

Estimating the delivery cost of reaching the IA2030 target for Zero-Dose Children

Liru Wang (Dalberg)
Wouter Deelder (Dalberg)
Emma Clarke-Deelder (Swiss TPH)

Email: emma.clarke-deelder@swisstph.ch

Agenda

- Objective and context of the study
- Methodology
- Results
- Discussion

Objective and context of the study

Objective

- This study aimed to build a model to estimate the **delivery costs of reaching IA2030 targets for zero-dose (ZD) children** across the Gavi 55 countries in the 2026-2030 period.
- This was a **rapid analysis, relying on existing literature and prior studies** to generate a range of high-level estimates.

Context

- **Studies of the incremental cost per dose of increasing coverage are scarce** and focus only on a subset of possible interventions and strategies in specific contexts.

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Our model used data from existing studies as inputs, and generated both unit and total cost estimates.

Model inputs

- Ozawa et al (2018): incremental cost per dose per percent coverage change by baseline coverage level
- Portnoy et al (2020): average vaccine delivery costs per dose by country at 2018 DTP3 coverage levels for fixed site delivery
- Immunization Delivery Cost Catalogue (IDCC): ratio of the cost of outreach to the cost of fixed-site delivery
- World Bank (2022): ratio of urban to rural population
- Gavi: country-level forecasts for DTP1 coverage and number of zero-dose children reached

Model outputs

- Total incremental costs of reaching additional ZD children in the period from 2026 to 2030 to achieve the IA2030 target.
- Cost per incremental ZDC overall and for each country.

1 Ozawa, Sachiko, et al. "Systematic review of the incremental costs of interventions that increase immunization coverage." *Vaccine* 36.25 (2018): 3641-3649.

2 Portnoy, Allison, et al. "Producing standardized country-level immunization delivery unit cost estimates." *Pharmacoeconomics* 38 (2020): 995-1005.

3 [Immunization delivery Cost Catalogue](#)

4 Accessed on 27th November 2023 ([The World Bank](#))

We compared a baseline scenario of constant coverage from 2026-2030 to a counterfactual scenario of linear coverage improvements.

Baseline scenario

- DTP1 coverage remains constant at 2025 levels for all Gavi 55 countries from the 2026-2030 period.

Counterfactual scenario

- DTP1 coverage increases linearly from a baseline value in 2025 to the IA2030 target in 2030 in all Gavi 55 countries.

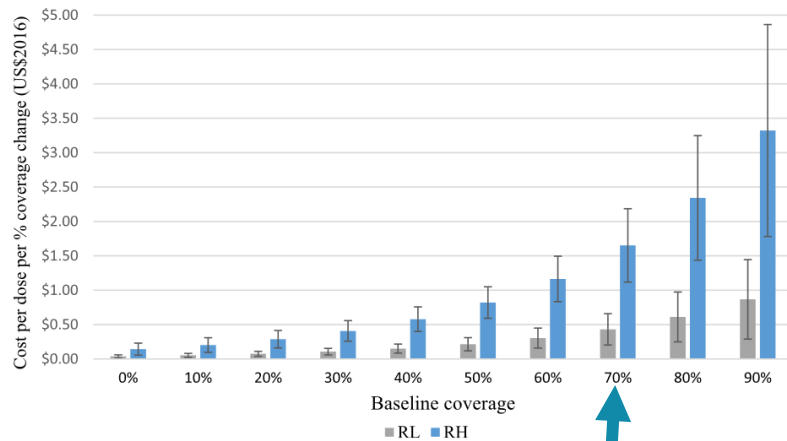
Definition of an incremental zero-dose child reached

- An “incremental zero-dose child reached” is defined as a child who receives DTP1 under the counterfactual scenario but not under the baseline scenario.
- Each “incremental zero-dose child reached” is **assumed to be fully-vaccinated** (receiving 13 doses of routine vaccines).
 - Our estimates are for reaching these children with 13 doses (not just 1 dose)

We generated country-specific cost curves by combining regression results from Ozawa (2018) with average cost estimates from Portnoy (2020).

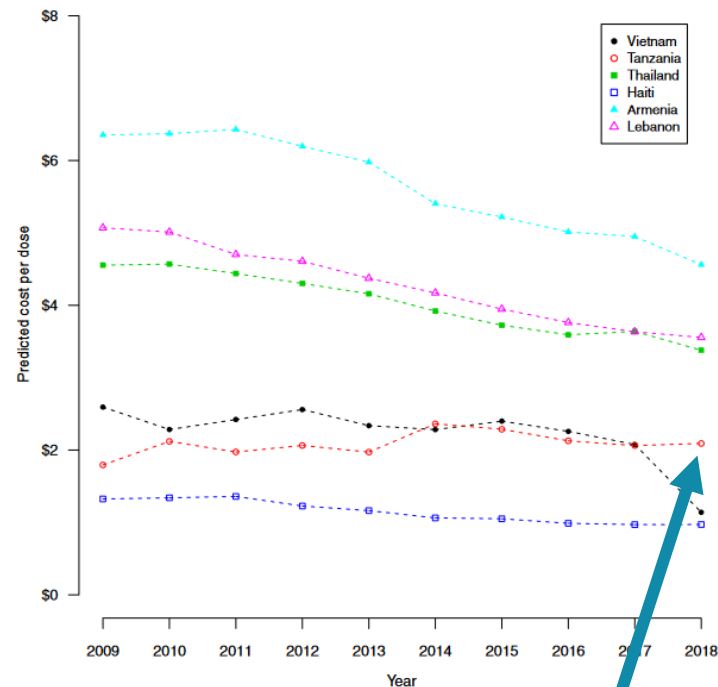
Incremental cost per dose for coverage improvements from Ozawa et al (2018)

S. Ozawa et al./Vaccine 36 (2018) 3641–3649



For a country with 70% DTP3 baseline coverage, this is the incremental cost per dose of increasing coverage from 70% to 71%.

Average programmatic cost per dose at baseline coverage level from Portnoy et al (2020)



For Tanzania, this is the estimated average programmatic cost per dose delivered in 2018.

To generate country-specific cost curves, we combined results from Ozawa (2018) with country-specific average cost estimates from Portnoy (2020).

Let:

x = baseline DTP1 coverage

z = a country-specific adjustment factor

$g(x) = \exp(ax + z)$ = the incremental cost per dose of increasing coverage when starting from a baseline of x

Ozawa (2018) gives us: $a = 3.49$

To solve for z in each country, we use:

$$\text{Portnoy's estimated cost (P)} = \frac{1}{x} \times \int_0^x g(x) dx$$

Solved algebraically, this is:

$$z = \text{LN} \left[\frac{P \times ax}{\exp(ax) - 1} \right]$$

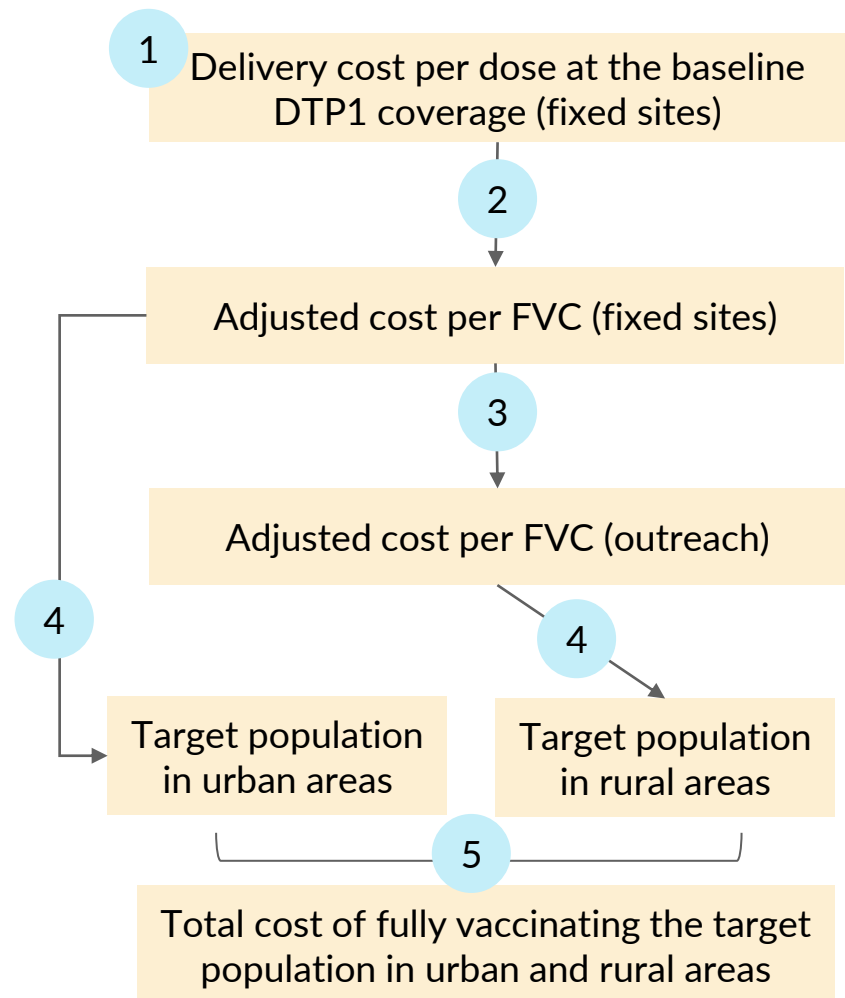
This gives us country-specific cost curves that align with the Portnoy (2020) estimates. **On our cost curves, when coverage is equal to the level used in Portnoy (2020), the average programmatic cost per dose is equal to the Portnoy (2020) cost per dose.**

Overview of the methodology (1/2)

Calculation steps in the model

- 1 Building on the models from Portnoy et al (2020) and Ozawa et al. (2018), we generate country-specific cost curves and estimate the average delivery cost per dose through fixed site immunisation at the baseline DTP1 coverage.
- 2 We adjust the delivery cost per dose to cost per fully vaccinated child (FVC) through fixed sites immunisation by using a multiplier of 13.
- 3 We estimate the relative costs per FVC through outreach strategies as compared to fixed site immunisation.
- 4 We multiply the cost per FVC through fixed site by target urban population and the cost per FVC through outreach by target rural population.
- 5 We sum up the results from step 4 to obtain the total cost of FVC at the baseline DTP1 coverage.

Calculating total cost at baseline DTP1 coverage

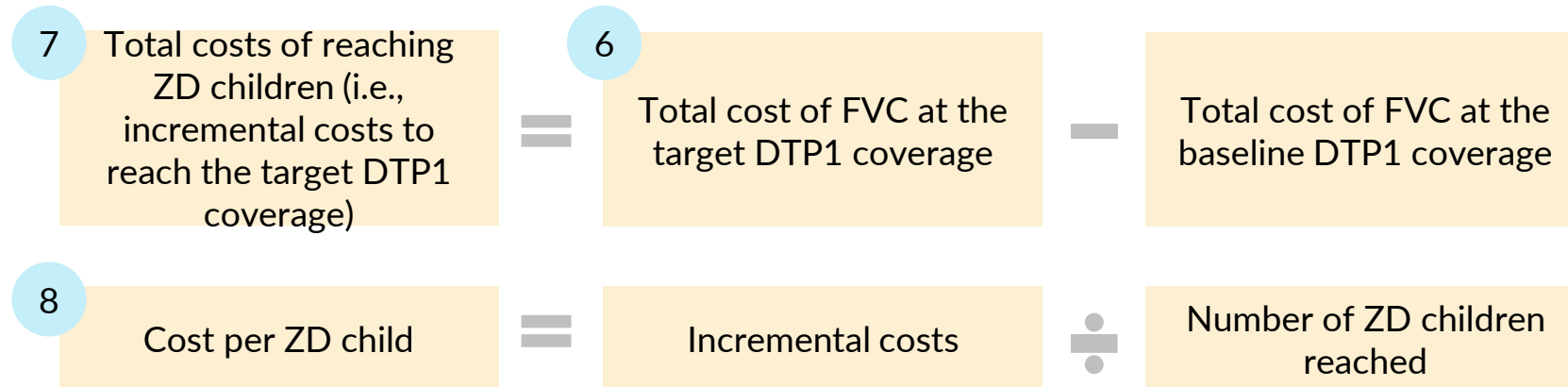


Overview of the methodology (2/2)

Calculation steps in the model (continued)

- 6 Repeating the steps in the previous slide, we calculate the total cost of FVC at the target DTP1 coverage.
- 7 We calculate the total costs of reaching ZD children by taking the difference between total cost at target coverage and total cost at baseline.
- 8 We calculate the cost per ZD child reached by using incremental costs divided by the number of ZD child reached.

Calculating total cost of reaching additional ZD children



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Lower bound estimate: the avg. cost per ZD child reached is estimated at \$115 in Gavi 55 from 2026-2030

- The average cost per ZD child reached in Gavi 55¹ from 2026 to 2030 is ~\$115.
 - The cost per ZD child is estimated to be \$112 in 2026 and increases over the years to \$118 in 2030.
 - The rising costs are linked to the expected increases in DTP1 coverage, which typically lead to higher cost per dose as coverage expands from 2026 to 2030.
- The number of ZD children reached would be 7.5M, and the total costs would be ~\$871M over 5 years.
- The lower bound estimate applies a multiplier of 2 to each country's cost curve² to convert cost per FVC through fixed sites immunisation to cost per FVC through outreach strategies. The 'adjusted costs for outreach efforts' are used specifically for the estimated population segment in rural areas.

	Baseline (2025)	2026	2027	2028	2029	2030	TOTAL
Number of ZD children (M)	6.7	6.2	5.8	5.4	5.0	4.5	
Number of ZD reached (M)		0.5	1.0	1.5	2.0	2.5	7.5
[Lower bound] Total incremental costs (\$M)		54.3	111.2	170.6	237.1	297.4	870.6
[Lower bound] Avg. cost per incremental ZD child (\$)		112.0	113.4	114.9	116.6	118.0	

(1) Please see estimates for India in annex

(2) The cost curves are derived from studies by Ozawa et al. and Portnoy et al. Please see the Technical Annex for more details

Note: the prices are in US\$ 2022, pre-inflation adjustment

Upper bound estimate: the avg. cost per ZD child reached is estimated to be \$197 in Gavi 55 from 2026-2030

- The average cost per ZD child reached in Gavi 55¹ from 2026 to 2030 is around \$197.
 - The cost per ZD child is estimated to be \$193 in 2026 and increases over the years to \$201 in 2030.
 - The rising costs are linked to the expected increases in DTP1 coverage, which typically lead to higher cost per dose as coverage expands from 2026 to 2030.
- The number of ZD children reached would be 7.5M, and the total costs would be ~\$1,490M over 5 years.
- The upper bound estimate applies a multiplier of 4 to each country's cost curve² to convert cost per FVC through immunisation at fixed sites to cost per FVC through outreach efforts. The 'adjusted costs for outreach efforts' are used specifically for the estimated population segment in rural areas.

	Baseline (2025)	2026	2027	2028	2029	2030	TOTAL
Number of ZD children (M)	6.7	6.2	5.8	5.4	5.0	4.5	
Number of ZD reached (M)		0.5	1.0	1.5	2.0	2.5	7.5
[Upper bound] Total incremental costs (\$M)		93.6	191.2	292.5	405.8	506.5	1,489.6
[Upper bound] Avg. cost per incremental ZD child (\$)		193.2	195.0	196.9	199.6	200.9	

(1) Please see estimates for India in annex

(2) The cost curves are derived from studies by Ozawa et al. and Portnoy et al. Please see the Technical Annex for more details

Note: the prices are in US\$ 2022, pre-inflation adjustment

Overview

- We aimed to use existing data sources to estimate the incremental cost of reaching zero dose children in line with the IA2030 targets.
- To do this, we combined an estimate of the relationship between baseline coverage and incremental costs (Ozawa et al 2018) with country-specific estimates of average costs (Portnoy et al 2020) to generate country-specific cost curves.
- We used multipliers informed by the literature to go from “incremental cost of reaching a child with DTP1 through fixed-site delivery” to “incremental cost of fully vaccinating a child through fixed-site or outreach delivery (depending on urban or rural location).”
- Our final estimates for the average cost for zero dose child reached (across Gavi countries and years 2026-2030) ranged from \$115 (lower bound) to \$197 (upper bound).

Limitations

- (1) Limitations of using the Ozawa curve
 - Derived from dataset that was mostly comprised of studies in HICs
 - Reflects costs and effectiveness of interventions that have been studied, which is a subset of the possible interventions that could be used
 - True relationship between baseline coverage and incremental costs may not be monotonically increasing
- (2) Limitations of using the Portnoy estimates
 - Generated based on a meta-regression analysis of data from 24 countries; not representative sample of all LMICs
 - Small number of sites in each study in meta-regression
 - Focus on the cost of vaccine delivery at fixed sites; needed to use multiplier to derive estimates for outreach costs
- (3) DTP1 coverage vs. DTP3 coverage
 - We assume that the incremental cost per dose of DTP1 delivered would be the same as the incremental cost per dose of DTP3 delivered, and that the relationship between baseline coverage and the incremental cost per dose is the same for DTP1 and DTP3.
- (4) There is very little data from fragile or conflict-affected settings, where many zero-dose children live.
- (5) Estimates have not been adjusted for country-specific inflation / currency fluctuations.

Reflections for the zero-dose costing community

- It is important to be clear about **what we are measuring**, as there are many different ways we could think about these outcomes.
 - Are we measuring the cost of reaching zero-dose children with DTP1, or of fully vaccinating them?
 - What is the counterfactual scenario we are comparing to?
 - Interventions that improve DTP1 coverage are likely to also improve coverage of other vaccines. How are the costs allocated across these different positive outcomes?
- There are **important gaps in the data** on the costs of reaching zero-dose children.
 - Geography -- Most of the studies in Ozawa et al. came from high-income countries. Evidence from fragile settings is particularly scarce.
 - Intervention type -- The literature on the costs and effectiveness of different strategies for improving coverage has covered only a small subset of possible interventions.

Thank you!

Annex

India: the avg. cost per ZD child reached is estimated to be \$158 from 2026-2030

- The average cost per ZD child reached in India from 2026 to 2030 is around \$148 .
 - Range between \$114 (lower bound) and \$201 (upper bound).¹
- Total costs would be \$113M-\$198M over 5 years (accounting for 13% of total costs in Gavi 55).

	Baseline (2025)	2026	2027	2028	2029	2030	TOTAL
Number of ZD children (M)	1.0	1.0	0.9	0.8	0.8	0.7	
Number of ZD reached (M)		0.1	0.1	0.2	0.3	0.3	1.0
[Lower bound] Total incremental costs (\$M)		7.5	15.1	22.5	30.0	37.5	112.6
[Lower bound] Avg. cost per incremental ZD child (\$)		113.9	114.1	114.4	114.6	114.8	
	Baseline (2025)	2026	2027	2028	2029	2030	TOTAL
Number of ZD children (M)	1.0	1.0	0.9	0.8	0.8	0.7	
Number of ZD reached (M)		0.1	0.1	0.2	0.3	0.3	1.0
[Upper bound] Total incremental costs (\$M)		13.3	26.6	39.7	52.6	65.6	197.8
[Upper bound] Avg. cost per incremental ZD child (\$)		201.2	201.2	201.2	201.1	201.1	

(1) Lower bound estimate: The cost per ZD child is estimated to be \$114 in 2026 and increases slightly over the years to \$115 in 2030. Upper bound estimate: The cost per ZD child remains stable at \$201 from 2026 to 2030. The cost per ZD child remains stable due to consistent target DTP1 coverage at 97% from 2029 to 2030, and a decrease in the target population from 22.4M in 2026 to 22.1M in 2030.

Note: the prices are in US\$ 2022, pre-inflation adjustment

Fragile counties: the avg. cost per ZD child reached is estimated to be \$156 from 2026-2030

- The average cost per ZD child reached in fragile countries from 2026 to 2030 is around \$156.
 - Range between \$113 (lower bound) and \$198 (upper bound)¹
- The total costs would be \$191M - \$335M over 5 years (accounting for 22% of total costs in Gavi 55).
- These estimates are a subset of Gavi 55, using the same assumptions and approach.

	Baseline (2025)	2026	2027	2028	2029	2030	TOTAL
Number of ZD children (M)	1.4	1.3	1.2	1.1	1.1	0.9	
Number of ZD reached (M)		0.1	0.2	0.3	0.5	0.6	1.7
[Lower bound] Total incremental costs (\$M)		11.2	23.3	36.4	54.7	65.4	191.1
[Lower bound] Avg. cost per incremental ZD child (\$)		107.5	110.1	112.7	116.5	118.3	

	Baseline (2025)	2026	2027	2028	2029	2030	TOTAL
Number of ZD children (M)	1.4	1.3	1.2	1.1	1.1	0.9	
Number of ZD reached (M)		0.1	0.2	0.3	0.5	0.6	1.7
[Upper bound] Total incremental costs (\$M)		19.8	41.0	63.8	96.2	114.1	334.9
[Upper bound] Avg. cost per incremental ZD child (\$)		189.4	193.4	197.6	204.8	206.4	

(1) Lower bound estimate: The cost per ZD child is estimated to be \$108 in 2026 and increases over the years to \$118 per ZD child in 2030. The increasing numbers are due to the annually increasing DTP 1 coverage rate modelled from 2026 to 2030. Upper bound estimate: The cost per ZD child is estimated to be \$189 in 2026 and increases over the years to \$206 in 2030. The increasing numbers are due to the annually increasing DTP 1 coverage rate modelled from 2026 to 2030.

Note: the prices are in US\$ 2022, pre-inflation adjustment

Assumptions used to calculate:

a) costs per FVC, b) outreach vs. fixed site immunisation

- **We apply a multiplier of 13 to convert the cost per vaccine dose delivered to cost per FVC.** This is to capture the expected cost of reaching ZD children with three doses each of DTPcv, Polio, PCV, Rota, and one dose of MCV.
 - Studies on delivery costs typically allocate labour costs equally across each dose delivered to calculate the incremental cost per dose. To calculate the cost per FVC, we need to multiply the cost per dose by the number of doses delivered to the child.
 - We use Portnoy et al.'s estimated cost per dose as an input to our model. Their predicted cost is 'programmatic' cost per dose (i.e., for all vaccines in the vaccination schedule).
 - Portnoy et al.'s meta-regression model adjusted for whether a study estimated a 'programmatic' cost per dose or a single-antigen.¹ The model also considered the number of vaccines in the vaccine schedule in each country. The average number of doses considered in the study was around 15 doses for Gavi 54 countries.
- **We assume ratios to convert cost per FVC through fixed sites immunisation to cost per FVC through outreach efforts.** The ratios were determined by reviewing the studies in the Immunization Delivery Cost Catalogue (IDCC). Since the range of the ratios fall between 2 and 4, we calculate a lower bound estimate by using a multiplier of 2 and an upper bound estimate by using a multiplier of 4. (*Please refer to the slide in Annex*).

(1) 46% of the input studies in Portnoy et al.'s model costed the entire vaccination program, while the rest focused on a single antigen

Multipliers to convert the cost per dose at fixed sites to outreach/mobile strategy

- We reviewed 300+ studies and reports included in IDCC from January 2005 to March 2019.
- We identified a subset of studies comparing costs for outreach/mobile strategy and health facility (fixed sites). Please see illustrative screenshot below and collected data in Excel.
- The ratio between outreach strategy and health facility mostly falls between 2 and 4. Notably, there are two higher ratios from a study in Zimbabwe that specifically focused on delivering HPV to older children and adolescents. We have treated these two figures as outliers and chosen to use a multiplier of 2 for the lower bound estimates and 4 for the upper bound estimates.

Screenshots from Dalberg's data collection

Author (year)	Country	Geographic setting	Outreach unit cost (without vaccine)	Facility unit cost (without vaccine)	Unit (e.g., per dose or per fully immunised child)	Outreach/health facility ratio	Economic, financial, or fiscal costs
Sume et al. (2013)	Cameroon	Urban and rural	\$ 24.71	\$ 18.55	Cost per dose	1.33	Not reported
Immunization Costing Action Network (ICAN).	Tanzania	Rural (without nomads)	\$ 3.23	\$ 1.08	Cost per dose	2.99	Financial
Immunization Costing Action Network (ICAN).	Tanzania	Rural (with nomads)	\$ 3.71	\$ 0.91	Cost per dose	4.08	Financial
Immunization Costing Action Network (ICAN).	Tanzania	Urban and rural	\$ 3.16	\$ 1.10	Cost per dose	2.87	Financial
Immunization Costing Action Network (ICAN).	Tanzania	Urban	\$ 1.02	\$ 1.47	Cost per dose	0.69	Financial
Immunization Costing Action Network (ICAN).	Viet Nam	Urban and rural	\$ 4.44	\$ 2.10	Cost per dose	2.11	Economic
Immunization Costing Action Network (ICAN).	Viet Nam	Rural	\$ 4.44	\$ 2.09	Cost per dose	2.12	Economic
Immunization Costing Action Network (ICAN).	Viet Nam	Urban and rural	\$ 3.67	\$ 1.42	Cost per dose	2.59	Fiscal
Immunization Costing Action Network (ICAN).	Viet Nam	Rural	\$ 3.42	\$ 1.70	Cost per dose	2.01	Fiscal
Hidle A et al. (2018)	Zimbabwe	Peri-urban (two-thirds rural)	\$ 171.04	\$ 18.26	Cost per dose	9.37	Financial
Hidle A et al. (2018)	Zimbabwe	Peri-urban (two-thirds rural)	\$ 288.63	\$ 34.90	Cost per FIC (without vaccine)	8.27	Financial