Costs of Fully Vaccinating a Child

Countries Eligible for Gavi Vaccine Prices

August 2024

unicef
for every child

Introduction

Costs of Fully Vaccinating a Child: Countries Eligible for Gavi Vaccine Prices is a summary paper developed in response to a need expressed by advocacy and resource mobilization stakeholders to be able to better communicate the costs involved in vaccinating a child residing in low- and middle-income countries (LMICs). Using an assumed, standard vaccination schedule, the paper provides benchmark values that can be helpful for advocacy and fundraising purposes. However, actual costs at country level may vary due to different immunization schedules and differences in operational delivery costs. This document is an update to estimates first published in August 2020.

In this summary paper, delivery costs were combined with costs of vaccine commodities to derive an estimate for total costs of delivering a 'standard' childhood immunization schedule. In 2024, the average costs of fully vaccinating a child under the age of 24 months against eleven different diseases is estimated at US$73 for LMICs that procure vaccines through UNICEF and are eligible for Gavi prices. The range in costs across countries is between US$46 and US$130 per fully vaccinated child less than 24 months, reflecting the difference in delivery costs between settings.

Section A

Assumptions

Vaccines

The assumed 'standard' immunization schedule for children less than 24 months of age encompasses the vaccines most frequently used by countries that procure through UNICEF. Assumptions on number of doses per child, vaccine wastage rates and vaccine prices per dose of this schedule are seen in **Table 1**. Weighted average vaccine prices were used for relevant vaccines funded by Gavi, the Vaccine Alliance.[1] For vaccines without a Gavi price, the average price across the different products procured by UNICEF was used.[2]

Table 2 shows assumptions for vaccines recommended for certain geographic or high-risk areas and for Human Papilloma Virus (HPV) vaccine. A single dose of HPV vaccine was assumed to be delivered to adolescents.[3] The RTS,S/AS01 malaria vaccine, which was recommended by the World Health Organization (WHO) in October 2021 and prequalified in July 2022, is also included.[4]

UNICEF handling fee is 3 per cent of the price for HPV, injectable polio (IPV), malaria, pentavalent, PCV, rotavirus, typhoid and yellow fever. The handling fee is 4 per cent of the price for Bacille Calmette Guerin (BCG), diphtheria-tetanus-pertussis (DTP), Hepatitis B, Japanese Encephalitis, measles-rubella, meningococcal A, and oral polio (OPV) vaccines.[5,6]

Table 1. Assumed 'standard' immunization schedule for children less than 24 months

Antigen	Number of doses in schedule	Injection syringe[a]	Reconstitution syringe	Doses per vial	Vaccine wastage[b]	2024 price per dose (US$)
First year of life						
Bacille Calmette Guerin (BCG)	1	✔	✔	20	54%	0.20
Hepatitis B (HepB) birth dose	1	✔		10	32%	0.24
Oral polio (OPV)	3			10	32%	0.14
Pentavalent (DPT-HepB-Hib)	3	✔		10	32%	0.84
Pneumococcal conjugate (PCV13)[c]	3	✔		4	17%	2.75
Injectable polio (IPV)	2	✔		10	32%	2.10
Rotavirus	2			1	3%	2.22
Measles-rubella (MR)	1	✔	✔	10	32%	0.82
Second year of life						
Measles-rubella (MR)[e]	1	✔	✔	10	32%	0.82
Diphtheria-tetanus-pertussis (DTP)[f]	1	✔		10	32%	0.19

Hib: *Haemophilus influenzae* type b; PCV13: 13-valent pneumococcal conjugate vaccine.

[a] BCG injection syringe is 0.05 ml. Injection syringes for all other vaccines are 0.5 ml.
[b] WHO. Vaccine Wastage Rates Calculator. March 2023. https://www.who.int/publications/m/item/vaccine-wastage-rates-calculator. Note that the August 2020 version used the recommended indicative wastage rates that were in place prior to the launch of this calculator, which in some cases varied significantly from those now recommended by the calculator.
[c] In the August 2020 version, we assumed 1 dose vial presentation, but PCV13 in a 4-dose vial is now the most common presentation.
[d] In the August 2020 version, we assumed 1 dose of IPV, but two doses are now recommended. https://cdn.who.int/media/docs/default-source/immunization/immunization_schedules/table_1_april_2024_english.pdf?sfvrsn=2e112cea_2&download=true.
[e] Some countries may use measles (US$0.42/dose) instead of MR.
[f] Although 1 dose of DTP is recommended, it is understood that many countries do not offer this to children in the second year of life.

Table 2. Vaccines used in certain geographic areas and HPV vaccine for adolescents

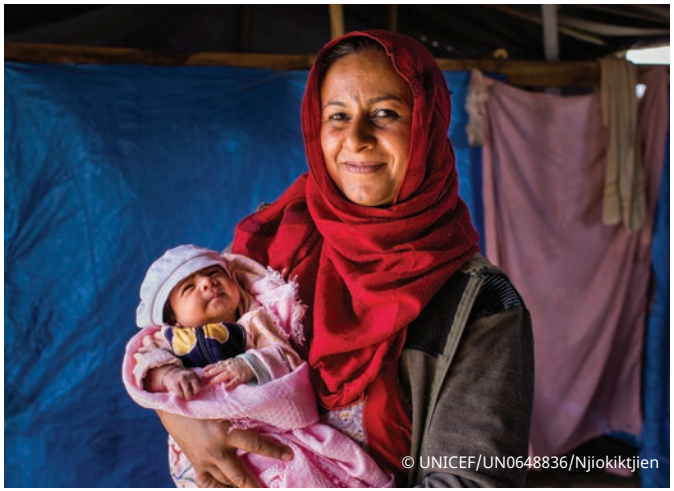
Antigen	Number of doses in schedule	Injection syringe	Reconstitution syringe	Doses per vial	Vaccine wastage	2024 price per dose (US$)
Vaccines used in certain geographic areas						
Japanese encephalitis	1	✔	✔	5	30%	0.45
Malaria	4	✔	✔	2	10%	9.86
Meningococcal A	1	✔	✔	10	32%	0.79
Typhoid conjugate	1	✔		10	20%	1.50
Yellow fever	1	✔	✔	10	32%	1.33
Adolescents						
Human papillomavirus (HPV)	1	✔		1	3%	4.50

Injection devices

Syringe and safety box prices reflect weighted average prices as of May 2024.[7]
Assumptions on parameter values for injection devices are seen in **Table 3**.

Table 3. Assumed injection device parameter values

Parameter	Value
Injection syringes	
Unit price of BCG 0.05 ml injection syringe (2024 US$)	0.0378
Unit price of 0.5 ml injection syringe (2024 US$)	0.0376
Injection syringe wastage	5%
Reconstitution syringes	
Unit price of reconstitution syringe (2024 US$)	0.0419
Reconstitution syringe wastage	5%
Safety boxes	
Unit price of safety box (5 litres)	0.5382
Capacity of safety box (number of syringes)	100
Freight and handling fees	
Injection device freight charge	30%
Injection device UNICEF handling fee	8%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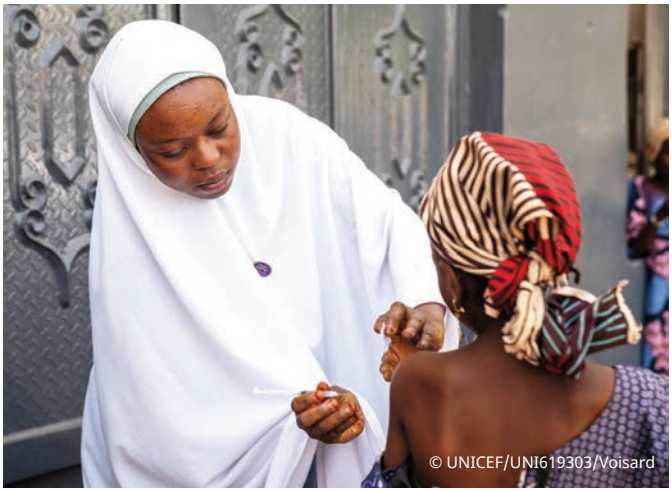
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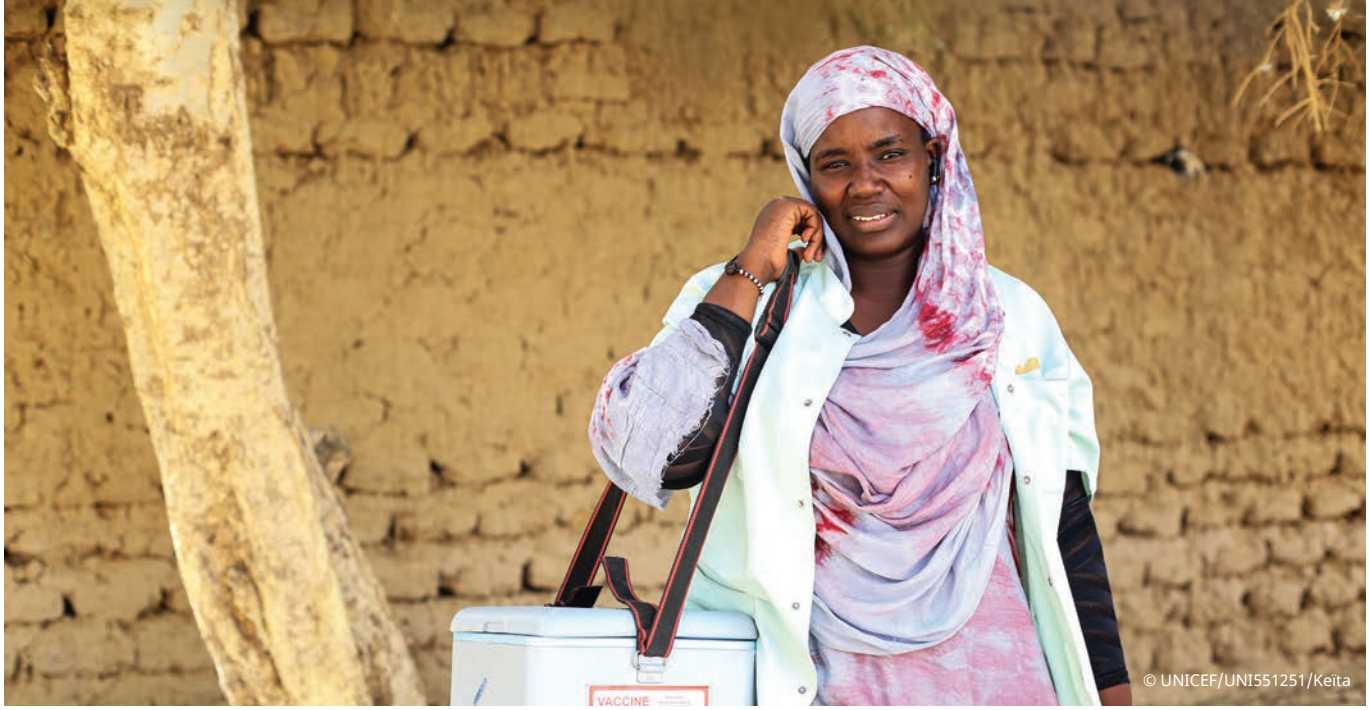

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Delivery costs

Delivery costs, also referred to as operational costs, are the costs associated with delivering vaccines, exclusive of vaccine procurement costs (**Box 1**). A large systematic review on vaccine delivery costs in LMICs screened over 15,000 published and unpublished resources and included data from 61 studies (2005 to 2019).[8,9] Portnoy and colleagues used this review to model average delivery costs across all LMICs, estimating a delivery cost per dose of US$1.87 with a 95 per cent uncertainty interval of US$0.64 – US$4.38.[10] Brought to 2024 US$, the estimated **delivery cost per dose is US$2.34** (US$0.80-US$5.47).[11,12]

HPV vaccine has only recently started to be introduced in routine schedules in LMICs. Countries are using different strategies for delivery of HPV vaccine, including through schools, health facilities, outreach services and during child health days. Based on cost findings from 15 studies, we assumed a delivery cost per dose for HPV of US$6.01 (US$1.11-US$35.52).[13] This wide uncertainty range reflects the use of varying delivery strategies; in general school delivery is more expensive than delivery at health facilities because of the involvement of teachers and the need for health care staff to travel to schools. Many countries report using multiple delivery strategies.

Box 1. Definition of vaccine delivery costs

Delivery costs may include any of the following recurrent and capital cost items:

1. Human resources
2. Per diem and travel allowances
3. Cold chain equipment
4. Vehicles, transport and fuel
5. Program management
6. Training and capacity building
7. Social mobilization and advocacy
8. Waste management
9. Buildings, utilities and other shared costs
10. Vaccine-preventable disease surveillance
11. Monitoring of adverse events following immunization

Section B

Costs per child

Costs of fully vaccinating a child according to the 'standard' schedule are seen in **Table 4**. Costs of vaccine and injection supplies for a child less than 12 months amounts to US$29.41. When adding delivery costs, total costs are US$66.77 per child (range US$42.19 – US$116.92).[14] When including costs of MR and DTP in the second year of life, costs of vaccine and injection supplies increase to US$31.12 and total costs per child to US$73.15 (range US$45.51 – US$129.57).[15]

The costs of geographically specific vaccines and HPV are seen in **Table 5**. As an example, for a country using meningococcal A, yellow fever and HPV vaccines, the costs of fully vaccinating an adolescent total US$92.34 (range US$56.72 – US$184.53).[16] For a country also using malaria vaccine, total costs of fully vaccinating an adolescent amount to US$149.06 (US$107.30– US$253.79).

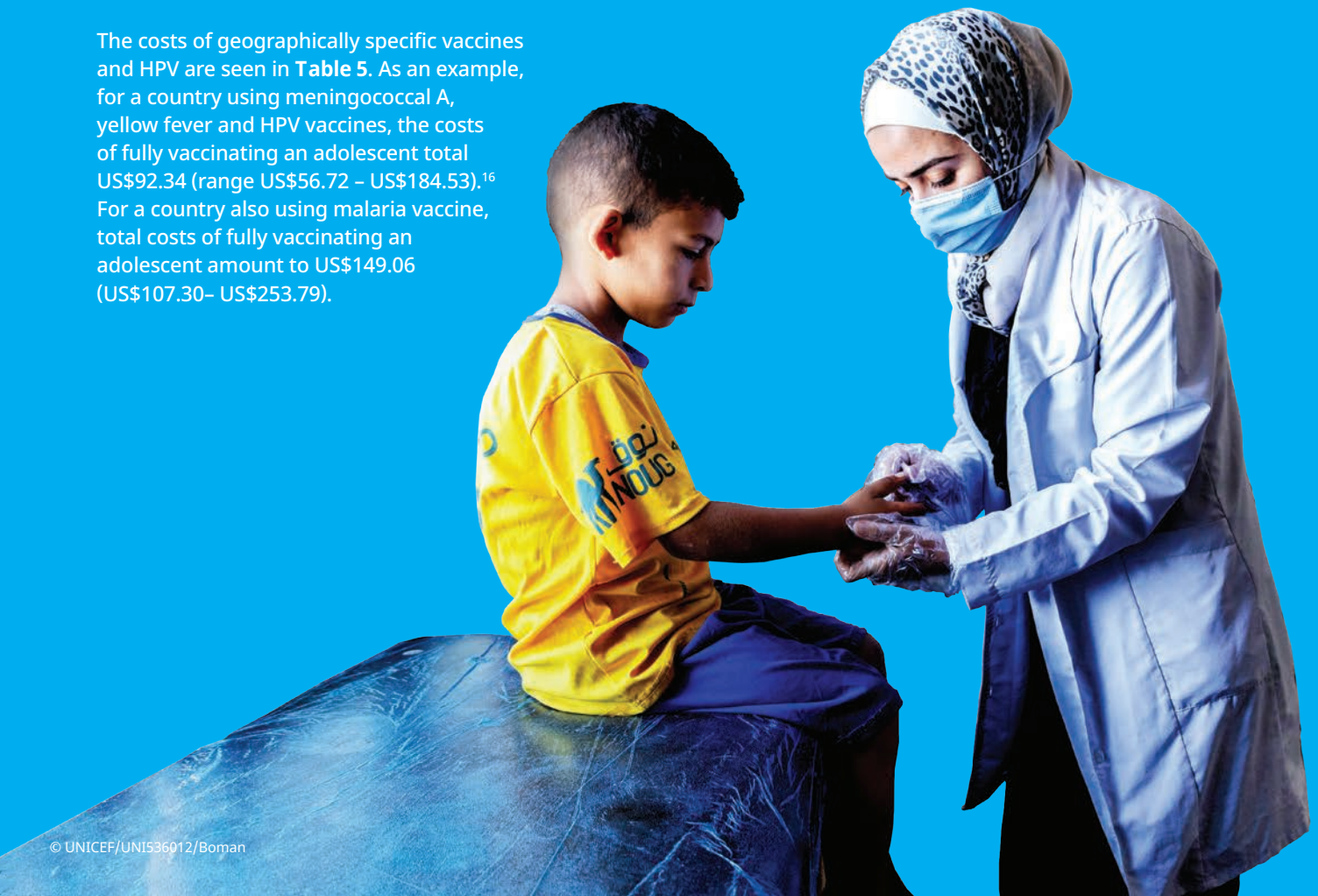


Table 4. Costs per fully vaccinated child with standard schedule for children < 24 months (2024 US$)

Antigen	Vaccine costs	Injection supply costs	Vaccine and injection supply costs	Average delivery costs	Total
First year of life					
Bacille Calmette Guerin (BCG)	0.44	0.07	0.52	2.34	**2.86**
Hepatitis B (HepB) birth dose	0.38	0.05	0.44	2.34	**2.78**
Oral polio (OPV)	0.66	-	0.66	7.01	**7.66**
Pentavalent (DPT-HepB-Hib)	3.91	0.16	4.09	7.01	**11.09**
Pneumococcal conjugate (PCV13)	10.60	0.16	10.78	7.01	**17.78**
Injectable polio (IPV)	6.51	0.11	6.63	4.67	**11.30**
Rotavirus	4.93	-	4.93	4.67	**9.60**
Measles-rubella (MR)[a]	1.28	0.07	1.36	2.34	**3.70**
Subtotal: First year of life	**28.71**	**0.63**	**29.41**	**37.36**	**66.77**
Second year of life					
Measles-rubella (MR)*	1.28	0.07	1.36	2.34	**3.70**
Diphtheria-Tetanus-Pertussis (DTP)	0.30	0.05	0.36	2.34	**2.69**
Subtotal: Second year of life	**1.58**	**0.13**	**1.72**	**4.67**	**6.39**
TOTAL	**30.29**	**0.76**	**31.12**	**42.03**	**73.15**

[a] For countries using measles instead of MR, vaccine costs are US$0.66, injection supply costs $0.07. Vaccine and injection supply costs amount to US$0.74 and delivery costs to US$2.34. Total costs are US$3.07 per measles dose delivered.

Table 5. Additional costs per child vaccinated with geographically specific vaccines and HPV (2024 US$)

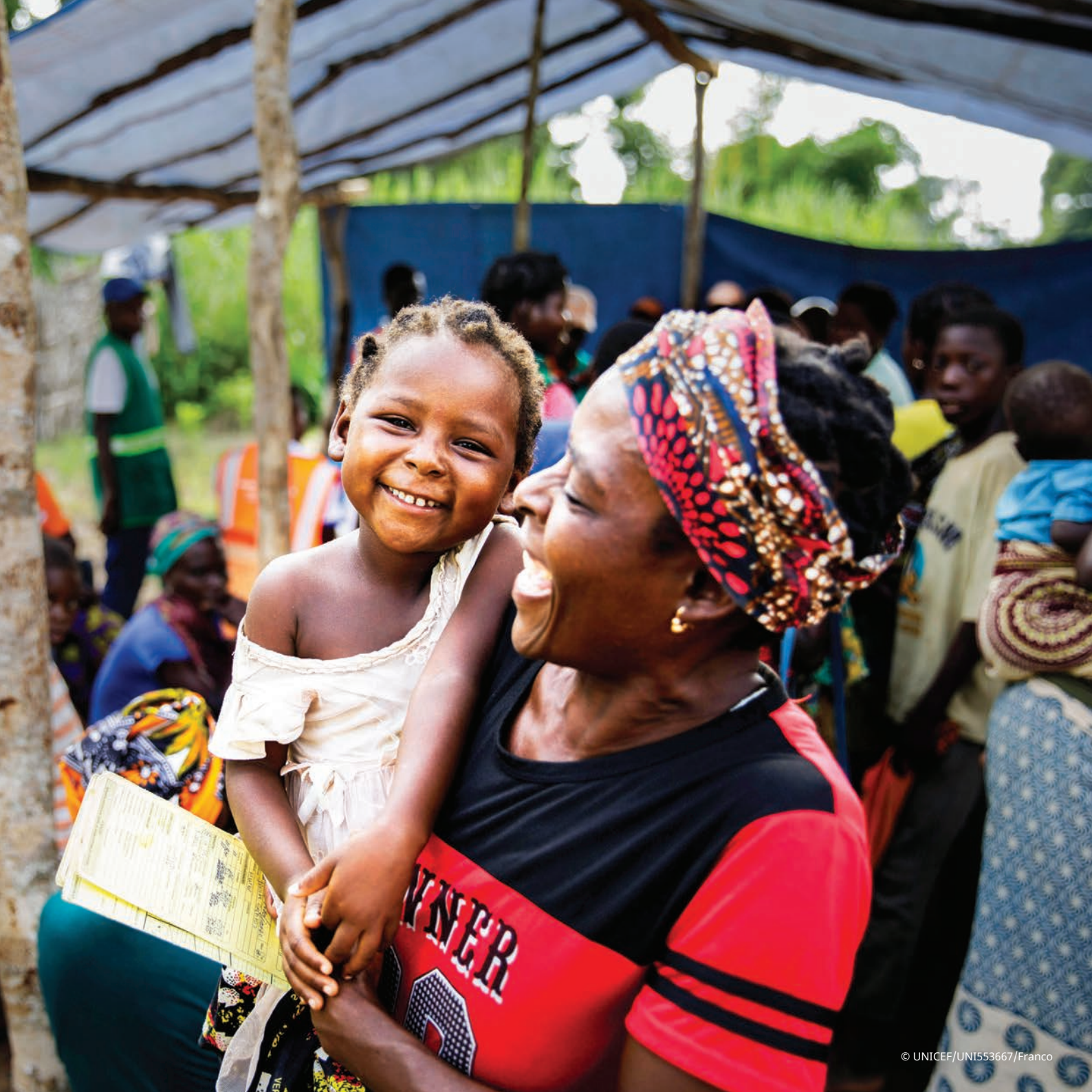
Antigen	Vaccine costs	Injection supply costs	Vaccine and injection supply costs	Average delivery costs	Total
Vaccines used in certain geographic areas					
Japanese encephalitis	0.60	0.08	0.69	2.34	**3.02**
Malaria	46.98	0.37	47.38	9.34	**56.72**
Meningococcal A	1.23	0.07	1.30	2.34	**3.63**
Typhoid	2.00	0.05	2.05	2.34	**4.39**
Yellow fever	2.06	0.07	2.14	2.34	**4.48**
Adolescents					
Human papillomavirus	5.00	0.05	5.06	6.01	**11.07**

Conclusion

Based on the best available data, this document provides benchmark values for the costs of vaccine delivery in LMICs eligible for Gavi vaccine prices in 2024. Since costs differ between settings, the benchmark values cannot be used for planning and budgeting in a particular country. The values are instead intended to give a rough indication of the resources needed for fully vaccinating a child, when taking both vaccine commodities and delivery activities into consideration.

Our estimates have used economic delivery costs, which reflect the full value of the resources being used (including existing health workers). Economic costs account for the fact that these human resources could have been used elsewhere, known as an opportunity cost. Required financial outlays to support vaccine delivery will be less, although programmatic implications of using existing human resources for vaccination as opposed to other activities should be considered at operational level. The ranges provided are relatively wide, reflecting the variation in delivery costs between settings, due to the use of different delivery strategies as well as cost differences, including salaries, fuel and per diems for outreach services.

Compared to 2020, the cost of fully vaccinating a child under the age of 24 months against eleven different diseases has increased by US$13.82. This reflects changes in the recommended schedules and indicative wastage rates, as well as general inflation. Our analysis shows that significant fundraising efforts (US$56.72 per child) will be required in countries wishing to introduce the malaria vaccine due to the relative high price of the vaccine as well as the associated delivery costs for delivering four doses.



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1 Gavi weighted prices are available for the following vaccines: DTP-HepB-Hib, HPV, IPV, Japanese encephalitis, malaria, measles, measles-rubella, meningococcal A, PCV, rotavirus, typhoid conjugate, and yellow fever vaccines. Weighted average prices come from UNICEF's report to Gavi for orders placed in 2023, regardless of the delivery date. All other prices and commodities are based on 2024 prices. Some prices are applicable across the span of the original 72 Gavi supported countries, whereas others are not.

2 https://www.unicef.org/supply/pricing-data. The weighted average price for OPV comes from the Bivalent Oral Polio Vaccines: Supply and Demand Update, released by UNICEF Supply Division in April 2024. The source of the weighted average price for IPV is a UNICEF Polio Programme update.

3 HPV vaccine initially targeted adolescent girls, but some countries also offer the HPV vaccine to boys. The current cost estimates reflect a 1-dose schedule as per new SAGE recommendations, see https://www.who.int/news/item/11-04-2022-one-dose-human-papillomavirus-(hpv)-vaccine-offers-solid-protection-against-cervical-cancer. The August 2020 version of this document assumed a 2-dose schedule as per recommendations valid at that time.

4 Malaria Vaccine: Questions and Answers on Vaccine Supply, Price and Market Shaping. June 2024. https://www.unicef.org/supply/media/21901/file/Malaria-vaccine-Q-A-May-2024-update.pdf.

5 https://www.unicef.org/supply/procurement-services.

6 https://www.unicef.org/supply/handling-fees.

7 Weighted average prices for syringes and safety boxes were provided by the Safe Injection Equipment (SIE) Unit, UNICEF Supply Division, Copenhagen.

8 Vaughan K, Ozaltin A, Mallow M, Moi F, Wilkason C, Stone J, Brenzel L. The costs of delivering vaccines in low- and middle-income countries: Findings from a systematic review. Vaccine X. 2019 Jul 15;2.

9 Immunization Delivery Cost Catalogue: http://immunizationeconomics.org/ican-idcc.

10 Bayesian meta-regression modelling techniques were used to extrapolate cost data to LMICs with no studies available. Only studies of routine vaccine delivery of children less than five years of age that specified cost categories included in the estimate were used for the modelling. Data from 29 studies from 24 different countries, which generated 52 estimates of costs per dose, were used. Reference: Portnoy A, Vaughan K, Clarke-Deelder E, *et al*. Producing Standardized Country-Level Immunization Delivery Unit Cost Estimates, *Pharmacoeconomics*. 2020;10.

11 Using annual inflation, average consumer prices. International Monetary Fund, World Economic Outlook Database, Apr 2024. https://www.imf.org/en/Publications/WEO/weo-database/2024/April/download-entire-database.

12 Since evidence on the costs of malaria vaccine delivery is currently limited to pilot projects and prospective estimates, it was assumed that the costs per dose delivered are equivalent to that for children less than 24 months.

13 Based on 15 studies on delivering HPV at scale, with estimates brought from 2022 US$ to 2024 US$. ThinkWell. 2024. The Immunization Delivery Cost Catalogue: The status of evidence on immunization delivery costs in low- and middle-income countries. Geneva.

14 This represents an increase of US$13.82 compared to 2020 estimates. The increase is mainly due to one more recommended second dose of IPV and the inflation-adjusted delivery costs as well as the change in indicative wastage rates..

15 This represents an increase of US$15.14 compared to 2020 estimates.

16 This represents an increase of $13.67 on to 2020 estimates; the increase in delivery costs is offset by cost savings due to reduced recommended number of doses.

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