BMC Public Health

RESEARCH Open Access

Overcoming challenges and achieving high HPV vaccination uptake in Cameroon: lessons learned from a gender-neutral and single-dose program and community engagement

Andreas Ateke Njoh[1,2†], Dur-E-Nayab Waheed[3*†], Tchokfe Shalom Ndoula Josue Kedakse[1], Lionel Junior Ebongue[5], Eugene Justine Kongnyuy[2], Adidja Amani[4], Afizu Chrakoh Tambasho[1], Yauba Saidu[5], Mohamed Il Kaba[6], Clovis Nchinjoh Sangwe[7], Herman Kenfack[1], Judith Seungue[1], Daniel Nebongo[1], Nadege Edwige Nnang[8], Alex Vorsters[3] and Laurent Cleenewerck de Kiev[2]

Abstract

Introduction Human papillomavirus (HPV) is sexually transmissible and affects almost all sexually active people. The virus infects females and males, causing genital warts, cervical cancer, and oropharyngeal cancers in some. The disease burden is highest in resource-constrained countries, and it is a leading cause of cancer-related mortality in Cameroon. HPV infection is preventable by vaccination. Despite the merits of HPV vaccination, improving coverage has remained difficult in Cameroon. This paper highlights the challenges, lessons learned, and progress in HPV vaccination as part of Cameroon's gender-neutral-single-dose approach and the periodic intensification of routine immunization (PIRI).

Methods This ecological cross-sectional study, conducted from July to December 2023, examines the introduction of the HPV vaccine in Cameroon, along with associated challenges, strategies, and progress. Vaccination data from 2020 to 2023 were retrieved from Cameroon's District Health Information Software (DHIS2), while information on the vaccine introduction process and challenges was sourced from Expanded Programme on Immunisation (EPI) reports. Data analysis was performed using Python. The Shapiro–Wilk test assessed normality, and segmented regression analysis within an interrupted time series framework was applied to evaluate the contribution of each intervention to HPV vaccination uptake among girls. Statistical significance was set at a 95% confidence interval (CI) with a p-value < 0.05. Microsoft Excel 365 was used for calculating vaccination coverage proportions and visualizing results through figures and tables.

Results Cameroon introduced the HPV vaccine to nine-year-old girls in October 2020 amidst negative rumours. The first dose coverage stayed around 20% for three years. Following the National Immunization Technical Advisory

†Andreas Ateke Njoh and Dur-e-Nayab Waheed contributed equally.

*Correspondence:
Dur-E-Nayab Waheed
nayab.waheed@uantwerpen.be

Full list of author information is available at the end of the article

Group recommendation, the Ministry of Health intensified communication and community engagement, switched to a single-dose vaccination for nine-year-old boys and girls in January 2023, and PIRI in households and schools in March 2023. All regions improved, with four (Adamawa, East, Far North, and North) having coverages for girls over 90% and around 40% for boys. National-level vaccination coverage for girls improved three-fold, and boys recorded 26%. Interrupted time series highlighted an immediate improvement in girls' vaccination following PIRI in 70% of regions and nationally. In contrast gender-neutral-single-dose vaccination led to immediate improvement in coverage in 30% of regions (Far North, South, South West) and at the national level, while intensified communication lacked significant contribution.

Conclusion HPV vaccination in Cameroon has faced significant challenges. However, interventions such as adopting a gender-neutral, single-dose policy and implementing PIRI have greatly improved coverage across various levels of the health system since 2023.

Keywords Cervical cancer, HPV, Vaccination, Intensified communication, Gender-neutral vaccination, Single-dose, PIRI, Cameroon

Introduction

Human papillomavirus (HPV) is a common sexually transmissible infection that affects almost all sexually active people at some point in their life [1]. The virus infects females and males, causing disease [2]. Although the immune system resolves the infection in most people, it causes genital warts, cervical cancer, oropharyngeal and anal cancers in some [3]. In 2018, this preventable disease was responsible for around 690 000 new cancer cases, with 620 000 occurring in women and 70 000 in men [4]. HPV is the primary cause of cervical cancer, the fourth most common cancer among women worldwide [1, 2]. Early cancer detection improves survival and quality of life [5–7]. Unfortunately, most of these cancers are diagnosed in a more advanced stage. The HPV burden is highest in resource-constrained settings like the sub-Sahara African Region [8–10]. Vaccination is safe and effective in protecting against HPV-related diseases when it is administered to all preteens (or starting at the age of 9 to 13 years), including boys and girls, before the onset of sexual activities [11, 12]. After a two-dose schedule for girls under 15 in 2015, the World Health Organization (WHO) updated its recommendations, acknowledging positive outcomes with a single vaccine dose for adolescents in 2022 [11]. This WHO position paper recommends vaccinating adolescent girls as a priority target and expanding to the vaccination of secondary targets, such as boys and older females, where feasible and affordable.

HPV infections are common in Cameroon. The disease is a leading cause of cancer-related deaths [13]. The country recorded a crude incidence of cervical cancer in 2020 of 20.9 per 100 000 women and 1 600 deaths in 2019 [14]. To control disease, Cameroon piloted HPV vaccination through the Cameroon Baptist Convention Health Service in 2013 in three regions (South West, Littoral, and West). During this phase, 6 851 girls received at least one vaccine dose [15]. The country later introduced HPV vaccination nationwide. Although the country's target was nine-year-old girls, health actors commonly vaccinated nine- to thirteen-year-old girls and reported both groups separately through the Expanded Programme on Immunization (EPI) following vaccine introduction in October 2020 during the COVID-19 pandemic. The vaccine was administered in two doses with a six-month dosing schedule.

However, the introduction of the HPV vaccine led to resistance from both Muslim and Christian leaders, who forbade their followers from being vaccinated [16, 17]. These religious authorities raised the alarm through official letters and messages that promoted public concern regarding the decision to vaccinate only adolescent girls. In addition, the dissemination of rumours, including speculations about the potential infertility effects of the vaccine, added to the scepticism. To counteract these misconceptions, the EPI initiated a media campaign in 2021 featuring testimonials from girls who had received the vaccine during the pilot phase. Despite these efforts, vaccination coverage remained less than 20% for the first dose and less than 5% for the second dose, even two years after the introduction of the HPV vaccine. Notably, the South West Region, affected by armed violence-induced disruptions in the health system, implemented a strategy known as the periodic intensification of routine immunization (PIRI) to improve vaccination coverage. This proactive approach aimed to mitigate the impact of the crisis on immunization efforts within the region helped enhance HPV vaccination coverage to 40% in the region [18].

The introduction of the HPV vaccine in Cameroon has faced several other challenges at various levels, hampering its uptake [16, 19]. In this work, we aim to discuss the implementation process and improvement in coverage through the adoption of strategies such as the nationwide implementation of gender-neutral (GN) vaccination, PIRI, and the switch to a single-dose vaccine regimen.

Methods

Study design

This ecological cross-sectional study was conducted from July to December 2023. This study reviewed HPV vaccine introduction strategies and coverage in Cameroon from January 2020 to December 2023, as well as associated challenges and progress.

Study setting and population

This study was carried out in Cameroon. According to the national population estimate for 2023, the country had a total population of 28 433 067, with approximately 850 806 individuals aged nine years and nearly 51% being girls. This population is distributed in ten administrative regions and 52 divisions, which are regional sub-units. The regions are further divided into 205 health districts. At least three of the country's regions experienced insecurity. These regions include the South West and North West in sociopolitical crisis and the Far North experiencing periodic attacks from Boko Haram [20]. The country's major religions are Christianity and Islam [21].

Study data

Data on the number of adolescents vaccinated against HPV was obtained from the district health information software (Dhis)-2 for the period of HPV vaccination: October 2020 to December 2023. Information on the implementation strategies, period of implementation, number of adolescents vaccinated, vaccination targets, and challenges for the entire study period came from the EPI annual reports [22, 23]. Vaccination coverages were calculated based on vaccinated adolescents and expressed as a proportion of the national target of adolescent females and males aged nine for each of the regions and for the country yearly. The PIRI and intervention cost data came from the campaign reports.

Data quality assurance

The data was checked for correctness and consistency. Data on the adolescent females and males vaccinated per month and year per locality were obtained from the Dhis2. The research team relied on Cameroon's health system's data verification and validation policy. The districts and regional managers engage in monthly data review meetings to review the data reported with the health facility-level staff, who justify or correct the data when necessary. The national EPI team also reviews monthly data to check incoherence and sends feedback to the operational level for adjustment. This research design may not detect incoherence that was missed by the health system. All available regional data in the system were included in the study.

The data on infants vaccinated during PIRI for routine childhood vaccines was checked from the EPI reports. Vaccines given at the same time were verified for coherence. Any discordances identified were verified with the health staff and adjusted when necessary. The research compared the vaccine doses used in the study period to the number of people vaccinated to ensure coherence, which permitted the inclusion of all PIRI data in the research.

Data management and analysis

Python was used for statistical analysis. The Shapiro–Wilk test was performed to assess the normality of data distribution. This non-normal distributed data was run through segmented regression analysis in interrupted time series to depict the value of each intervention relative to the vaccination trend. Intensified communication was evaluated from August 2022 to December 2023. Gender-neutral single-dose vaccination was analysed from January to December 2023, while PIRI was assessed from March to June 2023, as shown in Fig. 1. Statistical

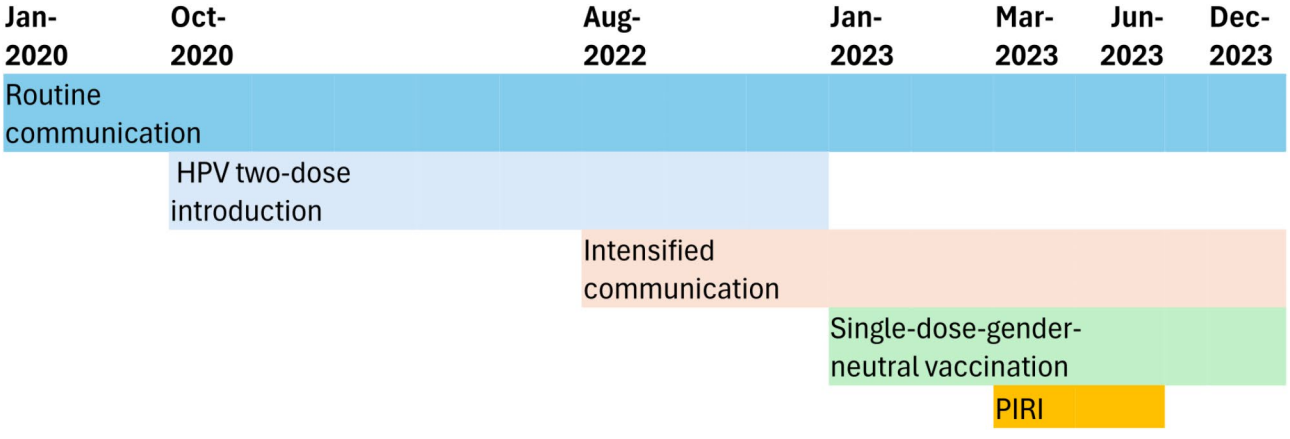

Fig. 1 Major interventions timeline during HPV vaccine rollout from 2020 to 2023. *The figures highlight major intervention milestones in the HPV vaccination in Cameroon. Each colour corresponds to a specific intervention, starting from the onset of the activity and ending with it during the study period. Blue represents the period of routine communication. Purple denotes the period of the HPV two-dose protocol for adolescent girls. Brown highlights the period of intensified communication. Green depicts the period of gender-neutral-single-dose HPV vaccination, and yellow denotes the PIRI period*

analysis was conducted at a 95%CI, with a p-value < 0.05 considered statistically significant. Microsoft Excel 365 was used to express vaccination coverage in proportion to the target population and to present the results in figures and tables.

This secondary analysis used data extracted from the existing anonymous database of the Ministry of Health, which was part of the Expanded Program on Immunization research assessing the contribution of gender-neutral HPV vaccination. Ethical approval was obtained from the National Ethics Committee for Research on Human Health.

The number of people vaccinated per locality and year was extracted from the Dhis2 monthly and yearly records. The monthly nationwide vaccination trend was expressed using a lined graph to illustrate the progression of HPV vaccination from the two-dose introduction to single-dose gender-neutral vaccination and PIRI to the end of 2023. This line graph helped to depict the impact points of single-dose and gender-neutral policies and also PIRI on the number of adolescents vaccinated over time.

The Dhis2 reported number of adolescents vaccinated against HPV eased coverage estimates. The coverages were calculated using the national target population from the Ministry of Health per locality and year. Excel facilitated these calculations, expressing the results as percentages and presenting them through charts and tables.

The data on infants who received their catchup doses for routine childhood immunization came from the PIRI Excel sheets used in data reporting. In addition, the cost per infant vaccinated in routine childhood immunization catchup was an expression of the total amount spent during the PIRI to the total number of infants vaccinated. The HPV vaccine cost was estimated using the UNICEF stated cost per dose for the quadrivalent HPV vaccine [24]. Considering the USD 4.5 per dose, the cost of HPV vaccine doses used in the target (girls and boys) vaccination in 2023 was a multiplication of the number of adolescents vaccinated by USD 4.5.

Results

This study highlights the implementation process and major interventions used to improve coverage.

Organization of HPV vaccine introduction

HPV vaccination was introduced through routine immunization in 2020 in all vaccination health facilities and selected schools. The first phase involved a cascade training of health and communication stakeholders at all the health pyramid levels. This step was followed by sensitization of the public through communication with focal people using the media, authorities in rural settings, and community gatherings.

Vaccination occurs routinely using existing health facilities and routine communication channels in each region. The northern regions (Adamawa, North, and Far North) and the East Region, beginning in 2020, benefitted from the existing traditional community structure to sensitize the population. The health staff enforced the sensitization of community leaders and traditional rulers through workshops and sensitization sessions in the community following guidance from the EPI. This intervention prompted the community representatives to mobilize the population. On a day selected by the representatives, they gathered the target age cohort for vaccination at the residence of the traditional leader or any other appropriate site in the community, such as the health facility. Parent-teacher association meetings also helped to sensitize parents, obtain their consent, and vaccinate adolescents in schools in these regions (northern regions and the East).

Two-dose vaccination coverage among girls

The HPV vaccination was introduced in two doses to adolescent girls from nine years old in October 2020. After the first dose, they received the second dose six months later. Three months after the introduction of the HPV vaccine, the national coverage rate on December 31, 2020, was 16% for the first dose (Fig. 2). The Southwest Region (SW) recorded 37% coverage, whereas every other region had less than 20% coverage (the national target). In 2021, the first dose national coverage improved to 18%; the SW maintained its performance, whereas the Far North, Adamawa, North, and Northwest recorded between 20% and 38% of the first dose coverage (Fig. 2). The lowest coverages were in the South and West regions from the first year and the Center and Littoral regions from the second year.

Major interventions

Vaccination coverages remained low, prompting the review and adaptation of vaccination strategies. In early 2022, the performance of the EPI at the national level was examined through desk reviews and dialogue sessions with major stakeholders, such as religious authorities, the Ministry of Basic Education, civil society organizations, health experts, school managers, and staff, which were organized at the national and sub-national levels. During these sessions, the EPI presented HPV/cervical cancer and other HPV-related disease burdens and how to prevent them. The EPI took the opportunity to engage in multisectoral collaboration with these organizations and ministries, which could facilitate access to the target population. The stakeholders targeted in the partnership included the Association of Paediatricians, the Association of Obstetricians and Gynaecologists, the Ministry of Basic Education, the Ministry of the Woman and the

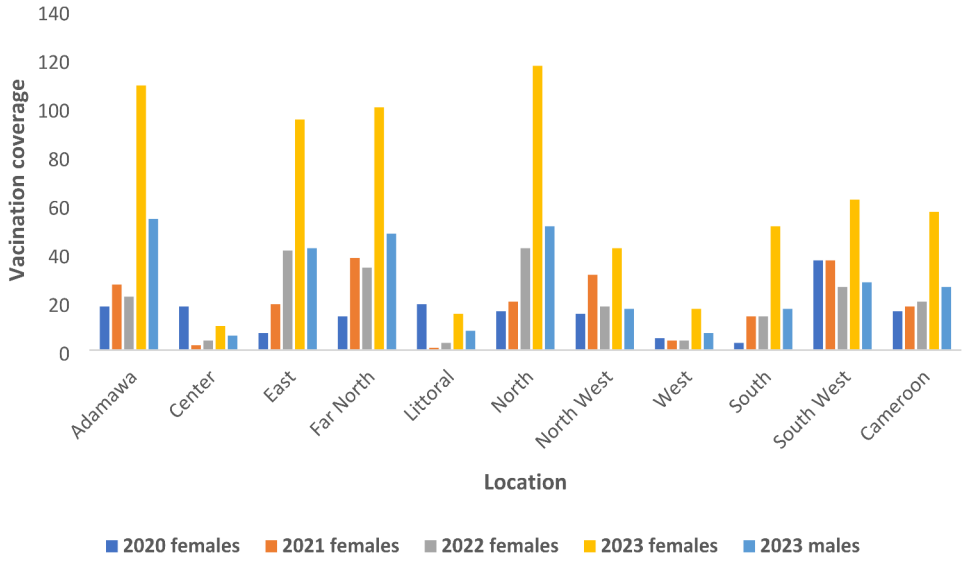

Fig. 2 First-dose HPV vaccination coverage for girls by region (October 2020–December 2023) and for boys (January– December 2023). *The bars represent the first-dose vaccination coverage for 9-year-old girls for the respective years. Blue represents coverage for girls in 2020, brown represents coverage for girls in 2021, grey represents coverage for girls in 2022, and yellow represents coverage for girls in 2023. Moreover, indigo coverage is used for boys 9 years old. The first four bars per locality report the coverages for the first dose of the HPV vaccine for the girls for the corresponding years.*

Family, civil society organizations, and representatives of religious groups, including Catholics and Muslims.

The working session with each group allowed the stakeholders to share their opinions and queries. Each session was led by a renowned community representative or scientific expert and ended with an interest and/or commitment from the invited stakeholders to support HPV vaccination. This activity occurred at all levels of the health pyramid, including the community. These series of engagement conversations facilitated the commitment of religious leaders to HPV vaccination.

The last sessions included an invitation from the president of the National Immunization Technical Advisory Group (NITAG) to the Expanded Program on Immunization. In June 2022, the NITAG reviewed the country's HPV vaccination, challenges, and current guidelines. These evidence-based conversations prompted the NITAG to draft interventions and strategies to improve HPV vaccination coverage. So, the NITAG reviewed the evidence presented and made a few recommendations [25]. First, they called for a switch to a single HPV vaccine dose to ensure cost-effectiveness. Second, they recommended switching to gender-neutral HPV vaccination targeting adolescent girls and boys to promote equity and strengthen the HPV epidemiological response by preventing the virus from spreading in both females and males. In addition, the NITAG recommended intensified communication and vaccination to improve vaccination coverage.

Intensive and improved communication

Following the NITAG recommendations, in late 2022, the Ministry of Health engaged and sensitized various stakeholders from the community, such as religious groups, the education sector, and actors supporting health activities, including civil society organizations and professional associations, to communicate about HPV and related diseases and the benefits of vaccination. These stakeholders communicated on various platforms, including social media, radio, television, schools, and religious gatherings in communities from August 2022.

The communicators presented the challenge of managing HPV-related diseases such as cancer and how the HPV vaccine is effective in controlling these diseases. Various images helped in showing the gravity of HPV-related diseases and cancers in males and females. These influential figures highlighted the gains in effectively controlling HPV by vaccinating adolescent females and males.

Gender-neutral intervention and switching to single-dose vaccination

Intensive communication among community stakeholders was followed by vaccinating adolescent boys and girls. The country began vaccinating adolescent girls and boys in January 2023. There was an increasing trend in the number of girls vaccinated compared with that in the previous years following boys' vaccination in January 2023 (Fig. 3).

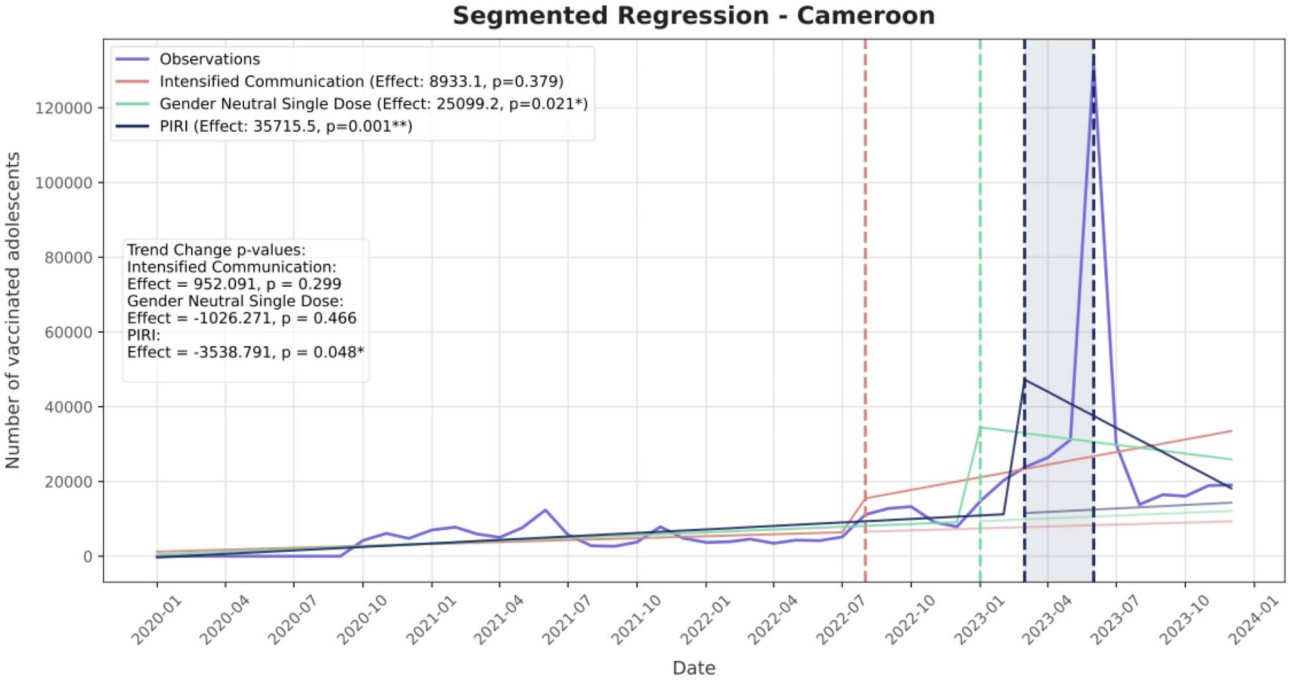

Fig. 3 Girls' first HPV dose vaccination in Cameroon from October 2020 to December 2023 Interrupted time series analysis following three key interventions. The continuous blue line represents the observed number of girls vaccinated with the first HPV dose. *The continuous red line depicts the regression model for girls' vaccination following communication intensification. The continuous green line represents the regression model for girls' vaccination following gender-neutral single-dose vaccination, and the continuous black line depicts the regression model for girls' vaccination following PIRI.On the other hand, the red vertical broken line presents the onset of intensified communication. Also, the green vertical broken line presents the onset of gender-neutral single-dose vaccination, and the black broken vertical lines highlight the start and end of PIRI.* Supplementary Fig. 1–10 highlight individual regions gain following each of the interventions

Periodic intensification of routine immunization (PIRI)

Multiple donors and the state were committed to generating funds for this activity. The PIRI program received some funding from Gavi, UNICEF, WHO, other international partners, and the State of Cameroon. The PIRI started in March 2023. Each district chose a period to begin vaccination between March and June 2023. In addition to health facilities and community-predefined sites, vaccination during PIRI occurred in locations where people gathered during community sensitization, schools, and homes.

The PIRI was followed by a surge in vaccinated girls with a single (first) HPV vaccine dose (Fig. 3). The PIRI, gender-neutral, and single-dose vaccination policy statistically significantly increased adolescent females' first-dose vaccination at regional and national levels (Table 1; Fig. 3). It integrated the catchup vaccination of infants with their routine childhood vaccines. From January to December 2023, 362 204 adolescents, nine years old, received the HPV vaccine for the first time. Among them were 69% of girls and 31% of boys.

PIRI offered the opportunity to catch up with infants 0 to 11 months for their routine childhood vaccine. So, 5 965 infants received their first pentavalent vaccine dose, and 5 441 completed the series. Furthermore, 5 598 infants received the first measles and rubella, and 4 963 individuals received the second measles-rubella vaccine dose.

HPV vaccination of adolescent males and females occurred in all health facilities, communities, and schools that provided consent. The collective effect of interventions improved the national coverage of 2023 for females and males (Fig. 2). The highest coverage for females was in the northern regions (Adamawa, North, and Far North), East, and Southwest, whereas the lowest coverage was in the Littoral, Centre, and West regions. For males, the highest coverage was in the northern regions, whereas the lowest coverage was in the Centre, Littoral, and West regions (< 20%).

Regions with the least coverage, such as the Centre, Littoral, and West Regions, were far from reaching a high coverage compared with the previous year (Fig. 2). The 2023 annual national coverage was 57% for girls and 26% for boys.

The single dose, gender-neutral vaccination, and PIRI 2023 period multiplied the vaccination coverage for girls nearly three-fold compared to the previous year (Fig. 2).

The immediate effect of intensified communication, gender-neutral, single-dose-vaccination, and PIRI positively impacted all parts of the country. However, the

Table 1 Trend in the number of adolescent girls' first dose HPV vaccination following various interventions 2020 to 2023 interrupted time series analysis

Region	Intervention	Immediate Effect	Immediate *p*-value	Trend Change	Trend *p*-value
Adamawa	Intensified com	456	0.7	85.9	0.4
	GNSV	1616.5	0.1	-34.1	0.8
	PIRI	2855.1	**0.01***	-260	0.2
Center	Intensified com	86.2	0.7	23.9	0.2
	GNSV	446.7	0.06	-8.6	0.78
	PIRI	739.7	**< 0.01***	-64.4	0.1
East	Intensified com	1350.1	0.19	-7.8	0.93
	GNSV	1081.5	0.338	-61.7	0.679
	PIRI	2074.5	0.067	-243.7	0.2
Far North	Intensified com	1743.3	0.35	84	0.58
	GNSV	5200.6	**0.01***	-358.8	0.166
	PIRI	6817.4	**< 0.01***	-842.5	**0.01**
Littoral	Intensified com	422	0.35	26.8	0.51
	GNSV	497.5	0.32	-9.5	0.88
	PIRI	1016.7	**0.04***	-102	0.22
North	Intensified com	2415.5	0.12	83.8	0.558
	GNSV	2628.1	0.12	-82.9	0.71
	PIRI	4225.2	**0.02***	-403.1	0.16
North West	Intensified com	99.7	0.75	7.4	0.79
	GNSV	438.7	0.19	-31.5	0.47
	PIRI	972	**< 0.01***	-124.2	**0.02***
West	Intensified com	69.6	0.86	26.8	0.45
	GNSV	513.1	0.23	-15	0.79
	PIRI	810.1	0.07	-74.8	0.3
South	Intensified com	64.8	0.72	11.3	0.49
	GNSV	465.7	**0.02***	-30.5	0.22
	PIRI	798	**< 0.01***	-97.6	**< 0.01***
South West	Intensified com	466.1	0.26	-8	0.83
	GNSV	1540.2	**< 0.01***	-159.8	**< 0.01***
	PIRI	1282.8	**< 0.01***	-216.5	**< 0.01***
Cameroon	Intensified com	8933.1	0.37	952.1	0.29
	GNSV	25099.2	**0.02***	-1026.3	0.466
	PIRI	35715.5	**< 0.01***	-3538.8	**0.04***

PIRI: *Periodic intensification of routine immunization*, ***GNSV***: *Gender-neutral-single-dose vaccination*, ***Intensified-com***: *Intensified-communication*, **Statistically significant*

Table 1*depicts the immediate and trend change in the number of adolescent girls who received the first HPV vaccine from 2020 to 2023 following intensified communication, PIRI, and gender-neutral-single-dose interventions, and the statistically significant values using interrupted time series analysis*

contribution of intensified communication was not significant (Table 1). Gender-neutral-single-dose vaccination had a positive, statistically significant immediate effect in 30% of regions (Far North, South, and South West) and at the national level. In comparison, PIRI had a positive, statistically substantial immediate effect in 70% of regions (Adamawa, Center, Far North, North, North West, South, South West) and at the national level. There was a negative significant trend change thereafter (Table 1). A statistically significant negative trend occurred following gender-neutral-single-dose vaccination in 10% of regions (South West) and PIRI in 40% of regions (Far North, North West, South, and South West) (Table 1).

For each intervention's study period, the availability of data was limited especially for gender-neutral-single-dose vaccination and PIRI. This limitation makes it impossible to obtain the impact of each intervention across all regions.

The girls vaccinated with at least a dose of HPV vaccine moved from 83 406 in 2022 to 249 594 in 2023. The additional 166 188 females were immunized, using an extra USD 747 846 of the cost of available vaccine doses in the country compared to 2022. Also, 112 610 males were vaccinated, consuming USD 506 745 of HPV vaccine purchase prize.

Discussion

Cameroon's EPI experience with improving HPV vaccination coverage has demonstrated the crucial role of multisectoral coordination, enhanced communication, and the need to implement innovative strategies such as PIRIs, switching to single-dose and gender-neutral approaches in the evolving landscape. Targeted strategies, such as door-to-door vaccination campaigns, have proven effective in certain regions, such as the Southwest, and have surpassed national targets within the first three months of HPV vaccination. Additionally, leveraging platforms such as parent-teacher association meetings facilitated consent and increased vaccination coverage to nearly 20% of national coverage in 2021 for the first dose. Community leaders played a pivotal role in mobilizing populations for vaccination in various regions, and the national coverage for the first dose was over 20%, and that for the second dose was over 6% in 2022.

To enhance coverage, EPI fostered collaboration with ministries, including the Ministry of Education and Women and the Family. Additionally, they engaged the Association of Obstetricians and Gynecologists and the National Pediatric Society in advocacy efforts. Working closely with religious leaders, these experts facilitated an understanding of the importance of HPV vaccination, leading to increased uptake. Through diverse communication channels such as television, radio, WhatsApp, and religious gatherings, stakeholders effectively communicated with the population, paving the way for improved vaccination rates [26]. The active involvement of the community and strategic communication are pivotal in enhancing HPV vaccination, as demonstrated in other countries such as Nigeria, Liberia, and Rwanda [27, 28]. Community ownership and engagement are vital in immunization strategies to overcome vaccination hesitancy, enhance vaccination confidence, and improve immunization coverage [29].

NITAG played a crucial role in shaping Cameroon's HPV vaccination strategy. It recommended an intensified communication effort and advocated adopting a cost-effective single-dose approach, considering the challenges associated with second-dose uptake and aligning with WHO guidelines. Furthermore, the NITAG proposed a gender-neutral approach after local concerns regarding HPV vaccination among girls were assessed. Combining interventions, including vaccinating boys, helped to alleviate doubts surrounding the vaccination of girls and immediately significantly improved the vaccination of girls in three regions and at the national level (Table 1). The vaccination of boys holds added value, as the vaccine limits HPV transmission and offers protection against various HPV-related diseases, including genital warts and anal, penile, and oropharyngeal cancers [30, 31]. Although we observed a negative trend later on, it was significant only in 10% of regions (South West).

Within the context of single-dose-gender neutral vaccination, PIRI preceded a surge in the number of girls vaccinated and vaccination coverage in 2023 compared to the previous year and non-PIRI period (Figs. 2 and 3). PIRI intervention within this context was projected to significantly improve vaccination in 70% of regions immediately. Although a negative trend was observed post-PIRI, it was only statistically significant in four regions (Table 1).

Although intensifying communication improved girls' vaccination, the results were not statistically significant (Table 1). However, strengthening communication with the population enhances knowledge of HPV risk, vaccination benefits, and building trust in immunization practices [32].

Despite the upsurge in vaccinations in all regions and nationwide, regional disparities in vaccine coverage and intervention impact underscore the need for targeted interventions. Remarkable progress has been made, with vaccine uptake rates increasing from 16% for the first dose for girls in 2020 to 57% in 2023 and 26% for boys in 2023. Although all regions showed an absolute increase in girls vaccinated, the direct impact of specific activities was significant in some parts of the country. PIRI was the single intervention that directly, immediately, and significantly contributed to improvement in seven regions and at the national level. However, it later resulted in a significant negative trend in four regions (Table 1). Similarly, gender-neutral single-dose vaccination led to an immediate improvement in three regions and at the national level but was followed by a significant negative trend in the South West.

Despite the gains recorded in vaccination coverage in all regions, coverage improvements in 2023 were higher in regions where coverage exceeded 10% in the previous year (Fig. 2). Four regions attained the 90% elimination target [33]. Regions with low performance in previous years, such as the Center, Littoral, and the West, recorded the least coverage. These regions contain cities such as Douala and Yaounde, which experience high vaccine hesitancy [34, 35]. Addressing vaccine hesitancy in these regions may further improve vaccine uptake.

The increasing vaccination coverage in Cameroon following the gender-neutral-single-dose and PIRI approach partly demonstrates the added value of the interventions [36]. In this vaccination context, these interventions enabled a threefold increase in vaccination of girls at the national level in 2023 compared to 2022, with an additional 166 188 girls vaccinated nationwide compared to the previous year. The cost of these additional doses to protect more girls was USD 747,846, while the cost for males was USD 506,745, based on the purchase price of

vaccine doses available in the country. The cost associated with vaccinating additional girls compared to the previous year highlights not only the expense of the vaccines but also the financial gains to the program by preventing vaccine wastage that would have occurred in the absence of these interventions. The government covered the vaccine cost for males. An inherent challenge with this approach lies in the government's need to allocate funding and secure vaccines specifically for male vaccination, as the Vaccine Alliance (Gavi) predominantly directs its resources towards vaccinating girls at present [26].

Additionally, the gender-neutral vaccination approach was coupled with a single-dose schedule, thus making distinguishing the effect and outcome of one of these approaches on improved uptake challenging. However, for each strategy, at least in parts of the country, a statistically significant increase in vaccinated girls was immediately observed with the gender-neutral-single-dose-PIRI interventions. It is imperative to conduct thorough investigations into the impact of vaccinating boys on HPV control within this setting. Also, the limited data restricted the ability to obtain robust results for each region. There is a need to pursue this research over time to clearly assess and present each intervention's gains across each region. Additionally, there is a need to assess the long-term cost sustainability of PIRIs.

The Adamawa, Far North, North, and East Regions, where coverage reached 90%, have existing traditional community strategies that may support increased coverage through intensified efforts. Leveraging these strategies will be valuable in improving coverage. With further research, these strategies could provide useful lessons.

Lessons learned

The lessons from Cameroon's three years of implementation experience are promoting gender equality in HPV vaccine administration, adopting single-dose and PIRIs, and intensified communication to improve coverage. The gender-neutral-single-dose and PIRI intervention rapidly improved vaccination coverage for girls and protected boys [37]. Although every region experienced increased coverage in 2023, only four had approximately 90% vaccination coverage, as recommended by the WHO for cervical cancer elimination [33]. There is a need for further research to understand the reasons for low uptake in some regions, identify tailored approaches to improve their performance and work towards sustainable and consistently high national HPV coverage and population protection.

The PIRI, coupled with strategies such as gender-neutral-single-dose vaccination, community engagement, and intensified communication with expert interventions, contributed to the coverage of the first dose of the HPV vaccine in girls to increase from 20% in December 2022 to 57% in 2023. Similarly, the coverage rate for boys during this period was 26%. Mapping or reaching out to girls for a second dose has been a considerable challenge, particularly in low-income regions [38, 39]. The single-dose approach in Cameroon has dramatically eased the logistical difficulties of reaching the target population for the second dose [40] and has been shown to be cost-effective [41, 42].

Engaging in PIRI was critical (Fig. 3; Table 1). This approach helped health workers to sensitize parents and reach boys and girls. The PIRI granted access to adolescents in school and out of school. The integration of HPV vaccine catchup with other childhood routine vaccines also promoted the uptake of missed childhood routine vaccines and reduced the number of zero-dose and under-immunized infants, promoting a positive narrative of the community's overall well-being [18, 43].

Strengths, limitations, and threats to external validity

This research highlights interventions that improve HPV vaccination in Cameroon by nearly threefold for girls after three years of persistently low coverage. The study shows the collective impact of gender-neutral-single-dose vaccination, PIRI, and intensified communication on HPV vaccine uptake. The vaccine uptake ensured population immunity to females and males and limited disease risk.

Despite the merit of this study, it has some limitations. The coverage improvement was more remarkable in just four regions (Adamawa, Far North, North, and East) with approximately 90% elimination target coverage. In addition, the coverages relied on administrative estimates of the population at the national level, which may not always reflect the actual situation of the target population. Also, the study had data for a limited period for each intervention period and could not depict the impact of each intervention at the region and country level. In addition, PIRI was implemented alongside gender-neutral single-dose vaccination and intensified communication. This combined approach makes it challenging to isolate the independent contribution of each intervention.

In spite of these limitations, the study discusses barriers to and facilitators of HPV vaccination in a low and middle-income setting. It highlights vital interventions like the NITAG assessment and orientation tailored to local context and the adoption of gender-neutral-single-dose regimens. When combined with PIRI, these efforts significantly promoted vaccine uptake and facilitated reaching the targets in diverse and remote areas [18, 39, 40]. These interventions can improve HPV vaccination coverage in similar contexts. We hope this study will stimulate further research on the contribution of each

strategy discussed in this manuscript to improving HPV vaccination coverage in this context. Additionally, the successes achieved in the four regions where at least 90% of the HPV elimination target was reached can be leveraged to improve performance in the poorly performing sites and applied to similar settings. Furthermore, it is also essential to investigate the reasons behind the minimal increases recorded in the Center, Littoral, and West regions (Fig. 2).

Conclusion

The introduction of HPV vaccination in Cameroon initially presented numerous challenges, but the country achieved substantial progress through targeted interventions in 2023. Key strategies included gender-neutral-single-dose vaccination and PIRI. These interventions immediately statistically significantly improved adolescent girls' first-dose vaccination in parts of the country [18, 39, 40].

PIRIs are critical in sensitizing parents and reaching adolescents in and out of school, increasing uptake and positively impacting overall immunization rates [18]. This approach eased the targeting and vaccination of girls and boys without discrimination. Also, community engagement is key to immunization strategies. Community involvement enhanced communication and vaccine acceptance and improved coverage [29].

The country's shift to a single-dose HPV vaccine alleviated logistical challenges associated with second-dose administration, proving cost-effective and operationally feasible [40]. This study provides insights into the implementation strategies, challenges, and interventions contributing to improving HPV vaccine coverage in Cameroon. In addition, the study found that HPV vaccination coverage was greater than 90% in some regions, highlighting the possibility of reaching the 90% vaccination coverage elimination goal.

In settings with low HPV vaccination coverage, some practical steps are helpful, as observed in this research. It is vital to leverage the NITAG's potential in the context of challenges to reaching the HPV vaccination goal. In addition, PIRI and gender-neutral-single-dose vaccination collectively immediately significantly stimulate HPV vaccine uptake and population immunity in the fight against HPV-related conditions affecting females and males.

This paper further underscores the need for further research with a more robust database to explore the benefits of these interventions in all regions and the cost-effectiveness and sustainability of gender-neutral single-dose HPV vaccination and PIRI approaches.

Abbreviations

CHAI	Clinton health access initiative
COVID	Coronavirus disease
Dhis	District health information software
EPI	Expanded program on immunization
Gavi	The vaccine alliance
GNSV	Gender-neutral-single-dose vaccination
HPV	Human papillomavirus
NITAG	National immunization technical advisory group
PIRI	Periodic intensification of routine immunization
SW	South west region
UNICEF	United nations children fund
WHO	World health organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-22776-3.

Supplementary Material 1

Supplementary Material 2

Acknowledgements

The authors thank the district medical officers and public health managers of the country for gathering the data that have made the preparation of this article possible. Additionally, special appreciation goes to the institutions that funded PIRI, the health workers who selflessly gathered the courage to implement PIRI within this challenging context of HPV vaccine hesitancy, and the WHO's technical guidance from the Country and Regional Office. Finally, the authors appreciate the technical advice received from Cameroon's NITAG.

Author contributions

AAN conceived the study's idea and design and elaborated on the first draft. DNW contributed to the design and shaped the paper. AAN, LJE, TA, KH, ND, and SJ contributed to data collection, analysis, and interpretation. AAN, DNW, TSNJK, YS, MK, SCN, NEN, and AA revised the subsequent drafts. EJK, AV, and LCK inspired, reviewed, and guided the article. All the authors reviewed and approved the final version of the manuscript.

Funding

Gavi, the WHO, UNICEF, the CHAI, and the Government of Cameroon financed the PIRIs. No funding was available for this article. AAN bore the cost of data collection.

Data availability

The data used in this study could be obtained from Cameroon's District Health Information Software.

Declarations

Ethics approval

This secondary analysis used data extracted from the existing anonymous database of the Ministry of Health, which was part of the Expanded Program on Immunization research assessing the contribution of gender-neutral HPV vaccination. Ethical approval was obtained from the National Ethics Committee for Research on Human Health.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Expanded Program on Immunization, Ministry of Public Health, Yaoundé, Cameroon
[2]School of Global Health and Bioethics, Euclid University, Bangui, Central African Republic
[3]Centre for Evaluation of Vaccination, Vaccine and Infectious Disease Institute, University of Antwerp, Antwerp, Belgium
[4]Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Yaoundé, Cameroon
[5]Clinton Health Access Initiative Inc, Yaoundé, Cameroon

[6]World Health Organization, Cameroon Country Office, Yaoundé, Cameroon
[7]Division of Public Health, Faculty of Health Sciences, University of the Free State, Bloemfontein, South Africa
[8]Gavi, The Vaccine Alliance, Geneva, Switzerland

Received: 27 November 2024 / Accepted: 11 April 2025
Published online: 08 May 2025

References

1. WHO. Human papillomavirus and cancer. 2024.https://www.who.int/news-room/fact-sheets/detail/human-papilloma-virus-and-cancer. Accessed 4 Nov 2024.
2. Giuliano AR, Anic G, Nyitray AG. Epidemiology and pathology of HPV disease in males. Gynecol Oncol. 2010;117:S15–9.
3. CDC. Cancers Associated with Human Papillomavirus. In: United States Cancer Statistics. 2024.https://www.cdc.gov/united-states-cancer-statistics/publications/hpv-associated-cancers.html. Accessed 4 Nov 2024.
4. de Martel C, Georges D, Bray F, Ferlay J, Clifford GM. Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis. Lancet Global Health. 2020;8:e180–90.
5. WHO. Cervical cancer. 2022.https://www.who.int/news-room/fact-sheets/detail/cervical-cancer. Accessed 26 Jul 2023.
6. CDC. Basic Information About Cervical Cancer. 2022.https://www.cdc.gov/cancer/cervical/basic_info/index.htm. Accessed 4 Jan 2023.
7. Crosby D, Bhatia S, Brindle KM, et al. Early detection of cancer. Science. 2022;375:eaay9040.
8. Bruni L, Diaz M, Castellsagué X, Ferrer E, Bosch FX, de Sanjosé S. Cervical human papillomavirus prevalence in 5 continents: meta-analysis of 1 million women with normal cytological findings. J Infect Dis. 2010;202:1789–99.
9. Felsher M, Setiawan D, Varga S, et al. Economic and humanistic burden of HPV-related disease in Indonesia: A qualitative analysis. Glob Public Health. 2023;18:2237096.
10. Vuyst HD, Alemany L, Lacey C, Chibwesha CJ, Sahasrabuddhe V, Banura C, Denny L, Parham GP. The burden of human papillomavirus infections and related diseases in Sub-Saharan Africa. Vaccine. 2013;31:F32.
11. WHO. WHO updates recommendations on HPV vaccination schedule. 2022.https://www.who.int/news/item/20-12-2022-WHO-updates-recommendations-on-HPV-vaccination-schedule. Accessed 11 Aug 2023.
12. CDC. STD Facts - Human papillomavirus (HPV). 2022.https://www.cdc.gov/std/hpv/stdfact-hpv.htm. Accessed 11 Aug 2023.
13. Roux AN, Kenfack B, Ndjalla A, Sormani J, Wisniak A, Tatrai K, Vassilakos P, Petignat P, Schmidt N. Barriers to cervical cancer prevention in rural Cameroon: a qualitative study on healthcare providers' perspective. BMJ Open. 2021;11:e043637.
14. WHO. Cervical cancer Cameroon 2021 country profile. 2021.https://www.who.int/publications/m/item/cervical-cancer-cmr-country-profile-2021. Accessed 11 Aug 2023.
15. Ogembo JG, Muffih TP, Maranda L et al. Cervical Cancer in Cameroon: A Three Pronged Approach to Increase Awareness, Vaccination, Screening and Treatment. 2014.https://doi.org/10.13028/8CFX-W920
16. Kingah L. Legideon news now //-After Catholic Church, Muslim community bans Administration of Gardasil vaccine on Girls. 2020.https://legideon.org/index.php?page=view/article/3024/1. Accessed 19 Sep 2022.
17. La Croix International. African Church voices doubts over cervical cancer vaccine. In: international.la-croix.com. 2020. https://international.la-croix.com/news/ethics/african-church-voices-doubts-over-cervical-cancer-vaccine/13314. Accessed 7 Jan 2023.
18. Njoh AA, Saidu Y, Bachir HB, et al. Impact of periodic intensification of routine immunization within an armed conflict setting and COVID-19 outbreak in Cameroon in 2020. Confl Health. 2022;16:29.
19. Amani A, Nolna SK, Ndje MN, Ndongo CB, Ngounoue MD, Tiedeu BA, Leke RGF. Social media controversy affecting the introduction of HPV vaccination for young girls in Cameroon. ARCH Women Health Care. 2019. https://doi.org/10.31038/AWHC.2019255.
20. Amnesty International. (2023) Human rights in Cameroon. In: Amnesty International. 2023. https://www.amnesty.org/en/location/africa/west-and-central-africa/cameroon/report-cameroon/. Accessed 20 Jan 2025.
21. US Department of State. 2022 Report on International Religious Freedom: Cameroon. In: United States Department of State. 2022. https://www.state.gov/reports/2022-report-on-international-religious-freedom/cameroon/. Accessed 20 Jan 2025.
22. EPI Cameroon. The 2020 annual report of the Expanded Program on Immunization in Cameroon. EPI Cameroon, Yaounde. 2021.
23. EPI Cameroon. The 2021 annual report of the Expanded Program on Immunization in Cameroon. EPI Cameroon, Yaounde. 2022.
24. UNICEF Supply Division. Vaccines pricing data. 2023. https://www.unicef.org/supply/vaccines-pricing-data. Accessed 7 Jan 2025.
25. Cameroon NITAG. Note de recommandation N° 009/2022 du groupe technique consultatif National pour La vaccination. Sur les options de calendrier vaccinal anti HPV. 2022.
26. Lahijani AY, King AR, Gullatte MM, Hennink M, Bednarczyk RA. HPV vaccine promotion: the church as an agent of change. Soc Sci Med. 2021;268:113375.
27. Premium T. HPV Vaccine: Nigeria attains 78% coverage in 14 states, Abuja. 2023.https://www.premiumtimesng.com/news/top-news/646050-hpv-vaccine-nigeria-attains-78-coverage-in-14-states-abuja.html. Accessed 1 Feb 2024.
28. Gavi. Promoting HPV vaccination in high-risk communities: lessons from Liberia, Nigeria and Rwanda. 2023.https://www.gavi.org/vaccineswork/promoting-hpv-vaccination-high-risk-communities-lessons-liberia-nigeria-and-rwanda. Accessed 1 Feb 2024.
29. Xie YJ, Liao X, Lin M, et al. Community engagement in vaccination promotion: systematic review and Meta-Analysis. JMIR Public Health Surveill. 2024;10:e49695.
30. Study Shows HPV Immunization Lowers Risk of Developing Cancer. 2024.https://www.cancer.org/cancer/latest-news/study-shows-hpv-immunization-lowers-risk-of-developing-cancer.html. Accessed 6 Mar 2025.
31. Gezimu W, Bekele F, Bekana T, Demeke A. Males' access to human papillomavirus vaccination in Resource-Limited settings. Immunotargets Ther. 2024;13:95–8.
32. Ekezie W, Igein B, Varughese J, Butt A, Ukoha-Kalu BO, Ikhile I, Bosah G. Vaccination communication strategies and uptake in Africa: A systematic review. Vaccines. 2024;12:1333.
33. WHO. Cervical Cancer Elimination Initiative. 2022.https://www.who.int/initiatives/cervical-cancer-elimination-initiative. Accessed 8 Jul 2024.
34. Kwedi Nolna S, Bonono C-R, Nsangou Moncher M, Bindé T, Nolna D, Ongolo Zogo P. Factors influencing the performance of routine immunization in urban areas: A comparative case study of two cities in Cameroon: Douala and Yaoundé. Vaccine. 2018;36:7549–55.
35. Yakum MN, Funwie AD, Ajong AB, Tsafack M, Ze LEE, Shah Z. The burden of vaccine hesitancy for routine immunization in Yaounde-Cameroon: A cross-sectional study. PLOS Global Public Health. 2022;2:e0001012.
36. Barnabas RV, Brown ER, Onono MA, et al. Efficacy of single-dose HPV vaccination among young African women. NEJM Evid. 2022;1:EVIDoa2100056.
37. Man I, Georges D, Sankaranarayanan R, Basu P, Baussano I. Building resilient cervical cancer prevention through gender-neutral HPV vaccination. eLife. 2023;12:e85735.
38. Bénard É, Drolet M, Laprise J-F, Jit M, Prem K, Boily M-C, Brisson M. Potential benefit of extended dose schedules of human papillomavirus vaccination in the context of scarce resources and COVID-19 disruptions in low-income and middle-income countries: a mathematical modelling analysis. Lancet Global Health. 2023;11:e48–58.
39. Nhumba N, Sunguya B. Low uptake of the second dose of human papillomavirus vaccine in Dar Es Salaam, Tanzania. Vaccines (Basel). 2022;10:1919.
40. Ogema NM. Single-dose HPV vaccine 'up to 97 per cent effective'. Sub-Saharan Africa; 2021.
41. Prem K, Choi YH, Bénard É, et al. Global impact and cost-effectiveness of one-dose versus two-dose human papillomavirus vaccination schedules: a comparative modelling analysis. BMC Med. 2023;21:313.
42. Burger EA, Campos NG, Sy S, Regan C, Kim JJ. Health and economic benefits of single-dose HPV vaccination in a Gavi-eligible country. Vaccine. 2018;36:4823–9.
43. Clarke-Deelder E, Suharlim C, Chatterjee S, Brenzel L, Ray A, Cohen JL, McConnell M, Resch SC, Menzies NA. Impact of campaign-style delivery of routine vaccines: a quasi-experimental evaluation using routine health services data in India. Health Policy Plan. 2021;36:454–63.

Publisher's note