

# Delivery cost of human papillomavirus vaccination of young adolescent girls in Peru, Uganda and Viet Nam

Carol E Levin,<sup>a</sup> Hoang Van Minh,<sup>b</sup> John Odaga,<sup>c</sup> Swampa Sarit Rout,<sup>d</sup> Diep Nguyen Thi Ngoc,<sup>e</sup> Lysander Menezes,<sup>f</sup> Maria Ana Mendoza Araujo<sup>g</sup> & D Scott LaMontagne<sup>h</sup>

**Objective** To estimate the incremental delivery cost of human papillomavirus (HPV) vaccination of young adolescent girls in Peru, Uganda and Viet Nam.

**Methods** Data were collected from a sample of facilities that participated in five demonstration projects for HPV vaccine delivery: school-based delivery was used in Peru, Uganda and Viet Nam; health-centre-based delivery was also used in Viet Nam; and integrated delivery, which involved existing health services, was also used in Uganda. Microcosting methods were used to guide data collection on the use of resources (i.e. staff, supplies and equipment) and data were obtained from government, demonstration project and health centre administrative records. Delivery costs were expressed in 2009 United States dollars (US\$). Exclusively project-related expenses and the cost of the vaccine were excluded.

**Findings** The economic delivery cost per vaccine dose ranged from US\$ 1.44 for integrated outreach in Uganda to US\$ 3.88 for school-based delivery in Peru. In Viet Nam, the lowest cost per dose was US\$ 1.92 for health-centre-based delivery. Cost profiles revealed that, in general, the largest contributing factors were project start-up costs and recurrent personnel costs. The delivery cost of HPV vaccine was higher than published costs for traditional vaccines recommended by the Expanded Programme on Immunization (EPI).

**Conclusion** The cost of delivering HPV vaccine to young adolescent girls in Peru, Uganda and Viet Nam was higher than that for vaccines currently in the EPI schedule. The cost per vaccine dose was lower when delivery was integrated into existing health services.

Abstracts in [عربي](#), [中文](#), [Français](#), [Русский](#) and [Español](#) at the end of each article.

## Introduction

Cervical cancer is a major public health problem: globally it is associated with over 560 000 new cases and around 275 000 deaths each year, more than 85% of which are in developing countries.<sup>1</sup> Systematic, organized screening programmes for cervical cancer have had limited success in low-resource settings.<sup>2</sup> However, human papillomavirus (HPV) vaccines may offer a new strategy for prevention and recent studies indicate that vaccination can greatly reduce cervical cancer incidence and mortality.<sup>3,4</sup>

As developing countries consider whether they can afford to introduce HPV vaccination, much attention has focused on the private sector price of two currently available HPV vaccines: the quadrivalent and bivalent formulations. These vaccines cost more than 100 United States dollars (US\$) per dose, or more than US\$ 300 for the three-dose series. Reported prices in the public sector have been declining and, in 2011, the manufacturer of the quadrivalent vaccine offered it at US\$ 5 per dose to the GAVI Alliance for use in countries eligible for Alliance support. Low- and middle-income countries in Latin America can purchase HPV vaccine for US\$ 10–US\$ 15 per dose through the Revolving Fund of the Pan American Health Organization (PAHO). Young adolescent girls will benefit most from vaccine-based protection against cervical cancer because they are less likely than older girls to have been infected with

the HPV types targeted by the vaccine. Although the price per vaccine dose will remain a key consideration when deciding whether to introduce the HPV vaccine, national governments and donors must also take into account the additional resources required for vaccine delivery.<sup>3</sup>

Between 2006 and 2010, the non-profit global health organization PATH collaborated with the governments of Peru, Uganda and Viet Nam to collect evidence that would assist government decision-making on whether and how to introduce HPV vaccination. The results of formative research<sup>5</sup> were used to design demonstration projects of different types of vaccine delivery in partnership with each country's ministry of health, subnational health and education sectors and other key stakeholders.<sup>6–10</sup> Three delivery strategies were investigated: school-based outreach, health-centre-based outreach and integrated outreach, which made use of existing health services. The eligible population was selected by either school grade or age. The areas of implementation were limited geographically but large enough to cover complete administrative districts and to be broadly representative of each country's population, thereby providing models that were suitable for scaling up in the future.

The strategies used in demonstration projects achieved high coverage among young adolescent girls and were found to be acceptable and feasible.<sup>11–17</sup> For school-based outreach, vaccine coverage was 82.6% in Peru, 88.9% in Uganda and

<sup>a</sup> Department of Global Health, University of Washington, 325 Ninth Avenue, Box 359931, Seattle, Washington, 98104, United States of America (USA).

<sup>b</sup> Department of Health Economics, Hanoi Medical University, Hanoi, Viet Nam.

<sup>c</sup> Child Health and Development Centre, Makerere University, Kampala, Uganda.

<sup>d</sup> Centre for Operations Research and Training, Vadodara, India.

<sup>e</sup> PATH, Hanoi, Viet Nam.

<sup>f</sup> PATH, New Delhi, India.

<sup>g</sup> Estrategia Sanitaria Nacional de Inmunización (National Expanded Programme for Immunization), Ministry of Health, Lima, Peru.

<sup>h</sup> PATH, Seattle, USA.

Correspondence to Carol E Levin (email: clevin@uw.edu).

(Submitted: 4 October 2012 – Revised version received: 30 April 2013 – Accepted: 2 May 2013 – Published online: 19 June 2013)

Table 1. Human papillomavirus vaccination of young adolescent girls in Peru, Uganda and Viet Nam, 2008–2010

Country and delivery strategy	Implementation year	Geographical area	Demonstration project			Current study
			No. of eligible girls <sup>a</sup>	No. of participating schools	No. of participating health centres	No. of facilities selected <sup>b</sup>
<b>Peru</b>	–	–	–	264	161	12
School-based	2008	Piura region	8092	–	–	–
<b>Uganda</b>	–	–	–	417	69	14
School-based	2008	Ibanda district	3459	–	–	–
	2009	Ibanda district	2835 <sup>c</sup>	–	–	–
Integrated outreach	2008–2009	Nakasongola district	2263 <sup>d</sup>	–	–	–
	2009	Nakasongola district	1923 <sup>c</sup>	–	–	–
<b>Viet Nam</b>	–	–	–	38	72	12
School-based	2008–2009	Quan Hoa, Nong Cong and Ninh Kieu districts	2412	–	–	–
	2009–2010	Quan Hoa, Nong Cong and Ninh Kieu districts	1890 <sup>c</sup>	–	–	–
Health-centre-based	2008–2009	Quan Hoa, Nong Cong and Binh Thuy districts	1507	–	–	–
	2009–2010	Quan Hoa, Nong Cong and Binh Thuy districts	1205 <sup>c</sup>	–	–	–

<sup>a</sup> The number of eligible girls was determined by counting and creating a list of those eligible at the facilities participating in the human papillomavirus vaccination (HPV) demonstration projects before administration of the first vaccine dose.

<sup>b</sup> The current study investigated the feasibility and cost of HPV vaccination strategies in a selection of facilities participating in the demonstration projects.

<sup>c</sup> The decrease from the first time period occurred because of population movements, primarily emigration.

<sup>d</sup> The figure was derived from a census estimate of girls aged 10 years rather than by a head count.

Source: Adapted from LaMontagne et al.<sup>11</sup>

87.8% in Viet Nam. In one project in Uganda, the HPV vaccination programme was integrated with Child Days Plus, a campaign that involves delivering vitamin A supplementation with one or more other child health services, and achieved 60.7% vaccine coverage. Full details of the demonstration projects' structures and the vaccine strategies used are published elsewhere.<sup>11</sup>

The primary objective of this study was to report data on the cost of different HPV vaccination strategies for young adolescent girls, a group that is not routinely targeted by other vaccinations or health interventions.<sup>18,19</sup> The data were obtained from demonstration projects in Peru, Uganda and Viet Nam. A secondary objective was to estimate the financial cost of implementing national HPV vaccination programmes in these countries.

## Methods

The feasibility and cost of HPV vaccination in young adolescent girls was assessed in a sample of the facilities that took part in demonstration projects in Peru, Uganda and Viet Nam.<sup>12,15</sup> Facilities were selected on the basis of criteria associated with the geographical loca-

tion and size of each facility, its expected workload and differences in coverage rates for diphtheria, tetanus and pertussis immunization. Details of the facilities surveyed for the cost analysis in each country are given in Table 1. In addition to the facility surveys, interviews were carried out with Expanded Programme on Immunization (EPI) managers at national, state or regional, provincial, and district or block administrative levels.

Cost data were collected using the ingredients-based costing methods recommended by World Health Organization (WHO) guidelines.<sup>20</sup> After the second or third round of HPV vaccination, project staff interviewed EPI managers and health-care personnel about the resources used for the most recent vaccination round. Data were obtained by direct observation on, for example, the activities of, and time spent by, personnel during community mobilization and vaccination sessions, the cold-chain equipment used to store HPV vaccine and the types of vehicle used to distribute vaccine or transport health-care workers to vaccination sites. These data were combined with price and expenditure data to estimate start-up and recurrent costs for service delivery. The potential financial costs

of scaling up HPV vaccination were estimated by extrapolating the data collected on resource use and costs. Any expenses related to project activities that would not normally have occurred during the introduction of a new vaccine, such as extensive planning, supervision, coordination and evaluation, were excluded from the analysis.

In all countries, start-up activities were carried out in accordance with WHO guidelines for the introduction of a new vaccine.<sup>21</sup> Activities included microplanning; information, education and communication; training of health-care workers; and community mobilization and sensitization. Start-up costs were treated as fixed costs because, although start-up activities typically occur in the first or second year of a vaccine's introduction, they influence the provision and use of services beyond the pilot phase. Our analysis included all expenses associated with training workshops, except the salaries of the health-care workers who received training. Start-up costs were estimated for each level of the health-care system, annualized over 5 years and distributed proportionately across the number of doses delivered in the three vaccination rounds.

Recurrent costs comprised the cost of: staff time required for HPV vaccina-

tion, including salaries and allowances; injection devices and supplies; waste disposal and management; and vaccine transport, storage and distribution. In all three countries, health-care workers received a per diem payment and travel allowances for HPV vaccination, regardless of the delivery strategy.

Annualized depreciation for capital goods was calculated for the vehicles and cold-chain equipment required to transport and store vaccines. The number of useful life-years of capital goods varied by country and depended on the type of vehicle or cold chain equipment used. A standard discount rate of 3% was used to annualize capital costs. Cost data were collected in each country's national currency and converted to US\$ using the exchange rate for the year of collection: US\$ 1.00 equalled 3.1 Peruvian soles in 2008, 1946 Ugandan shillings in 2009 and 19 000 Vietnamese dong in 2010. All cost estimates were adjusted to 2009 US\$ using the Consumer Price Index.<sup>22</sup>

The cost analysis was performed from a government perspective and we assumed that a national HPV vaccination programme would provide vaccine without cost to beneficiaries. For each country, we calculated the economic cost, which was defined as the cost of all resources used regardless of payer, from the average cost per dose for the resources used at the health centre level and added the average cost per dose for the resources used at the national, state or regional, provincial, and district or block level, by geographical region. In estimating the total economic cost of

the vaccination programme, we derived a weighted average cost per dose, which took into account the population living in different zones in each geographical region, and multiplied it by the total number of doses delivered. Subsequently, the incremental cost per fully immunized girl was calculated by dividing the total economic cost by the number of girls who received all three vaccine doses. In our study, the calculation took into account the dropout rate between doses, which was less than 3% in Peru and Viet Nam and 6% in Uganda.

We also estimated the annual incremental financial outlay needed to implement a nationwide HPV vaccination programme, where the financial outlay was defined as the actual expenditure on all goods and services. Since we assumed that currently available human resources and the capacity of the existing vaccine supply chain were sufficient for the programme, we omitted capital depreciation and salary costs shared with existing immunization or other health services. We applied the financial delivery cost per dose to a single cohort of 10-year-old girls and assumed 80% coverage, as this was the average coverage achieved in the demonstration projects.<sup>11</sup> We also included vaccine costs: the cost per dose for Uganda and Viet Nam was US\$ 0.20, which is the current country co-payment for the procurement of vaccines for poor and intermediate countries through the GAVI Alliance; the cost for Peru was US\$ 14.00 per dose, which is the cost for middle-income developing countries through PAHO's

Revolving Fund.<sup>23,24</sup> In accordance with GAVI Alliance policy,<sup>24,25</sup> a handling fee of 4% was added to the value of the co-payment for Uganda and Viet Nam. For Peru, a 3% PAHO Revolving Fund fee and a 3% supplement for freight and insurance were added to the cost of the vaccine.<sup>26</sup> Also added was a 5% allowance for wastage in all countries.

Table 2 presents the number of doses administered and the number of girls who were fully immunized in the demonstration projects, by country and vaccination strategy, and lists the economic and financial costs of vaccination derived using these figures. Data were processed and analysed using Excel (Microsoft, Redmond, United States of America).

## Results

The average economic delivery cost per HPV vaccine dose ranged from US\$ 1.44 for integrated outreach in Uganda to US\$ 3.88 for school-based outreach in Peru (Table 2). In general, vaccination programmes delivered in schools had a higher economic cost than those delivered in health centres or via integrated outreach. However, in Viet Nam there was only a small difference in economic cost between school-based outreach and health-centre-based outreach: US\$ 2.08 versus US\$ 1.92 per dose, respectively. A larger difference in cost between delivery strategies was observed in Uganda: the economic cost of school-based outreach was US\$ 3.15 per dose, compared with US\$ 1.44 per

Table 2. Incremental cost of delivering human papillomavirus vaccine to young adolescent girls in demonstration projects in Peru, Uganda and Viet Nam, 2008–2010

Country and delivery strategy	Average delivery cost per dose (2009 US\$)		No. of doses administered each year	No. of fully immunized girls <sup>a</sup>	Annual delivery costs <sup>b</sup> (2009 US\$)	
	Economic <sup>c</sup>	Financial <sup>d</sup>			Economic <sup>c</sup>	Financial <sup>d</sup>
<b>Peru</b>						
School-based	3.88	2.03	26 798	8 895	103 976	54 400
<b>Uganda</b>						
School-based	3.15	2.10	9 729	3 038	30 646	20 431
Integrated outreach	1.44	1.11	8 624	2 388	12 419	9 573
<b>Viet Nam</b>						
School-based	2.08	1.62	5 324	1 766	11 074	8 625
Health-centre-based	1.92	1.55	3 550	1 181	6 816	5 503

US\$, United States dollars.

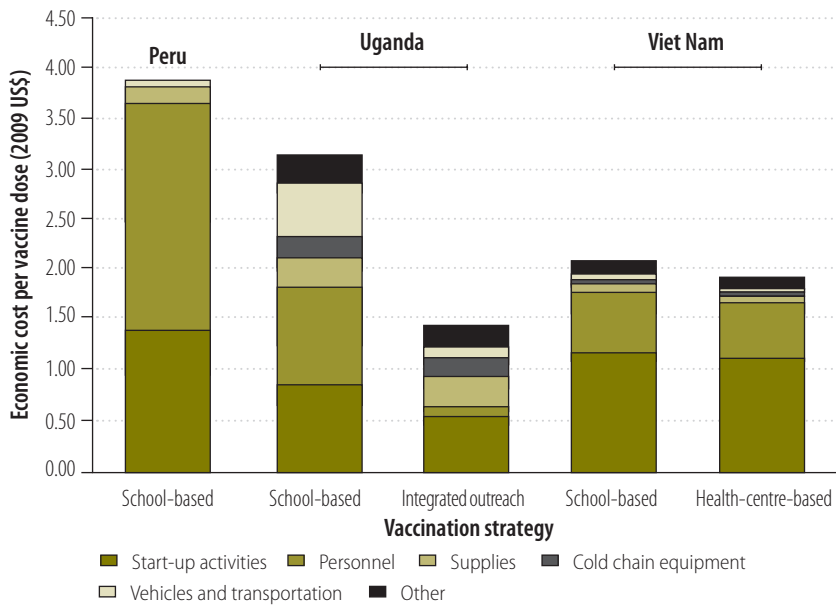
<sup>a</sup> A fully immunized girl was one who received all three vaccine doses.

<sup>b</sup> Annual delivery costs for the demonstration projects do not include the cost of the vaccine.

<sup>c</sup> The economic delivery cost was defined as the cost of all resources used, including donated or discounted goods and services, regardless of who paid.

<sup>d</sup> The financial delivery cost was defined as the actual expenditure on goods and services.

Fig. 1. Profile of the economic cost of human papillomavirus vaccination strategies for young adolescent girls, Peru, Uganda and Viet Nam, 2008–2010



US\$, United States dollars.

dose for integrated outreach. The average incremental economic cost per fully immunized girl was highest with school-based outreach in Peru and Uganda, at US\$ 11.69 and US\$ 10.09, respectively; it was lowest with integrated outreach in Uganda, at US\$ 5.20.

The average financial delivery cost per dose was both highest and lowest in Uganda: US\$ 1.11 with integrated outreach and US\$ 2.10 with school-based outreach. Correspondingly, the average financial cost per fully immunized girl in the country ranged from US\$ 4.01 with integrated outreach to US\$ 6.73 for school-based outreach.

The profiles of the economic cost of an HPV vaccine dose for different delivery strategies in Peru, Uganda and Viet Nam are shown in Fig. 1. Start-up costs contributed the largest share – approximately 60% – of the cost for the two delivery strategies used in Viet Nam but only 30 to 40% of the cost in Peru and Uganda. Information, education and communication activities and community mobilization and sensitization accounted for approximately 40% of start-up costs, whereas staff training and microplanning accounted for 25 to 30%. All other costs were classified as recurrent delivery costs. Personnel costs formed the largest component of these costs, except for integrated outreach in Uganda, where salary costs were low

because they were shared with the Child Days Plus campaign. Other important recurrent costs were associated with monitoring the programme and facilitating adverse event reporting.

More detailed profiles of both economic and financial costs are provided in Appendices A, B, C, D and E (available at: <http://www.rho.org/files/PATH-WHO-Bulletin-HPV-vac-delivery-costs-appendices-2012.pdf>). The profiles of financial and economic costs were similar. The largest component of the financial costs was the start-up costs, followed by personnel allowances and the cost of supplies.

### Outlay for national programmes

The incremental annual financial outlays needed in Peru, Uganda and Viet Nam to implement nationwide HPV vaccination programmes that would achieve 80% coverage are shown in Table 3. The highest financial outlay was for school-based outreach in Peru: US\$ 14 438 519, which comprised 13% of the country's total estimated budget for immunization in 2009. The lowest outlay was for integrated outreach in Uganda: US\$ 1 400 179 or 4% of the planned immunization budget for 2009. School-based outreach in Uganda would cost US\$ 2 443 243 (i.e. 7% of the immunization budget). In Viet Nam, school-based outreach would cost slightly more than health-centre-based

outreach and both strategies would have accounted for 10 to 11% of the country's immunization budget in 2009.

## Discussion

This analysis provides new information on the delivery cost of HPV vaccination in three low-resource countries that used school-based, health-centre-based and integrated outreach for vaccine delivery. The average economic delivery cost per dose of fully vaccinating around 80% of eligible girls ranged from US\$ 1.44 for integrated outreach in Uganda to US\$ 3.88 for school-based outreach in Peru. These figures are higher than the published cost of delivering vaccines in traditional EPI schedules, which ranges from US\$ 0.75 to US\$ 1.40 per dose, depending on vaccine, country and the year of the study.<sup>27–32</sup>

In Uganda, school-based outreach cost more than integrated outreach primarily because of personnel (e.g. payment for travelling time and allowances) and transportation costs. However, coverage was higher with school-based outreach than integrated outreach: 88.9% versus 60.9%, respectively. In Viet Nam, the difference in the cost of school- and health-centre-based strategies was not as great because each required substantial personnel time and other resources to raise awareness among teachers, parents and communities about the benefits of HPV vaccine.

Our findings are consistent with those reported in the literature, which show that the cost of vaccination per fully immunized child varies according to the mix of delivery strategies used, the cost of key inputs (e.g. personnel and transportation) and the scale of the programme.<sup>32</sup> In addition, the variation in cost reflects several key contextual factors, such as national income level, which affects public health service costs and personnel salaries, and health system policies and programmes, which influence country-specific implementation plans and lead to variations in resource use.<sup>6–10,12</sup> For example, countries used a variety of approaches and materials for microplanning, community sensitization, raising awareness and staff training. In Peru, Uganda and Viet Nam, national immunization programmes scheduled separate microplanning and training activities for HPV vaccination at multiple tiers of the health system rather than integrating

Table 3. Incremental annual financial cost of nationwide human papillomavirus vaccination for young adolescent girls, Peru, Uganda and Viet Nam, 2008–2010

Country and delivery strategy	No. of girls targeted for vaccination <sup>a</sup>	Cost (2009 US\$)				National immunization budget in 2009 <sup>b</sup>	
		Vaccine <sup>c</sup>	Vaccine delivery	Total	Delivery cost as a fraction of total cost (%)	Total (2009 US\$)	Percentage allocated to vaccination strategy
<b>Peru</b>	228 480	–	–	–	–	113 963 713	–
School-based	–	13 047 076	1 391 443	14 438 519	10	NA	13
<b>Uganda</b>	351 200	–	–	–	–	35 672 010	–
School-based	–	230 683	2 212 560	2 443 243	91	–	7
Integrated outreach	–	230 683	1 169 496	1 400 179	84	–	4
<b>Viet Nam</b>	534 720	–	–	–	–	28 083 812	–
School-based	–	351 227	2 598 739	2 949 966	88	–	11
Health-centre-based	–	351 227	2 486 448	2 837 675	88	–	10

NA, not available; US\$, United States dollars.

<sup>a</sup> The number of 10-year-old girls in each country was estimated using United Nations Development Programme population data. The number targeted was 80% of that number because it was assumed that only 80% would be fully vaccinated (i.e. would receive three vaccine doses).

<sup>b</sup> For Uganda and Viet Nam, the figure was derived from government multi-year plans; for Peru, information obtained from the National Expanded Program for Immunization was used.

<sup>c</sup> Each vaccine dose was assumed to cost US\$ 14.00 for Peru and US\$ 0.20 for Uganda and Viet Nam (US\$ 0.20 is the current country co-payment for the procurement of vaccines for poor and intermediate countries through the GAVI Alliance). For Peru, a 3% Pan American Health Organization Revolving Fund fee and 3% supplement for freight and insurance was added. For Uganda and Viet Nam, a 4% handling fee was added. A 5% allowance was added for wastage in all countries.

them with scheduled meetings and used an established training-of-trainers strategy. In addition, in the demonstration projects, even workers based at health centres received per diem payments for the days on which they administered HPV vaccine to girls.

Start-up costs were high for the demonstration projects in all countries, with the bulk of these costs being due to activities for raising awareness and community mobilization. Investment in communications increased the community's acceptance of vaccination, which translated into a high vaccine uptake.<sup>33</sup> The cost of introducing new vaccines was similarly high in other settings. For example, the start-up cost for the pentavalent vaccine in Ethiopia was an additional US\$ 4.7 million, or US\$ 1.50 per fully vaccinated child.<sup>34</sup> In Cambodia, the introduction of Japanese encephalitis vaccine cost approximately US\$ 1.50 per child, or 60% of the total cost per child vaccinated.<sup>35</sup>

The economies of scale that occur in national HPV vaccination programmes mean that the unit cost of the development and production of materials for information, education and communication, and for training and the unit cost of community mobilization meetings at the national or subnational levels, are likely to be lower than in a demonstration project. Since the costs of these activities tends to be fixed, they will be spread over a higher number of deliv-

ered doses when a country's vaccination programme is scaled up, resulting in a lower unit cost per dose. In addition, total start-up costs should also decline, depending on how quickly a country decides to introduce and scale up HPV vaccination.

Evidence from the HPV vaccine demonstration projects indicates that the cost per dose was lower when vaccine delivery was integrated into existing health services. For example, in Uganda, personnel and transportation costs were lower with integrated outreach than school-based outreach because HPV vaccination took place alongside an existing programme delivering other health services. Integrating the distribution of HPV vaccine and injection devices with the distribution of other EPI vaccines and immunization supplies is likely to reduce the delivery cost per dose. However, any reduction will depend on existing vaccine storage and transport capacity in the country and on whether the HPV vaccine is introduced in conjunction with other new vaccines, such as rotavirus or pneumococcal vaccine.

In the immediate future, considerable government support will be needed to pay for the delivery of HPV vaccine as well as for its purchase through either the GAVI Alliance or another public sector provider. Although immunization budgets have been increasing recently in countries that took part in the dem-

onstration projects, national decision-makers have noted that co-financing a national HPV vaccination programme is challenging.<sup>32</sup> Our analysis indicates that introducing HPV vaccination for young adolescent girls could increase national immunization budgets by 5 to 13%. Consequently, countries will need to allocate public health resources and seek greater support from external donors to cover these costs. Peru increased its national immunization budget by 500% between 2006 and 2010<sup>36</sup> and, in 2011, the country successfully funded and launched a nationwide HPV vaccination programme.<sup>37</sup> In 2012, the GAVI Alliance announced support for introducing the HPV vaccine in low-income countries and Uganda has applied for continued support.<sup>38,39</sup>

Our cost estimates for countries that took part in the demonstration projects have several limitations. First, in some instances it was not possible to identify all the costs that were integral to the projects but that may not make up the same proportion of the costs for a national immunization campaign. Second, although the same methods were used for all countries and costs were calculated in the same way, some costs may have been unique to a particular country and may have affected both the absolute cost per dose and the cost profile. Third, we omitted labour costs for volunteers who participated in community mobilization and for the

time health-care workers spent in training or microplanning sessions. These costs are likely to vary across countries and their inclusion may change relative costs and cost profiles. Finally, the estimated financial outlays for introducing national HPV vaccination programmes are merely indicative, since scaling up a programme to the national level may involve additional costs related to the development of a comprehensive cervical cancer prevention programme and

to investment in human and capital resources that are not captured in this analysis.

In conclusion, the cost of delivering HPV vaccine to young adolescent girls is likely to be higher than the cost of delivering vaccines currently included in the EPI schedule but may decline as delivery becomes integrated into immunization and school-based health services. Our findings can assist donors and national governments estimate

budgetary requirements and can provide information on the resources needed to introduce and eventually scale up HPV vaccination. ■

**Funding:** This project was funded in whole by a grant from the Bill & Melinda Gates Foundation.

**Competing interests:** None declared.

## ملخص

تكاليف إيتاء التطعيم ضد فيروس الورم الحليمي البشري للفتيات المراهقات صغيرات السن في بيرو وأوغندا وفيت نام الغرض تقدير تكلفة الإيتاء التكميلية للتطعيم ضد فيروس الورم الحليمي البشري للفتيات المراهقات صغيرات السن في بيرو وأوغندا وفيت نام. الطريقة تم جمع البيانات من عينة من المرافق التي شاركت في خمسة مشاريع إيضاحية لإيتاء لقاح فيروس الورم الحليمي البشري: تم استخدام الإيتاء المستند على المدارس في بيرو وأوغندا وفيت نام؛ وتم كذلك استخدام الإيتاء المستند على المراكز الصحية في فيت نام؛ كما تم استخدام الإيتاء المتكامل، الذي اشتمل على الخدمات الصحية القائمة، في أوغندا. وتم استخدام طرق التكاليف الجزئية لتوجيه جمع البيانات بشأن استغلال الموارد (أي الموظفين والإمدادات والمعدات) وتم الحصول على البيانات من السجلات الإدارية الخاصة بالحكومة أو المشاريع إيضاحية أو المراكز الصحية. وتم التعبير عن تكاليف الإيتاء بمبلغ 2009 دولاراً أمريكياً. وتم استبعاد النفقات المرتبطة بالمشروع على نحو حصري وتكلفة اللقاح.

## 摘要

秘魯、烏干達和越南年輕少女的人類乳頭狀瘤病毒疫苗的配送成本

**目的** 估算秘魯、烏干達和越南年輕少女的人類乳頭狀瘤病毒 (HPV) 疫苗的配送成本。

**方法** 從參與五個 HPV 疫苗配送示範項目的設施樣本中收集數據：秘魯、烏干達和越南使用基於學校的配送；越南還使用基於健康中心的配送；烏干達還使用包含現有衛生服務的综合配送。使用微成本計算方法指導資源（即人員、物資和設備）使用相關數據的收集並從政府、示範項目和健康中心行政記錄中獲取數據。以 2009 年美元表示配送成本。不含項目相關的專項費用和疫苗的成本。

**結果** 每劑疫苗的经济配送成本為從烏干達综合推廣的 1.44 美元到秘魯基於學校配送的 3.88 美元不等。在越南，基於健康中心的最低每劑配送成本是 1.92 美元。成本資料顯示，一般來說，最大的影响因素是項目启动成本和經常性人力成本。HPV 疫苗的配送成本高於由疫苗擴大免疫规划 (EPI) 建議的传统疫苗公开成本。

**結論** 秘魯、烏干達和越南年輕少女 HPV 疫苗配送成本高於 EPI 规划当前的疫苗成本。如果將配送集成到現有衛生服務中，則每劑成本較低。

## Résumé

**Coûts d'administration du vaccin contre le papillomavirus humain chez les jeunes adolescentes au Pérou, en Ouganda et au Viet Nam**

**Objectif** Estimer les coûts d'administration croissants du vaccin contre le papillomavirus humain (VPH) chez les jeunes adolescentes au Pérou, en Ouganda et au Viet Nam.

**Méthodes** Des données ont été recueillies auprès d'un échantillon d'établissements qui ont participé à cinq projets de démonstration de l'administration du vaccin contre le VPH: un mode d'administration en milieu scolaire a été utilisé au Pérou, en Ouganda et au Viet Nam, un

mode d'administration dans un centre de santé a également été utilisé au Viet Nam, et un mode d'administration intégrée, qui a impliqué les services de santé existants, a également été utilisé en Ouganda. Une approche verticale ascendante (Microcosting) a été utilisée pour guider la collecte de données sur l'utilisation des ressources (personnel, fournitures et équipement), et d'autres données ont été obtenues auprès des gouvernements, et dans les dossiers administratifs des centres de

santé et des projets de démonstration. Les coûts d'administration sont exprimés en dollars des États-Unis (\$) de 2009. Seules les dépenses liées au projet et les coûts du vaccin ont été exclus.

**Résultats** Le coût économique d'administration par dose de vaccin variait de 1,44 \$ pour une administration intégrée en Ouganda, à 3,88 \$ pour une administration en milieu scolaire au Pérou. Au Viet Nam, le coût le plus bas par dose était de 1,92 \$ pour une administration dans un centre de santé. Le profil des coûts a révélé qu'en général, les facteurs les plus importants étaient les coûts de démarrage du projet et les coûts

récurrents du personnel. Les coûts d'administration du vaccin contre le VPH sont plus élevés que les coûts indiqués pour les vaccins traditionnels recommandés par le Programme d'immunisation élargi (PIE).

**Conclusion** Les coûts d'administration du vaccin contre le VPH chez les jeunes adolescentes au Pérou, en Ouganda et au Viet Nam étaient supérieurs à ceux des vaccins actuellement indiqués dans le calendrier du PIE. Le coût par dose de vaccin était le plus bas lorsque l'administration du vaccin était réalisée dans les services de santé existants.

## Резюме

### Стоимость вакцинации против вируса папилломы человека среди девушек-подростков в Перу, Уганде и Вьетнаме

**Цель** Оценить увеличение стоимости вакцинации против вируса папилломы человека (ВПЧ) среди девушек в подростковом возрасте в Перу, Уганде и Вьетнаме.

**Методы** Данные были собраны в отдельных выбранных учреждениях, которые принимали участие в пяти демонстрационных проектах по проведению вакцинации против ВПЧ. В Перу, Уганде и Вьетнаме вакцинация проводилась в школах, во Вьетнаме также проводилась вакцинация в медицинских учреждениях. В Уганде также использовалась комплексная вакцинация, с привлечением доступного медицинского обслуживания. Были использованы методы с минимальными затратами на проведение сбора данных по используемым ресурсам (т.е. сотрудникам, материалам и оборудованию), данные также были получены из административных записей государственных учреждений, демонстрационных проектов и центров здравоохранения. Стоимость вакцинации была выражена в 2009 году в долларах США. Расходы, относящиеся исключительно к организации проведения проекта и стоимость

самой вакцины были исключены.

**Результаты** С экономической точки зрения стоимость вакцинации в расчете на одну дозу варьировалась от 1,44 доллара США для комплексных мероприятий в Уганде до 3,88 долларов США для вакцинации в школах в Перу. Во Вьетнаме самая низкая стоимость дозы составила 1,92 доллара США для вакцинации в центрах здравоохранения. Динамика затрат указывает на то, что в целом наиболее затратными статьями были расходы на организацию проекта и циклическое привлечение персонала. Стоимость проведения вакцинации против ВПЧ была выше опубликованных расходов на традиционные вакцины, рекомендуемые Расширенной программой иммунизации (РПИ).

**Вывод** Стоимость вакцинации против ВПЧ среди девушек-подростков в Перу, Уганде и Вьетнаме была выше стоимости вакцин, запланированных в настоящее время РПИ. Стоимость дозы вакцины была ниже, когда вакцинация проводилась в рамках комплексных мероприятий существующих служб здравоохранения.

## Resumen

### Gastos de la administración de la vacuna contra el virus del papiloma humano a adolescentes mujeres en Perú, Uganda y Viet Nam

**Objetivo** Estimar el incremento del coste de la administración de la vacuna contra el virus del papiloma humano (VPH) a adolescentes mujeres en Perú, Uganda y Viet Nam.

**Métodos** Se recabaron datos a partir de una muestra de los centros que participaron en cinco proyectos de demostración sobre la administración de la vacuna contra el VPH: en Perú, Uganda y Viet Nam, la administración se efectuó en la escuela; la prestación de asistencia sanitaria en centros de salud se realizó también en Viet Nam; y la entrega administración, que incluía los servicios de salud existentes, también se realizó en Uganda. Se emplearon métodos de microcosteo para orientar la recolección de datos sobre el uso de los recursos (es decir, el personal, los suministros y los equipos). Los datos se obtuvieron del gobierno, de los proyectos de demostración y los registros administrativos del centro de salud. Los gastos de administración se expresaron en 2009 dólares de los Estados Unidos (US\$). Se excluyeron los gastos derivados exclusivamente del

proyecto y del coste de las vacunas.

**Resultados** El coste del envío económico por dosis de vacuna varió de US\$ 1,44, en la difusión integrada en Uganda, a US\$ 3,88 en la entrega en las escuelas en Perú. En Viet Nam, el coste más bajo por dosis fue de US\$ 1,92 para la prestación de asistencia en centros sanitarios. Los perfiles de costes revelaron que, en general, los factores que más contribuyen son los costes de la puesta en marcha del proyecto y los del personal constante. El coste de administración de la vacuna contra el VPH fue mayor que los costes publicados de las vacunas tradicionales recomendadas por el Programa Ampliado de Inmunización (PAI).

**Conclusión** El coste de la entrega de vacunas contra el VPH a las adolescentes jóvenes en Perú, Uganda y Vietnam fue mayor que el de las vacunas incluidas actualmente en el programa de EPI. El coste por dosis de vacuna fue menor cuando la entrega estaba integrada en los servicios de salud actuales.

## References

1. Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *Int J Cancer* 2010;127:2893–917. doi: <http://dx.doi.org/10.1002/ijc.25516> PMID:21351269
2. World Health Organization [Internet]. Immunization, vaccines and biologicals. Human papillomavirus (HPV). Geneva: World Health Organization. Available from: <http://www.who.int/immunization/topics/hpv/en/> [accessed 16 June 2013].
3. Goldie SJ, O'Shea M, Campos NG, Diaz M, Sweet S, Kim SY. Health and economic outcomes of HPV 16,18 vaccination in 72 GAVI-eligible countries. *Vaccine* 2008;26:4080–93. doi: <http://dx.doi.org/10.1016/j.vaccine.2008.04.053> PMID:18550229
4. Marra F, Cloutier K, Oteng B, Marra C, Ogilvie G. Effectiveness and cost effectiveness of human papillomavirus vaccine: a systematic review. *Pharmacoeconomics* 2009;27:127–47. doi: <http://dx.doi.org/10.2165/00019053-200927020-00004> PMID:19254046

5. Bingham A, Janmohamed A, Bartolini R, Creed-Kanashiro H, Katahoire A, Khan I et al. An approach to formative research in HPV vaccine introduction planning in low-resource settings. *Open Vaccine J* 2009;2:1–16. doi: <http://dx.doi.org/10.2174/1875035400902010001>
6. Katahoire RA, Jitta J, Kivumbi G, Murokora D, Arube WJ, Siu G et al. An assessment of the readiness for introduction of the HPV vaccine in Uganda. *Afr J Reprod Health* 2008;12:159–72. PMID:19435020
7. Bartolini RM, Drake JK, Creed-Kanashiro HM, Díaz-Otaya MM, Mosqueira-Lovón NR, Penny ME et al. Investigación formativa para diseñar estrategias para la introducción de la vacuna contra el VPH en el Perú. [Formative research to shape HPV vaccine introduction strategies in Peru]. *Salud Publica Mex* 2010;52:226–33. Spanish doi: <http://dx.doi.org/http://dx.10.1590/S0036-36342010000300007>
8. Nghi NQ, Lamontagne DS, Bingham A, Rafiq M, Mai TP, Lien N et al. Human papillomavirus vaccine introduction in Vietnam: formative research findings. *Sex Health* 2010;7:262–70. doi: <http://dx.doi.org/10.1071/SH09123> PMID:20719213
9. Jacob M, Mawar N, Menezes L, Kaipilyawar S, Gandhi S, Khan I et al. Assessing the environment for introduction of human papillomavirus vaccine in India. *Open Vaccine J* 2010;3:96–107. doi: <http://dx.doi.org/10.2174/1875035401003010096>
10. Biellik R, Levin C, Mugisha E, LaMontagne DS, Bingham A, Kaipilyawar S et al. Health systems and immunization financing for human papillomavirus vaccine introduction in low-resource settings. *Vaccine* 2009;27:6203–9. doi: <http://dx.doi.org/10.1016/j.vaccine.2009.08.003> PMID:19698808
11. LaMontagne DS, Barge S, Le NT, Mugisha E, Penny ME, Gandhi S et al. Human papillomavirus vaccine delivery strategies that achieved high coverage in low- and middle-income countries. *Bull World Health Organ* 2011;89:821–830B.
12. Penny M, Bartolini R, Mosqueira NR, LaMontagne DS, Mendoza MA, Ramos I et al. Strategies to vaccinate against cancer of the cervix: feasibility of a school-based HPV vaccination program in Peru. *Vaccine* 2011;29:5022–30. doi: <http://dx.doi.org/10.1016/j.vaccine.2011.04.078> PMID:21609748
13. Bartolini RM, Winkler JL, Penny ME, LaMontagne DS. Parental acceptance of HPV vaccine in Peru: a decision framework. *PLoS One* 2012;7:e48017. doi: <http://dx.doi.org/10.1371/journal.pone.0048017> PMID:23144719
14. Cover JK, Nghi NQ, LaMontagne DS, Huyen DT, Hien NT, Nga T. Acceptance patterns and decision-making for human papillomavirus vaccination among parents in Vietnam: an in-depth qualitative study post-vaccination. *BMC Public Health* 2012;12:629. doi: <http://dx.doi.org/10.1186/1471-2458-12-629> PMID:22877158
15. PATH, National Institute of Hygiene and Epidemiology & National Center for Health Education and Communication. *HPV vaccination in Southeast Asia: lessons learned from a pilot program in Vietnam*. Seattle: PATH; 2012. Available from: [http://www.rho.org/files/rb4/HPV\\_lessons\\_learned\\_Vietnam\\_PATH\\_2012.pdf](http://www.rho.org/files/rb4/HPV_lessons_learned_Vietnam_PATH_2012.pdf) [accessed 16 June 2013].
16. Katahoire AR, Murokora D, Arube-Wani J, Mugisha E, LaMontagne DS. Acceptability of HPV vaccine among young adolescent girls in Uganda: young people's perspectives count. *Int J Child Adolesc Health* 2013;6. In press.
17. PATH, Child Health and Development Centre & Uganda National Expanded Program on Immunization. *HPV vaccination in Africa: lessons learned from a pilot program in Uganda*. Seattle: PATH; 2011. Available from: [http://www.rho.org/files/rb2/HPV\\_lessons\\_learned\\_Uganda\\_PATH\\_2011.pdf](http://www.rho.org/files/rb2/HPV_lessons_learned_Uganda_PATH_2011.pdf) [accessed 16 June 2013].
18. *HPV vaccine adoption in developing countries: cost and financing issues*. New York & Seattle: International AIDS Vaccine Initiative & PATH; 2007.
19. Temin M, Levin R. *Start with a girl: a new agenda for global health*. Washington: Center for Global Development; 2009. Available from: [www.cgdev.org/files/1422899\\_file\\_Start\\_with\\_a\\_Girl\\_FINAL.pdf](http://www.cgdev.org/files/1422899_file_Start_with_a_Girl_FINAL.pdf) [accessed 7 June 2013].
20. *Guidelines for estimating costs of introducing new vaccines into the national immunization system*. Geneva: World Health Organization; 2002 (WHO/V&B/02.11).
21. *Preparing for the introduction of HPV vaccines: policy and programme guidance for countries*. Geneva: World Health Organization; 2006.
22. The World Bank [Internet]. Consumer price index (2005 = 100). Washington: The World Bank; 2012. Available from: <http://data.worldbank.org/indicator/FPCPI.TOTL> [accessed 7 June 2013].
23. Pan American Health Organization. PAHO Revolving Fund: vaccine and syringe prices, 2011. *Immunization Newsletter* 2011;XXXIII:5.
24. *Co-financing new vaccines and sustainability: meeting report of the Africa Region workshop*. New York: United Nations Children's Fund; 2009.
25. GAVI Alliance [Internet]. Co-financing policy. Geneva: GAVI Alliance; 2010. Available from: [www.gavialliance.org/about/governance/programme-policies/co-financing](http://www.gavialliance.org/about/governance/programme-policies/co-financing) [accessed 7 June 2013].
26. *Operating procedures of the PAHO Revolving Fund for the purchase of vaccines, syringes and other related supplies*. Washington: Pan American Health Organization; 2008.
27. Acharya A, Diaz-Ortega JL, Tambini G, de Quadros C, Arita I. Cost-effectiveness of measles elimination in Latin America and the Caribbean: a prospective analysis. *Vaccine* 2002;20:3332–41. doi: [http://dx.doi.org/10.1016/S0264-410X\(02\)00296-7](http://dx.doi.org/10.1016/S0264-410X(02)00296-7) PMID:12213403
28. Walker D, Mosqueira NR, Penny ME, Lanata CF, Clark AD, Sanderson CF et al. Variation in the costs of delivering routine immunization services in Peru. *Bull World Health Organ* 2004;82:676–82. PMID:15628205
29. Griffiths UK, Wolfson LJ, Quddus A, Younus M, Hafiz RA. Incremental cost-effectiveness of supplementary immunization activities to prevent neonatal tetanus in Pakistan. *Bull World Health Organ* 2004;82:643–51. PMID:15628201
30. Dayan GH, Cairns L, Sangrujee N, Mtonga A, Nguyen V, Strebel P. Cost-effectiveness of three different vaccination strategies against measles in Zambian children. *Vaccine* 2004;22:475–84. doi: <http://dx.doi.org/10.1016/j.vaccine.2003.07.007> PMID:14670330
31. Hoang MV, Nguyen TB, Kim BG, Dao LH, Nguyen TH, Wright P. Cost of providing the expanded programme on immunization: findings from a facility-based study in Viet Nam, 2005. *Bull World Health Organ* 2008;86:429–34. doi: <http://dx.doi.org/10.2471/BLT.07.045161> PMID:18568271
32. Brenzel L, Wolfson LJ, Fox-Rusby J, Miller M, Halsey NA. Vaccine preventable diseases. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, et al., editors. *Disease control priorities in developing countries*. 2nd ed. Washington: The World Bank; 2006.
33. Galagan SR, Paul P, Menezes L, LaMontagne DS. Influences on parental acceptance of HPV vaccination in demonstration projects in Uganda and Vietnam. *Vaccine* 2013. Epub May 15
34. Griffiths UK, Korczak VS, Ayalew D, Yizgaw A. Incremental system costs of introducing combined DTwP-hepatitis B-Hib vaccine into national immunization services in Ethiopia. *Vaccine* 2009;27:1426–32. doi: <http://dx.doi.org/10.1016/j.vaccine.2008.12.037> PMID:19146901
35. Touch S, Suraratdecha C, Samnang C, Heng S, Gazley L, Huch C et al. A cost-effectiveness analysis of Japanese encephalitis vaccine in Cambodia. *Vaccine* 2010;28:4593–9. doi: <http://dx.doi.org/10.1016/j.vaccine.2010.04.086> PMID:20470803
36. Perú, Ministerio de Economía y Finanzas [Internet]. Presupuesto público. Lima: MEF; 2013. Available from: [www.mef.gob.pe](http://www.mef.gob.pe) [accessed 7 June 2013].
37. Ministerio de Salud [Internet]. Llega al Perú primer lote de vacunas contra el cáncer de cuello uterino. [The first batch of cervical cancer vaccines arrives in Peru]. Lima: Ministerio de Salud; 2011. Spanish. Available from: [http://www.minsa.gob.pe/portada/prensa/notas\\_auxiliar.asp?nota=9896](http://www.minsa.gob.pe/portada/prensa/notas_auxiliar.asp?nota=9896) [accessed 7 June 2013].
38. GAVI Alliance [Internet]. Human papillomavirus vaccine support. Geneva: GAVI; 2013. Available from: <http://www.gavialliance.org/support/nvs/human-papillomavirus-vaccine-support/> [accessed 16 June 2013]
39. Okino P. First Lady launches cervical cancer fight. Kampala: *New Vision* 7 September 2012. Available from: <http://www.newvision.co.ug/news/635003-first-lady-launches-cervical-cancer-vaccination-drive.html> [accessed 7 June 2013]