



## Malawian caregivers' experiences with HPV vaccination for preadolescent girls: A qualitative study



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### ABSTRACT

**Introduction:** Many low- and middle-income countries have introduced the human papillomavirus (HPV) vaccine, but uptake remains extremely low. Malawi has the second-highest incidence of cervical cancer globally, and launched a national HPV vaccination program in 2019. We sought to understand attitudes about, and experiences with, the HPV vaccine among caregivers of eligible girls in Malawi.

**Methods:** We conducted qualitative interviews with 40 caregivers (parents or guardians) of preadolescent girls in Malawi to understand their experiences with HPV vaccination. We coded the data informed by the Behavioural and Social Drivers of vaccine uptake model and recommendations from WHO's Strategic Advisory Group of Experts Working Group on Vaccine Hesitancy.

**Results:** In this sample, 37% of age-eligible daughters had not received any HPV vaccine doses, 35% had received 1 dose, 19% had received 2 doses, and 10% had an unknown vaccination status. Caregivers were aware of the dangers of cervical cancer, and understood that HPV vaccine is an effective prevention tool. However, many caregivers had heard rumors about the vaccine, particularly its alleged harmful effect on girls' future fertility. Many caregivers, especially mothers, felt that school-based vaccination was efficient; but some caregivers expressed disappointment that they had not been more engaged in the school-based delivery of HPV vaccine. Caregivers also reported that the COVID-19 pandemic has been disruptive to vaccination.

**Conclusions:** There are complex and intersecting factors that affect caregivers' motivation to vaccinate their daughters against HPV, and the practical challenges that caregivers may encounter. We identify areas for future research and intervention that could contribute to cervical cancer elimination: better communicating about vaccine safety (particularly to address concerns about loss of fertility), leveraging the unique advantages of school-based vaccination while ensuring parental engagement, and understanding the complex effects of the COVID-19 pandemic (and vaccination program).

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## 1. Introduction

The human papillomavirus (HPV) vaccine is an essential part of the global fight against cervical cancer. The World Health Organi-

zation (WHO) strategy to eliminate cervical cancer includes a goal of fully vaccinating 90% of girls by age 15 before the year 2030 [1]. Modeling studies highlight that reaching this goal would vastly reduce cervical cancer burden in low- and middle-income countries over the next century [2,3]. Many African countries have introduced the HPV vaccine for preadolescent girls [4,5], but data about levels and correlates of uptake are scarce. This topic has been studied extensively in high-income settings like the United States and Europe [6,7]—but we know little about who is getting vac-

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nated against HPV in high-burden and resource-poor settings where the vaccine is most urgently needed.

Malawi has the second-greatest age-standardized incidence of and mortality attributable to cervical cancer globally [8]. In 2019, Malawi's government launched the national HPV vaccination program, primarily targeting 9-year-old girls through a strategy combining school-based campaigns and static and outreach clinics to reach out-of-school girls. Over time, community- and health facility-based approaches to delivering the HPV vaccine have been increasingly implemented [9]. Coverage of HPV vaccine remains very low, however, and it is important to understand reasons for this low uptake. Given the sparse literature on HPV vaccination and its correlates in high-burden African settings, we conducted a qualitative formative study to understand: (1) caregivers' (parents and guardians) knowledge and attitudes about their daughters' experiences with HPV vaccination; (2) messages caregivers have heard about HPV vaccination and how these have influenced their attitudes and behaviors; and (3) perceived factors that facilitate or hinder HPV vaccination, at individual, group, and contextual levels of influence.

## 2. Methods

**Study setting:** Malawi is a country of approximately 19.9 million people in southeastern Africa. Uptake of routine early childhood vaccines is high in Malawi, with approximately 75% of children aged 12–23 months having received all eight basic vaccinations per a 2015–16 household survey [10]. However, the HPV vaccine has failed to attain similarly high coverage in Malawi. The Malawi Ministry of Health introduced a national HPV vaccination program in January 2019, through which the quadrivalent (HPV4) vaccine (Gardasil) is offered to 9- to 14-year-old girls as a 2-dose series. The national program primarily targets 9-year-old girls through campaigns at schools and in communities, and via routine provision at health facilities. The national program has failed to achieve high coverage, however: in 2021 (the first year of high-quality population-level coverage data), only approximately 14% of 9-year old Malawian girls received a first dose of HPV vaccine [11].

**Interview guide:** We used the WHO Behavioural and Social Drivers (BeSD) of vaccine uptake framework [12] and the report from the WHO Strategic Advisory Group of Experts Working Group on Vaccine Hesitancy [13] to design an interview guide with open-ended and semi-structured questions. The BeSD framework posits that vaccination behavior is a function of what people “think and feel,” social processes, and access to vaccines. Interview questions reflected these multiple levels of factors hypothesized to influence attitudes and behaviors about the HPV vaccine and vaccination. We also asked respondents about the vaccination history/status of their children, and specifically whether, when, and where their age-eligible daughters had received the HPV vaccine. The interview guide was developed in English, translated to Chichewa by an experienced bilingual translator, and the translation was then revised based on feedback from the Malawian research team. The research team piloted the interview guides, first within the research team and then with three randomly-selected parents of preadolescent girls, to ensure the questions were comprehensible and relevant.

**Participant recruitment:** Potential participants were approached while in the outpatient department queue at four large health facilities in the Central and Southern regions of Malawi. Those interested in hearing about the study were assessed for eligibility, which included: having heard of the HPV vaccine and being a caregiver (parent or guardian) for at least one girl who was the target age for vaccination (nine years old) between the years of 2019–2021. Both biological parents, and non-biological caregivers with

a decision-making role around health and vaccination, were eligible; we use the term “caregiver” in this paper to encompass both categories. We collected data on reasons for ineligibility and refusals. Eligible respondents were brought to a private area at the health facility and, after providing oral and written informed consent, participated in the interview.

**Data collection:** Trained and highly experienced research assistants conducted interviews. They completed a specialized week-long training for this study, which included information about HPV vaccine and extensive practice with the interview guide, and received detailed feedback from both Malawian and U.S.-based qualitative researchers on collecting high-quality data during these interviews. Interviews occurred during November 2021, and lasted, on average, 33 min (range 22–59 min); this was a time of very low COVID-19 transmission in Malawi and health facilities were operating at regular volume. At the end of each interview, the respondent received 4000 Malawi Kwacha (equivalent to approximately US\$ 5) for their participation. All interviews were conducted in Chichewa, and were audio recorded with permission from the respondents. Recordings were then transcribed, and translated to English for analysis.

**Data analysis:** We developed a draft codebook by synthesizing constructs from the aforementioned WHO BeSD framework and Strategic Advisory Group of Experts Working Group on Vaccine Hesitancy report. Two coders independently applied the draft codebook to three randomly-selected transcripts; they then modified the codebook based on this experience. This process was repeated once more until the codebook was finalized. Transcripts were coded using Dedoose software by two researchers. During analysis, we sought to identify themes within and across the domains of the BeSD framework: thinking and feeling (perceived disease risk, perceived vaccination benefits), social processes (norms, trust), and practical issues (availability of vaccine, service quality, ease of access). We explored differences in findings and themes by respondent gender and age (above or below median age of respondents), and daughter's history of HPV vaccination. A girl's HPV vaccination status was classified based on caregiver's self-report and according to the Malawi national guidelines: zero doses received (unvaccinated), one dose received, or two doses received (fully immunized). Per Malawi guidelines, only people living with HIV should receive three doses and we did not collect information on HIV status. As the BeSD framework posits that vaccination behavior is shaped by access as well as motivation (which itself is influenced by both intra- and inter-personal factors), the analysis did not try to draw associations between these factors as individuals may in fact experience countervailing forces as they form an intention to vaccinate, and may translate this into a vaccination behavior.

**Ethical review:** The study protocol was reviewed and approved by the Institutional Review Board at the University of California Los Angeles (approval number 21–001174), and by the Malawi National Health Sciences Research Committee (approval number 21/04/2685). All respondents provided informed consent before participating.

## 3. Results

In total, 313 people were approached for eligibility screening. Potential respondents were asked if they had heard of the HPV vaccine and if they had an age-eligible daughter; 264 were not eligible for these reasons. Of the 49 eligible respondents, 8 declined to participate and 1 did not complete the interview, resulting in the final sample of 40 respondents.

There were 29 female and 11 male respondents. The average age of respondents was 39 years (range 21–64 years); men in the

sample were on average older than women (44.5 years and 36.7 years, respectively). Fifteen respondents had less than primary education (38%), 7 had completed primary (18%), 9 had some secondary (23%), 7 had completed secondary (18%), and 2 completed beyond secondary school level (5%). A higher percentage of male respondents completed secondary or beyond (36% of men versus 17% of women). All male respondents were married; 24 female respondents were married (83%), 3 were separated or divorced (10%), and 2 were widowed (7%). On average, respondents participated in health care decision-making for 4.4 living children (range 2–10).

Caregivers were asked who primarily makes health care decisions for children in their household. Two-thirds (66%) of female respondents said they alone make decisions about their daughters' health care, 31% said that both parents decided, and 3% said that the father decided. In contrast, most male respondents said both parents decide about their daughters' health care (73%), 18% said the father decides, and 9% said mostly the mother decides. Most respondents (72% of women and 73% of men) said they had not talked with a health care worker about the HPV vaccine.

The 40 respondents reported on HPV vaccination status for 52 girls (daughters) who had been age-eligible for vaccination under the national program launched in 2019, of whom 19 (37%) had not been vaccinated, 18 (35%) had received 1 dose, 10 (19%) had received 2 doses, and vaccination status was unknown for 5 (10%). Among the 28 girls with at least 1 vaccine dose reported, 25 had received the vaccine at school, 1 at a health facility, 1 in the community, and 1 at an unknown location.

### 3.1. High awareness and salience of cervical cancer among respondents

Many caregivers, particularly those whose daughters had received at least one dose of the HPV vaccine, spoke about cervical cancer as a major health problem—and the importance of the HPV vaccine as a prevention tool. This was mentioned by both male and female caregivers, and respondents of different ages.

*"This vaccine is very important because nowadays this disease is dangerous, and not easy to detect. Mostly it is detected when the situation is worse and maybe the remove of the cervix is the only solution, so it is important to have the vaccine so that one should be protected prior."* (Man, 40 years old, daughter who received 1 dose)

*"I think this vaccine is very important because women are losing their lives because of this dangerous disease of cervical cancer."* (Woman, 31 years old, daughter who received 1 dose)

Cervical cancer was commonly seen as dangerous because it affects childbearing; this concern was mentioned both by caregivers whose daughters had and had not received HPV vaccine.

*"If the child is attacked by the cancer, the cervix has to be removed, which consequently means that she will not even have a child."* (Woman, 37 years old, unvaccinated daughter)

A number of older respondents (most commonly people over the sample median age of 30) spoke about personal experiences with cervical cancer affecting either themselves or someone close to them—and, in some cases, this changed their mind about the importance of HPV vaccination.

*"My child was 8 years old, and I knew that at 9 she will be getting the vaccine, and I was not happy about it ... [But later] I was diagnosed with cervical cancer, that is why I decided [I will] encourage my child to get it [the vaccine]."* (Woman, 31 years old, unvaccinated daughter)

*"I heard it on the radio, but I had my own doubts... when my friend explained to me about his relative who was found with the cancer, I started to believe."* (Man, 34 years old, daughter who received 2 doses)

### 3.2. Caregivers with unvaccinated daughters expressed concerns about effectiveness and side effects of the HPV vaccine

Some respondents—more commonly those whose daughters had not received any HPV vaccine doses—said they had concerns about the vaccine. These included not understanding why young girls were getting vaccinated, fears about short-term side effects like fainting, and general concerns about the vaccine because it is new. These concerns were mentioned by both men and women, and primarily among older respondents (over the sample median age of 30).

*"At first I was questioning the effectiveness of the vaccine and why they are vaccinating kids, because in our time we have never had that vaccine at 9 years."* (Woman, 37 years old, unvaccinated daughter)

*"The vaccine was strong. If she had not taken enough food, she could have fainted and we would think they want to kill her."* (Woman, 47 years old, daughter who received 1 dose)

### 3.3. Common social discourse about the vaccine, especially its safety

Caregivers reported that they and children hear many rumors about the HPV vaccine, especially how it may cause girls to become infertile. This was mentioned by both male and female respondents of all ages, and regardless of daughter's vaccination status.

*"We are told by other people that if we try to get our daughters vaccinated, they will never bear children."* (Woman, 43 years old, unvaccinated daughter)

*"Women chat in a group and say that the population of female children in Malawi is high, and they are trying to control the population so that the children should not be able to give birth. So, some of us went to consult to the community health personnel, and we explained our worry that the vaccine's aim was to control their capability to give birth."* (Woman, 50 years, daughter who received 1 dose)

*"Some say that the vaccine is a lie and its purpose is to make children barren, and some parents say they cannot have their children vaccinated. The first time they came, the children ran away from them... It seems they were told in the village that they should run because it was not about the cervical cancer but population control."* (Man, 34 years, daughter who received 2 doses)

Several respondents mentioned broad anti-vaccination beliefs expressed by religious leaders, and hearing that the HPV vaccine is sinister or "satanic."

*"Some churches instruct their members to never go to the hospital, and we have people who have never received any vaccine because of their beliefs, so I believe that some will never get the [HPV] vaccine because of that."* (Man, 64 years old, unvaccinated daughter)

*"They distrust the vaccines because they are administered in schools when they are not around, so they assume that the vaccines are bad... People say it is satanic."* (Woman, 40 years old, daughter who received 2 doses)

However, some caregivers, primarily those with vaccinated daughters, spoke of positive perceptions of the HPV vaccine circulating in their community. Male respondents, and those over the age of 30, mentioned these more often.

“Mainly they [other parents in the community] were saying that cancer is a dangerous disease that no one would want his child to suffer from, so given the opportunity, they had to have the children vaccinated.” (Man, 42 years, daughter who received 1 dose)  
 “We were encouraging each other that the children should be vaccinated, so that they may prevent the cancer. . . Some said that the vaccine is bad, and I was telling them that they were wrong.” (Woman, 44 years old, daughter who received 1 dose)

### 3.4. School-based vaccination has advantages, but some caregivers felt left out

As noted above, most girls had been vaccinated at school. Many respondents—more commonly women (of all ages) and those whose daughters had received at least one dose of HPV vaccine—felt that the school-based immunization program had advantages, including being efficient and convenient.

“It is good because they find most of them in one place and logistically it is easy on the doctors.” (Woman, 42 years old, daughter who received 2 doses)

“It is good to do it in schools because as parents we send our children there. If they were administering the vaccines in other places other than school, as parents we would be lazy to take our children there since we have a lot of things to do in our homes.” (Woman, 33 years old, daughter who received 2 doses)

Other perceived advantages included that schools are trusted environments and thus can counteract some fears and rumors.

“The teachers also help in sensitization processes and it is easy for the children to listen to their teachers.” (Man, 42 years old, daughter who received 1 dose)

“[School-based vaccination] is an advantage because it is administered in public and not privately. . . People think something wrong is going on when you are doing things in private.” (Woman, 37 years, daughter who received 1 dose)

In addition, school-based programs can lessen the financial burden of accessing vaccines at a health facility.

“The advantage is that most children cannot afford to come here at the hospital, that is why it is easy . . . at school.” (Woman, 44 years old, daughter who received 1 dose)

“Some children come from less well-off families, so they cannot afford to come to the hospital. It makes us glad as parents when we see our children receiving vaccines while they are at school.” (Woman, 36 years old, unvaccinated daughter)

However, many caregivers said they felt sidelined in this process, and some felt that vaccination was forced on girls. This was mentioned by both women and men of all ages, and regardless of daughter’s vaccination status. These respondents expressed feeling uninformed, and that their permission or assent had not been sought. Several respondents said the school-based program’s lack of transparency added concerns about the vaccine.

“I don’t agree with how the exercise is being conducted, maybe they should find a way to inform parents and not just administer them to the children without seeking assent from parents.” (Woman, 31 years old, unvaccinated daughter)

“They did not approach parents first so that we should also advise our children. . . As they did it, they imposed it on them, and as parents we were worried of their intentions in blindsiding us.” (Woman, 37 years old, daughter who received 2 doses)

“The disadvantage is that some children are coerced into getting the vaccine and others don’t even inform their parents. . . The parents are mostly not there, we just are told that they have been vac-

inated and whether they are experiencing pains.” (Woman, 21 years old, daughter who received 2 doses)

There were also reports of children running away from vaccinators, or skipping school to avoid getting the vaccine.

“The disadvantage [of school-based vaccination] is whenever children see a vehicle that belongs to a hospital, they run away for lack of understanding. It requires parents to explain to them what really is about for them to understand.” (Woman, 28 years old, unvaccinated daughter)

### 3.5. Additional challenges during COVID-19 pandemic

Some respondents discussed how the COVID-19 pandemic affected HPV vaccination. First, it was common for girls’ vaccine series to have been interrupted.

“I should say that since COVID started, I have never heard of the initiative again in the schools.” (Man, 42 years old, daughter who received 1 dose)

In addition, confusion about whether the COVID-19 or HPV vaccine was being administered caused fear.

“When [children] see the [vaccination] vehicle, they run away, thinking they want to give them corona vaccines that would kill them.” (Woman, 38 years old, unvaccinated daughter)

“They were saying that there will be an administration of cervical cancer vaccine, but the kids were saying that they are just lying, instead they want to administer COVID-19 vaccine.” (Woman, 37 years old, daughter who received 1 dose)

## 4. Discussion

This qualitative study with caregivers in Malawi with preadolescent daughters identified several important potential facilitators and barriers to HPV vaccination. There were three thematic findings related to the domains hypothesized to be linked to vaccine uptake. First, the vaccine was generally seen as important and effective for protecting against cervical cancer, but there were widespread rumors about its safety and in particular, concern that it might cause infertility. Second, the school-based immunization program implemented in Malawi was praised for its efficiency and convenience by some parents, but others did not feel well-involved in the vaccination decision or process, which eroded trust in the program and in the vaccine. Lastly, the COVID-19 pandemic introduced challenges in ensuring completion of the vaccine series and added confusion and fueled rumors about vaccines.

Our results indicate a complex relationship between cervical cancer, the HPV vaccine, and fertility. Respondents worried that if their daughter was affected by cervical cancer, she would not be able to bear children, and they understood that the HPV vaccine is important for cervical cancer prevention—but they had also heard rumors that the vaccine itself would negatively affect their daughter’s fertility. Caregivers therefore face a dilemma about whether to protect their daughter’s reproductive future with a vaccine that might compromise this very capacity. This fear that the HPV vaccine could affect fertility has been noted in LMIC settings [14–20]; and there are many similar rumors in Malawi and throughout Africa about infertility related to vaccines and other public health interventions [21,22]. Research should further interrogate these perceptions—including survey questions about this belief rather than generic “side effects,” as it appears to be a specific and salient concern; and the public health community should work to develop effective approaches to reassuring caregivers in Malawi about the safety of the vaccine and lack of evidence show-

ing fertility-related impacts. It is also important to strengthen our understanding of the spillover effects of beliefs, exposure to misinformation, and vaccination experiences, both intra-personal (for example, if someone's concerns about one vaccine affects their attitudes toward other vaccines) [23,24] and inter-personal (how it may spread in social networks and communities both on- and off-line) [25,26].

Caregivers in this study had mixed feelings about the school-based immunization program. Many countries are implementing school-based HPV vaccination [27], and this has demonstrated success, including in Rwanda, South Africa, and Zimbabwe [28–30]. This study underscores the importance of actively involving caregivers in these campaigns—and of recognizing the potential decision-making power of preadolescent girls. According to these respondents, children may be “voting with their feet” and avoiding school if they do not want to receive the HPV vaccine. In addition, per the World Health Organization, vaccination programs for youth must obtain parental informed consent [31]. This can include written consent forms, or opt-out procedures that inform parents about campaigns so that they can keep their child home from school that day if they do not consent to vaccination. For this latter “implied consent” approach to be ethically sound, the WHO encourages adopting specific procedures to ensure that parents are truly informed and consenting. Therefore, future programs should engage both caregivers and girls through multi-level strategies aimed at ensuring their involvement as informed and active vaccination decision-makers; promising approaches include offering interactive information sessions, training teachers to sensitize caregivers and girls, integrating additional health services into vaccination programs (such as cancer screening programs for women), and implementing communications strategies that involve local leaders and multi-media forms [15,19,32–37].

The impact of the COVID-19 pandemic on immunization coverage remains to be seen although our data suggest it has affected attitudes about, and access to, the HPV vaccine. Many countries saw disruptions to vaccination programs, including HPV vaccination, particularly early in the pandemic, although these disruptions varied greatly in extent, duration, and mitigation [38–43]. We urgently need more data about how the pandemic has affected attitudes about, access to, and norms around vaccines, particularly non-routine vaccination like the HPV vaccine, which may face different barriers than childhood vaccines due to its timing and setting. Likewise, understanding and addressing rumors and barriers related to the HPV vaccine may have positive spillover effects for existing and future vaccines.

This study suggests several policy and program implications. First, we need messages that resonate and respond to “what people think and feel”—i.e., caregivers' and girls' concerns about HPV vaccination—and these messages should be delivered by diverse, trusted messengers. In particular, safety issues and concerns (including misinformation) about infertility must be addressed; more research is needed on how to do this effectively, and who the “right” representative is for disseminating this information to different audiences. Second, the unique “social processes” and “practical issues” of school-based immunization programs need to be attended to, including deliberately engaging caregivers—at minimum according to WHO guidelines for consent [31], but ideally in a more thorough and active process that ensures their and their daughters' buy-in. In addition, HPV vaccination programs should also deliver the vaccine at different venues to reach out-of-school girls and those who are hesitant of school-based immunization. Lastly, with a deeper understanding of how the COVID-19 pandemic has affected all correlates of vaccine uptake—what people think and feel, social processes, and practical issues—we can develop effective catch-up strategies and better messaging and approaches in future emergencies.

There are some limitations to this study that should be noted. First, participants were recruited at health facilities and so represent people who have greater engagement with the health system, which may reflect more favorable attitudes about health behaviors and/or greater access to health services. This may be one reason why reported uptake of HPV vaccine among study respondents' daughters was much higher (60% of those with a known vaccination status had received 1 or more doses) than the Malawi national average (only 14% of age-eligible girls had received any doses of the HPV vaccine in 2021). Additionally, respondents' responses may have been subject to social desirability bias as respondents were recruited from health facilities and then asked about a health-related topic. Future research about HPV vaccination should recruit respondents from a variety of settings. Related, due to budgetary and logistical constraints, these interviews were conducted only in the Central and Southern regions of Malawi; future work should also include respondents from Northern Malawi, where cultural and other factors may affect experiences with HPV vaccination. Second, data were collected in November 2021, between two large surges of COVID-19 infections and deaths in Malawi and during the early months of COVID-19 vaccination. It is possible that vaccine attitudes and experiences may vary during different phases of the pandemic. However, this timing allowed us to delve into the potential impact of the pandemic and COVID-19 vaccines on HPV vaccination. Third, as girls in Malawi are eligible for vaccination between the ages of 9 and 14 (with 9-year-olds as the target population e.g. for school-based campaigns), some caregivers in this sample may be intending to vaccinate their daughter but have not yet done so; therefore, classification of girls' vaccination status is a cross-sectional measure that should be interpreted with caution. Lastly, it is possible that context-specific factors—such as Malawi's very high cervical cancer burden and high coverage of routine immunization—may limit the generalizability of these findings to other settings and environments.

#### 4.1. Implications for policy and practice

As countries consider approaches for offering HPV vaccine, this study highlights the merits of school-based vaccination, and underscores the importance of engaging parents through a deliberate process. Offering HPV vaccination in diverse venues may also give caregivers multiple opportunities to engage with trusted messengers about the vaccine. The most successful approach may be a multi-pronged strategy that combines year-round routine administration in the health system with periodic campaigns at schools and other local settings (e.g., faith organizations), and leverages other stakeholders – like local leaders and community health workers – to increase buy-in among caregivers and young people. In addition, most caregivers in this study had never spoken with a health care provider about the HPV vaccine. As provider recommendation is a critically important factor for promoting vaccination (including HPV [44]), proactive communication about the vaccine by health workers should be included in vaccination guidelines.

## 5. Conclusions

The HPV vaccine has enormous public health potential, particularly in settings like Malawi with an extremely high burden of cervical cancer. Through interviews with Malawian caregivers, we elucidated factors that may be associated with low uptake of the HPV vaccine. These include consistent understanding of the importance of cervical cancer prevention, alongside concerns about the vaccine's effect on girls' future fertility; mixed experiences with the school-based vaccination approach whereby some parents felt

it was convenient and others felt sidelined from the process; and complex impacts of the COVID-19 pandemic on correlates of HPV vaccine uptake. Future work should further explore this range of intra- and interpersonal determinants across low- and middle-income countries in order to design stronger policies and programs that will increase coverage of this life-saving vaccine in the settings where it is most urgently needed.

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## Data availability

The authors do not have permission to share data.

## Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Corrina Moucheraud reports financial support was provided by University of California Los Angeles Jonsson Comprehensive Cancer Center.

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