurses in the success of these programs.

**Material and Methods:** A literature review was conducted regarding articles published from 2012 to 2022 in Greek and English languages in the online databases PubMed and Google Scholar with the keywords HPV vaccination, school nurse, health education, health promotion, prevention, community, cervical cancer. Randomized clinical trials, cohort studies, descriptive studies, meta-analyses and qualitative studies were searched. A total of 203 articles were found, however 14 of them were evaluated to meet the criteria for inclusion in the study.

**Results:** The decision about HPV vaccination is multifactorial. The main barriers were the young age of the student, ignorance regarding the effects of HPV and the benefits of vaccination, mistrust of the state and health workers, poor service delivery, and different health or religious beliefs. Information campaigns that were carried out in schools successfully improved adolescents' beliefs about ways to prevent HPV.

**Conclusions:** Vaccination constitutes the only means of preventing HPV infection. The contribution of the nurses to the primary prevention of HPV is crucial and effective through the implementation of educational programs and vaccination. School/community nurses necessitate knowledge and time to answer the questions and concerns of parents and students. These challenges highlight the importance of having a well-designed program targeting at education and vaccination coverage to promote public health.

**Keywords:** HPV vaccination, school nurse, health education, health promotion, prevention, cervical cancer.

### Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection in both sexes. Predominantly in developing countries, such as South Africa, the prevalence of HPV is currently estimated to be between 16.2 and 25.2% in women (Ramogola-Masire, Luckett and Dreyer, 2022). It is estimated that most men and women will contract the virus at some point in their lives (Boda et al., 2018). HPV is a group of

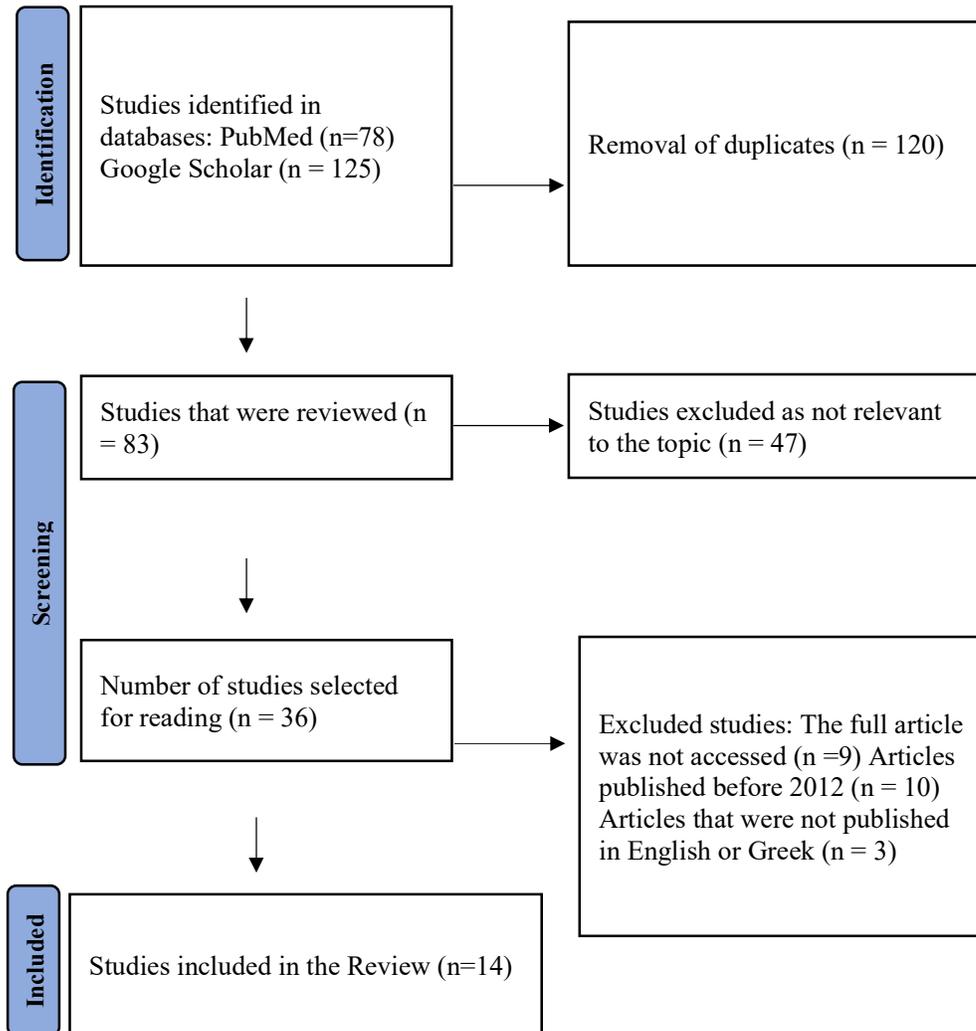
more than 200 viruses, a quarter of which is transmitted through sexual, oral, vaginal or anal contact even if the carrier is asymptomatic (Li and Xu, 2017). Depending on their carcinogenicity, they are classified into low or high risk groups. HPV 6 and 11 are the most common low-risk types and cause genital warts. HPV types 16 and 18 are high-risk, associated with cancer in various organs, namely the cervix, pharynx, anus, vagina, vulva and vulva (Viarisio, Gissmann and

Tommasino, 2017). Globally, HPV is associated with 99.7% of cervical cancer cases (Yang et al., 2019). HPV consists of a family of small, double-stranded DNA viruses that infect the skin epithelium. About 40 types infect the mucosal epithelium. These are categorized in accordance with their epidemiological relationship with cervical cancer. More than 90% of warts are caused by low-risk HPV types 6 or 11 (CDC/NCIRD, 2021). High-risk types (including types 16, 18, and others) can cause low-grade cervical cell abnormalities, high-grade abnormalities that are precursors of cancers of the female reproductive system. High-risk HPV types are detected in 99% of cervical precancerous lesions (Elbasha et al., 2009). Type 16 is the cause of approximately 50% of cervical cancers (Poras et al., 2009). Types 16 and 18 together account for the largest proportion of cervical cancers (Zampronha et al., 2013) and five high-risk subtypes 31, 33, 45, 52 and 58 account for approximately 90% of cervical cancers worldwide (Toh et al., 2019). In addition to cervical cancer, high-risk HPV infection is associated with less common cancers of the gynecological system, such as cancer of the vulva, vagina, penis, and anus. The aforementioned types of HPV can cause mouth and pharynx cancer (Anon, 2019). However, HPV vaccination can reduce the incidence of HPV-related cancers such as cervical, oral and pharyngeal cancer (Zhou, Jou and Cohen, 2021). In 2017, 80 countries had already recommended vaccination of the population (Human papillomavirus vaccines: WHO position paper, May 2017-Recommendations, 2017). Three HPV vaccines are available internationally: the bivalent vaccine, which contains VLPs (virus-like particles) of HPV types 16 and 18, is approved for protection against cancer and precancerous lesions (abnormal cell growth) in the genital area (cervix, vulva, vagina, anus) caused by certain types of human papillomavirus. The quadrivalent vaccine containing VLPs of HPV types 6, 11, 16 and 18 prevents precancerous lesions of the genitals (cervix, vulva and vagina), premalignant lesions of the anus, cervical and anal cancer causally related to certain types of oncogenic HPV. It also prevents the appearance of genital warts that are causally related to specific types of HPV. The monovalent vaccine, containing VLPs of HPV types 6, 11, 16, 18, 31, 33, 45, 52 and 58, is recommended for protection against precancerous lesions and cervix, vulva, vagina, anus cancer and

prevents genital warts (Signorelli et al., 2017). All vaccines contain VLPs of HPV types 16 and 18 which are associated with 71% of all cervical cancer cases worldwide. In Europe, the nine-valent vaccine is licensed (Hartwig et al., 2016; Anonymous, 2018). In 2017, worldwide, 570,000 cases of women and 60,000 cases of men attributed to HPV were recorded, respectively, 8.6% and 0.8% of all cancers appearing worldwide. HPV immunization programs started in 2007, mainly in developed countries, and cost-effectiveness studies have shown clear benefits (Gervais et al., 2017). The implementation of effective prevention strategies and information in the context of primary education are essential. School nurses play a key role in the training and implementation of vaccination programs (Fu et al., 2014). Adolescents have low awareness and knowledge about the virus, especially regarding the risk of cancer (Wingood et al., 2013). School-based educational interventions can increase adolescents' awareness and knowledge about HPV preventive measures and all sexually transmitted infections (Kwan et al., 2011). To date, not a large number of studies exist, examining the role of nurses in vaccination programs, as well as their knowledge and beliefs about HPV infection and vaccination. School-based health education is effective in increasing awareness and willingness to vaccinate. Health promotion regarding HPV and cervical cancer should be ensured so that the effectiveness of the measures to be continuous, as it constitutes an issue affecting public health (Basu et al., 2021).

**Aim:** The aim of this study was to investigate vaccination programs as a measure to prevent HPV and the role of community nurses in the success of these programs.

**Material and Methods:** A literature review was conducted regarding articles published from 2012 to 2022 in Greek and English in the online databases PubMed and Google Scholar with the keywords HPV vaccination, school nurse, health education, health promotion, prevention, community, cervical cancer. Randomized clinical trials, cohort studies, descriptive studies and meta-analyses were searched. A total of 203 articles were found, however 14 of them were evaluated to meet the criteria for inclusion in the study. Studies that were included in the systematic literature review are presented in Figure 1.



**Figure 1.** Flowchart of the systematic review.

## Results

The studies reviewed in the present study were 14. Amongst these, 5 investigated the effectiveness of vaccination regarding HPV prevention, 3 focused on the contribution of nurses to vaccination programs, and 6 studies focused on the vaccination policy and HPV vaccination programs.

**Effectiveness of vaccination in preventing HPV.** Basu et al. (2021) studied the efficacy of HPV vaccine 10 years after the first, second, and third doses of the quadrivalent HPV vaccine, focusing on girls in India and types 16 and 18. The study was conducted in unmarried, adolescent girls aged 10–18 years, in nine centers in India.

According to the number of vaccine doses, the participants were divided into four groups. The first group received two doses on days 1 and 180 or later, the second group three doses on days 1, 60 and 180 or earlier, the third group two doses on days 1 and 60 or later and the fourth group a dose of the vaccine. Cervical samples were obtained 18 months after marriage or 6 months after the first delivery to assess incident and persistent HPV infections. Married participants were screened for cervical cancer at age 25, while unvaccinated female peers served as the control group. A total of 4,348 girls received three doses, 4,980 two doses and 4,949 a single dose. 10 years after the first dose, 2,135 women from the single-

dose group, 1,452 women from the two-dose group, and 1,460 women from the three-dose group were evaluated. According to the research results, a single dose of the HPV vaccine provides similar protection against persistent HPV 16 and 18 infection compared to the protection provided

The study by Sankaranarayanan et al. reached to similar findings. In 2016, who also examined HPV vaccine immunogenicity after one, two, and three doses of quadrivalent HPV vaccine. The research was conducted in India, in unmarried girls aged 10-18 years who were vaccinated in four groups and particularly in girls who received three doses of the vaccine on days 1, 60 and 180 or later, in girls who received two doses on days 1 and 180 or later, in girls who received two doses on days 1 and 60 and finally to those who received one dose. Of the 17,729 girls in the study, 4,348 received three doses, 4,979 received two doses on days 1 and 180 or later, 3,452 received two doses on days 1 and 60, and 4,950 received one dose. The findings are in line with the World Health Organization (WHO) recommendation concerning two doses, at least 6 months apart, regarding routine vaccination of young girls (Sankaranarayanan et al., 2016).

Hestbech et al., (2015) investigated the interaction between primary and secondary prevention of cervical cancer by assessing the screening results of HPV-vaccinated women, examining cases of patients in Denmark. As observed, the rate of positive screening results decreased from 8.7% pre-vaccination to 6.5% post-vaccination. The rate of false-positive screening results regarding cervical cancer decreased from 5.5% pre-vaccination to 4.3% post-vaccination for cervical intraepithelial neoplasia grade 2 (CIN2+) and from 6.2% to 4.7% for cervical intraepithelial neoplasia grade 3 (CIN3+) (Hestbech et al., 2015).

Lee et al. (2022) studied the long-term efficacy of HPV vaccines in women aged 20–45 years in Thailand. In the study, a total of 933 women participated, of whom 493 were vaccinated between 2018 and 2019. Median follow-up periods were 7.3 years for vaccinated participants and 7.2 years for unvaccinated participants. Most of the women in the vaccinated group were single and university graduates. Vaccinated and unvaccinated participants had similar monthly income. As observed the long-term effectiveness of the HPV vaccine was >80% in adult women in the country. It was also found that the HPV vaccine helped to the reduction of HPV-related

by two or three doses of the vaccine. Implementation of a single dose of HPV vaccine and ensuring high coverage of HPV vaccination has been suggested to achieve a reduction in cervical cancer rates in a more affordable way (Basu et al., 2021).

types 16/18 in atypical squamous cells of undetermined significance in 88% of women and to the reduction of HPV types 16/18 positivity in 84.6% of women who took part in the research (Lee et al., 2022)

Finally, Arbyn et al., 2018 also studied the effectiveness of HPV vaccination regarding the prevention of cervical cancer through a retrospective study and meta-analysis of 26 studies with a total sample of 73,428 participants. The effects of the HPV vaccine against precancerous cervical cancer and HPV16/18 infection over 6 months to 7 years were evaluated in 23 of the studies. High-certainty evidence was observed regarding HPV vaccines protection against cervical precancerous lesions in adolescent girls and young women aged 15 to 26 years (Arbyn et al., 2018). These results are presented in Table 1.

#### **The contribution of nurses to vaccination programs.**

According to Grandahl et al., (2014) school nurses who have a high level of education and are well-informed about HPV, form a positive attitude towards the vaccination program. They are also instrumental in implementing vaccination programs with adequate knowledge about HPV, comprehensive training, skills and time to answer parents' questions, as well as providing evidence-based information regarding HPV (Grandahl et al., 2014).

Grandahl et al., in 2016 found that female students whose behavior was influenced by school nurses providing one-on-one HPV information in 30-minute sessions chose to be vaccinated at a significantly higher rate than girls who did not participate in individual sessions. The school-based educational intervention had a favorable effect on adolescents' beliefs about HPV primary prevention and increased vaccination participation (Grandahl et al., 2016).

Also, Lin et al., examined the supportive role of nurses in vaccination regarding HPV prevention in China, examining the views of 1,041 nursing students. As it was observed, 58.0% of participants expressed the intention to support

HPV vaccines, as counselors and 56.4% to provide information about HPV vaccines. However, there was also a percentage of 33.4% who stated that they do not intend to be supporters of the HPV vaccine. 1st-year students with higher annual family income and higher level of knowledge about HPV vaccination expressed a greater intention to support HPV vaccines, as counselors. Accordingly, students with a higher knowledge level regarding HPV vaccination that were HPV vaccinated reported a greater intention to provide information about HPV. Finally, the main barriers of supporting HPV vaccination include insufficient education (87.1%) and insufficient knowledge about HPV (84.8%) (Lin et al., 2022).

### **Vaccination policy and vaccination programs for HPV**

Long and Shah, in their research, demonstrated that nursing care is vital to improving the effectiveness of cancer prevention and that many barriers can be addressed through nursing curricula and through improved vaccination policy (Long and Shah, 2018).

Si et al. found that following an intervention, there is a difference between the intervention group and the control group, in the intention or refusal to be vaccinated regarding the prevention of HPV. The vaccination rate was increased after the intervention to 59% from 52.5% before, while no change was observed in the control group. These findings are important as they suggest that well-designed interventions can promote healthy behavior (Si et al., 2019).

In 2019, Kaul et al., in a study containing 2307 high school students, education about the HPV vaccine took place and a school vaccination program was implemented. The research was carried out in a high school which was the intervention school and in 2 schools, which were the comparison schools. It was found that the school with on-site vaccination and education had a higher rate of initiation and completion of HPV vaccination (53.67% and 28.36%) compared to schools where the intervention included only the education of students (41.56% and 20.53%). Students concerning the school that had received vaccinations were 3.6 times more likely to initiate and complete HPV vaccination than students from comparison schools (Kaul et al., 2019). Paterson et al. (2019) addressed the qualitative assessment of the adolescent vaccination program in England. They concluded that effective planning, data

management, and close collaboration between service providers and data system managers were key to the success of HPV vaccination programs. The researchers also noted that effective planning and data management are critical to the successful delivery of HPV vaccination services, as well as close collaboration between commissioners, service providers and data system managers. To maintain and improve adolescent vaccination rates in England, as part of an expanded school vaccination programme, it is necessary to strengthen the organizational capacity of the system (Paterson et al., 2021). In 2020, Costantino et al., studied the knowledge, attitudes and willingness to vaccinate minor students in secondary schools in Sicily. To that end, they carried out a survey with two questionnaires, before and after the implementation of an educational planned intervention, during school hours in a sample of 1,702 students attending secondary schools. According to the results of the study, third-grade students with a higher socio-economic level who had previously received information about sexually transmitted diseases (STDs) at home or at school had a higher baseline level of knowledge about HPV. Finally, according to the researchers, the standardization of educational and vaccination programs at school should be of primary importance, taking into account the effectiveness of the intervention (Constantino et al., 2020). Finally, Rosen, Ashwood and Richardson examined school nurses' knowledge, perceptions, and attitudes about their role as opinion leaders, self-efficacy, intention, and professional practice of the HPV vaccine. They also explored the factors influencing the practical implementation of the HPV vaccine. The survey was conducted on 145 members of the Ohio School Nurses Association and it was observed that there is a positive correlation between the level of knowledge of the participants and the intention and self-efficacy, as well as a positive effect between their attitude and the perception of the role as community leaders. opinion. A positive association was also observed between the intention to provide HPV vaccine education and professional practice. It was therefore suggested that in order to improve the professional practice of school nurses, interventions should focus on increasing knowledge, improving attitudes and intention to provide HPV vaccine education (Rosen, Ashwood and Richardson, 2015). Findings regarding HPV vaccination policy and programs are presented in Table 3.

**Table 1.** Effectiveness of vaccination in prevention

Authors, Year, Country	Material and Method	Aim	Results
Basuetal.,2021, India.	Cohort study, in a cluster-randomized trial.	Comparison of the efficacy of one dose of HPV vaccine to protect against HPV 16 and 18 infection, versus two and three doses, 10 years after vaccination.	A single dose of HPV vaccine protects the same against HPV 16, 18 infection compared to two or three doses.
Sankaranarayananetal., 2016, India.	Cohort study, in a cluster-randomized trial.	Investigation of the immunogenicity and incidence of infection and precancerous lesions of the cervix caused by HPV after vaccination with two doses of quadrivalent vaccine.	The short-term protection provided by one dose of HPV vaccine against HPV 16, 18, 6, and 11 infection is similar to that provided by two or three doses of vaccine.
Hestbechet al., 2015, Denmark.	Simulation study two birth cohorts.	Investigating the association between cervical cancer prevention by assessing screening outcomes in HPV-vaccinated women.	A small effect of HPV vaccination was observed in young women participating in cervical cancer screening, as well as small reductions in screening in both true-positive and false-positive screening tests.
Lee et al., 2022, Thailand.	Retrospective cohort study	Determination of HPV vaccine efficacy in adult Thai women $\geq$ 5 years post-vaccination.	HPV vaccine efficacy was high at $>80\%$ in adult women.
Arbyn et al., 2018, country not specified.	Systematic review and meta-analysis	Investigation of the effectiveness of the HPV vaccine in the prevention of precancerous lesions of the cervix.	HPV vaccination can reduce precancerous lesions, especially those associated with HPV16/18. No increased risk of serious side effects was identified.

**Table 2.** Contribution of nurses to vaccination programs.

Authors, Year, Country	Material and Method	Aim	Results
Grandahletal., 2014, Sweden.	Quantitative research using a questionnaire. Sample: 851 nurses.	The investigation of the perceptions and experiences of school nurses regarding the vaccination program in schools.	Positive association between school nurses' HPV vaccine education and positive attitudes toward vaccination.
Grandahl et al., 2016, Sweden.	Randomized controlled trial in 18 secondary schools in Sweden.	The aim was to improve primary prevention of HPV infection by promoting vaccination and condom use among adolescents.	School nurses provided 30-minute HPV prevention training to adolescent students. The intervention resulted in an increase in HPV vaccination rates.
Lin et al., 2022, China.	Contemporary study	Exploring the views of nursing students on their role as HPV vaccine advocates.	33.4% of students would not support vaccinations. This is due to insufficient education (87.1%) and inadequate knowledge about HPV (84.8%).

**Table 3.** Vaccination policy and HPV vaccination programs.

Authors, Year, Country	Material and method	Aim	Results
Long J and Shah J. 2018, USA.	Quantitative and qualitative research	Investigating nurses' barriers and how to overcome them.	Barriers can be addressed through well-designed training programs and policy changes.
Si et al., 2019, China.	Double-blind, controlled, randomized study in 3360 people aged over 18 years.	Identifying barriers and what would facilitate HPV vaccination.	-Improvement of vaccination rate (from 52.5% to 59%) after intervention, - no change in the control group, - well-designed interventions can promote healthy behaviors (uterine cancer prevention, HPV vaccination).
Kaul et al., 2019, USA.	Cohort study of 2307 high school students from 3 schools.	Investigating the effect of an education program on increasing school-based HPV vaccination.	A higher rate of HPV vaccination initiation and completion was found in schools that included HPV vaccination along with education, compared to those that only implemented the education program (53.67% and 28.36% vs. 41.56% and 20.53%).
Paterson et al., 2021, United Kingdom.	Qualitative research with semi-structured interviews	The aim was to evaluate the quality of the vaccination program at school.	The success of HPV vaccination programs requires effective planning, and data management, collaboration of health services and administrators, combination of skills and experienced staff, ready to respond to school prevention and parents' concerns.

Costantino et al., 2020, Italy.	Questionnaires before and after an educational intervention in a sample of 1,702 students.	Assessment of knowledge and attitudes about HPV infection and vaccination, before and after an educational intervention program.	Willingness for HPV vaccination increased significantly after the educational intervention.
Rosen, Ashwood and Richardson, 2015, USA.	Cross-sectional research	The assessment of school nurses' knowledge, attitudes and perceptions of HPV vaccine intention and professional practice.	School nurses' attitudes about HPV and the HPV vaccine influence their perceptions of their role as opinion leaders and their intention to provide HPV vaccine information.

## Discussion

In the present systematic review, factors that lead to the successful implementation of HPV vaccination programs as well as the contribution of nurses to primary prevention through vaccination were investigated. 14 studies that met the inclusion criteria were analyzed. Regarding the studies that examined HPV vaccination, it was noted that Basu et al. and Sankaranarayanan et al. focused on the case of adolescent girls in India, but came to different findings as Basu et al. suggested the implementation of a dose of HPV vaccine, while Sankaranarayanan et al. the application of two doses. The study of vaccine effectiveness in developing countries was also examined by Lee et al., who studied adult women in Thailand, while on the contrary, Hestbech et al., conducted a study in Denmark and observed benefits, in terms of the percentage of positive screening tests and the rate of false positive screening tests for cervical cancer. Arbyn et al. in their study concluded that there were benefits in reducing precancerous lesions. Accordingly, regarding the role of nurses in vaccination programs, it was observed that all studies that were included in the analysis, emphasize the crucial role of nurses in vaccination programs. Among these studies, Grandahl et al. and Lin et al. argued that the knowledge and training of nurses are decisive for strengthening their role in the context of vaccination programs, while Grandahl et al. and Lin et al. reported that nurses can provide adequate information about vaccination schedules. Finally, with regard to HPV vaccination policy and programs, research has

highlighted the importance of well-designed intervention to increase school vaccination rates (Kaul et al.; Si et al.; Paterson et al.), as well as the importance of collaboration between the agencies involved (Paterson et al.). However, Costantino et al. argued that students' attitudes towards vaccination are determined by their socio-economic characteristics, while Rosen, Ashwood and Richardson referred to the need of further improving nurses' knowledge.

**Conclusions:** The decision regarding HPV vaccination is complex and depends on many factors. The main causes which constitute barriers to vaccination are related to the age of the person, the existence of ignorance about the prevention of HPV and the benefits of vaccination. Other important factors influencing the decision are lack of confidence in state recommendations and information about HPV.

Being able to discuss HPV vaccination with the school nurse and providing additional vaccination opportunities later are strategies that facilitate participation and increase coverage in a school-based vaccination program. School-based programs are more effective than general vaccination programs that take place in health units or at the suggestion of a doctor. School nurses need adequate time to educate parents and students.

Educational intervention by school nurses or community nurses in the school setting can improve beliefs regarding HPV prevention and increase the rate of vaccinated adolescents.

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