

The Immunization Delivery Cost Catalogue: Methodology Note for the 2024 Update

November 14, 2024

BREAKING NEW GROUND

About this document: This document outlines the methodology for the 2024 systematic review and update of the Immunization Delivery Cost Catalogue (IDCC). It complements the [previous methodology note](#), published in December 2019, which describes methods employed in the original 2017 systematic review as well as the updates conducted in 2018 and 2019.

SYSTEMATIC REVIEW

Search of the published and grey literature

In December 2023 we searched two major electronic databases—PubMed and WHO Global Index Medicus—for peer-reviewed articles published between March 2019 and December 2023 that included immunization delivery costs for all countries of any income level. Search terms included three categories of keywords – “immunization” AND “cost” AND “delivery” – and were translated into the query language of each database. The search queries used for each database are provided in Table 1 and Table 2.

Table 1. PubMed search queries

Search	PubMed Query
#4	#1 AND #2 AND #3 Filters: Publication date from March 1, 2019 to December 31, 2023
#3	delivery[tiab] OR campaign*[tiab] OR incremental[tiab] OR strategy[tiab] OR strategies[tiab] OR “cold chain”[tiab] OR logistic*[tiab] OR equipment[tiab] OR personnel[tiab] OR overhead[tiab] OR operational[tiab] OR implementation [tiab] OR introduction[tiab] OR capital[tiab] OR transport*[tiab] OR distribut*[tiab] OR “non-vaccine”[tiab] OR “per dose”[tiab] OR “per capita”[tiab] OR “per child”[tiab] OR “per person”[tiab] OR “per fully immunized child” [tiab:~0] OR “per fully immunised child”[tiab:~0] OR “per FIC” [tiab:~0] OR “per fully immunized person”[tiab:~0] OR “per fully immunised person”[tiab:~0] OR universal[tiab] OR “disability-adjusted”[tiab] OR QALY[tiab] OR DALY[tiab] OR extrapolat*[tiab] OR project*[tiab] OR estimat*[tiab]
#2	immuniz*[tiab] OR immunis*[tiab] OR vaccin*[tiab]
#1	"Costs and Cost Analysis"[mh] OR costs[tiab] OR cost[tiab] OR cost effective*[tiab] OR cost-effective*[tiab] OR cost-efficiency*[tiab] OR cost-efficient*[tiab] OR costing[tiab] OR cost-benefit[tiab] OR cost-utility[tiab] OR "Immunization Programs/economics"[mh] OR "Vaccination/economics"[mh] OR "Mass Vaccination/economics"[mh]

Table 2. WHO Global Index Medicus search queries

Search	WHO Global Index Medicus Query
#4	#1 AND #2 AND #3 and date limit: March 1, 2019 to December 31, 2023
#3	Filter: Health economic evaluations
#2	(tw:(immuniz* OR immunis* OR vaccin*))
#1	(tw:(costs OR cost-effective* OR costing OR cost-benefit OR cost-utility))

We reviewed the resources included in two key systematic reviews on immunization delivery costs.^{i,ii} In addition, to capture unpublished reports, we posted a call for grey literature in immunization-related newsletters, communities of practice and web discussion forums. We also sent out direct requests to key contacts at organizations involved in global and national immunization-related work.

Finally, we included resources published prior to March 2019 that had been identified by the time of the 2019 IDCC update but that could not be included at the time as the full text of the articles or reports were not yet available.

Inclusion and exclusion criteria

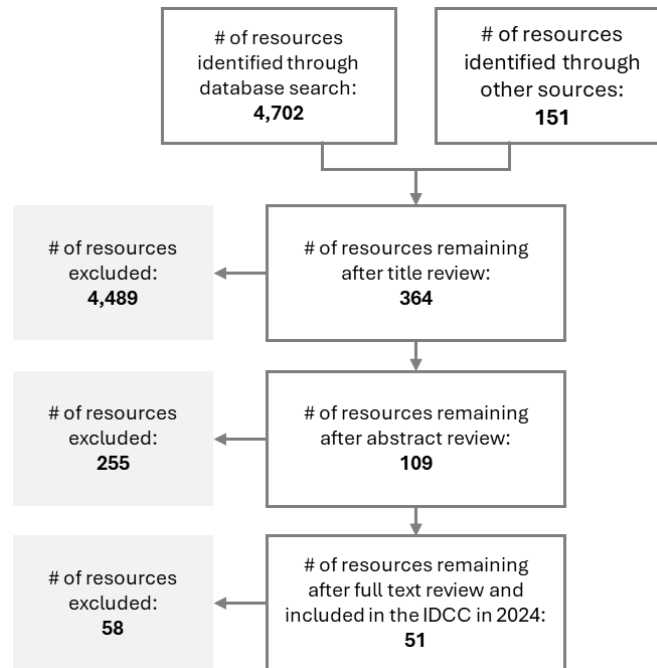
We included resources with full text availability in English, French, Spanish, or Portuguese conducted only in low and middle-income country study settings. The income level was determined using the World Bank country income classification for 2024.ⁱⁱⁱ We included resources that reported unit delivery costs (i.e., delivery cost per dose, per full immunization of a vaccine, per fully immunized child, and per person in the target population). Resources reporting costing, cost-effectiveness, cost-benefit, return on investment, cost-utility, and other analyses that included a form of unit cost data were included.

We excluded duplicate resources and clearly irrelevant resources—such as veterinary studies, in vitro studies, high-income country studies, qualitative studies, therapeutic studies—as well as resources that only presented secondary or modeled immunization delivery unit costs not based on actual program costs. We also excluded resources if the costing methodology reported was unclear, for example if the source of the data used for the analysis was not reported.

Title, abstract, and full text review

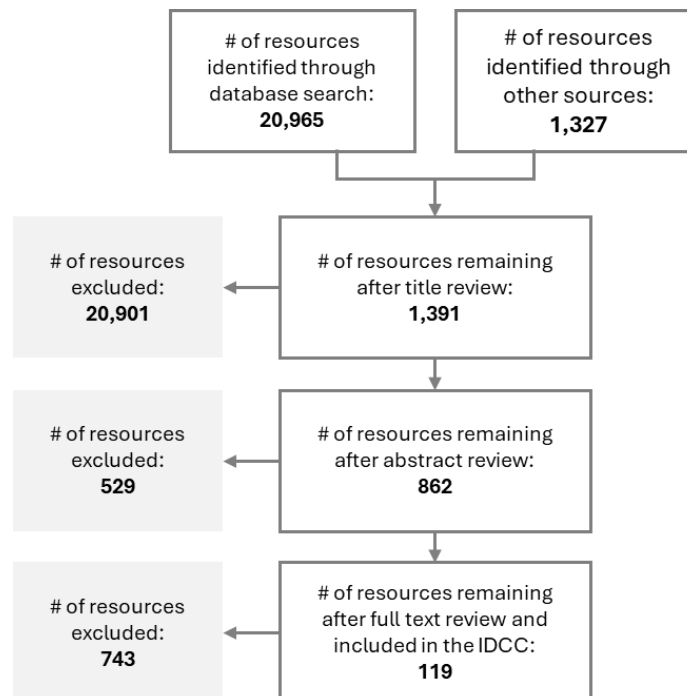
The search yielded 4,853 resources, including peer-reviewed journal articles and grey literature. Two investigators completed the title and abstract review on the published and grey literature search results using standard methods. Titles and abstracts that did not clearly meet all inclusion criteria were also reviewed by two supervisors and any disagreement was discussed and jointly resolved. Following the title and abstract review, a total of 109 resources remained for full text review. Of these, 51 met all inclusion criteria upon full text review and were extracted into the IDCC. Figure 1 below presents the total number of resources reviewed, excluded, and extracted at each stage of the search process.

Figure 1. Systematic review search results for the 2024 update



Considering the 17,439 resources found and reviewed and the 68 extracted in the previous iterations of the systematic review, the 2024 update brings the total number of resources reviewed to 22,292—of which 20,965 identified through database search and 1,327 through other sources—and the total number of resources extracted to 119, as shown in Figure 2.

Figure 2. Systematic review search results for the 2017, 2018, 2019 and 2024 updates



IDDC UPDATE

Data extraction

Resources meeting all inclusion criteria after title, abstract and full text review underwent data extraction. We extracted information on the context of country and costing study, details of the study design and costing methodology, the vaccines costed and their delivery strategies, the cost categories included, and the reported results. A list of all variables extracted, and their definition can be found in the [IDCC Codebook and Definitions](#) document.

We entered extracted data into a Microsoft Excel data extraction template. Each resource was extracted on one row in the Excel workbook unless the resource reported separate unit costs for different country contexts, delivery strategies, type of costs reported (e.g., economic costs and financial costs, full and incremental costs), vaccines, or other criteria, in which case multiple rows were used.

We extracted full or incremental delivery cost per dose, per target population, and per person vaccinated, with or without vaccine cost, depending on what the resource reported. We extracted unit costs across facilities and levels as averaged and aggregated by authors. All extractions were reviewed by a supervisor to ensure consistency and completeness.

Data cleaning

We combined all extractions into a single Microsoft Excel worksheet and cleaned the data to recode text for filtering and ensure consistent formatting and use of text. Cleaning also included:

- Identifying resources that are related to one another to ensure data are not reported twice (e.g., studies that reported findings in both a peer-reviewed publication and a grey literature report). In instances where there were multiple resources reporting the same data, we used the source that provided more extensive detail.
- Adding contextual information not included in the resources to each record to help with interpretation and analysis, such as country regionⁱⁱⁱ, income levelⁱⁱⁱ and country population^{iv} (at the time of the study).
- Adding descriptor columns to help identify records by their attributes (e.g., "This line reports economic costs by activity for measles only").

Conversion of cost findings to 2022 USD

We converted all cost findings to a common year (2022) and currency (US dollar, US\$) to ensure comparability across studies and different settings:

- **For costs reported in USD/EUR:** if costs were not reported in the local currency, we first converted from USD/EUR to local currency units (LCUs) of the same year using the exchange rate at the year of costing (or year of data gathering if year of costing was not reported; if neither of these two were available, we used the resource publication year). Exchange rates were taken from the World Bank (USD per LCU, period average).^v
- **With all costs in LCU:** We inflated to 2022 LCU using LCU inflation rates based on average consumer prices reported by the International Monetary Fund. Annual percentages of average consumer prices are year-on-year changes and are expressed in averages for the year, not end-of-period data.^{vi}
- **With all costs in 2022 LCU:** We converted from 2022 LCU to 2022 USD using the 2022 LCU to USD exchange rate. Exchange rates were taken from the World Bank (LCU per USD, period average).^v

For some countries and/or years, exchange and/or inflation data were not available from the referenced sources for 2022, we used data from 2021 from the same source. Costs were inflated to 2022 USD as at the time of the update 2023 inflation and exchange rate data from the World Bank were not yet available. For one study conducted in Zimbabwe and published in 2018, we inflated to 2022 USD using the USD inflation rate rather than the local inflation rate. During the period between the study and 2022, Zimbabwe experienced very high inflation and due to that USD were commonly used for local transactions. Moreover, following the conversion and inflation process outlined above led to artificially high cost estimates, which would have not been comparable with other datapoints included in the IDCC.

How this process differed from past IDCC updates

The methodology described in this document follows the principles established in the previous updates of the systematic review, outlined in detail in the 2019 IDCC update Methodology Note. However, the methods differed slightly. For instance, as the research team involved in the 2024 update included a Portuguese speaker, Portuguese language resources were also included in this update. Moreover, prior to the 2024 update, we reviewed in detail the methodology employed in the previous iterations, weighing its cost and benefits, and in consultation with key stakeholders, we identified ways to make the process of updating the IDCC more efficient. For instance, in the 2024 update we searched only the two key databases, as searching multiple databases yielded many duplicates a few additional resources. We also significantly reduced the number of extracted columns reporting contextual information, bringing the total columns extracted from 245 to 124.

REFERENCES

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ⁱⁱ Slavkovsky R, Callen E, Pecenka C, Mvundura M. Costs of human papillomavirus vaccine delivery in low- and middle-income countries: A systematic review. *Vaccine*. 2024 Feb 27;42(6):1200-1210. doi: 10.1016/j.vaccine.2024.01.094. Epub 2024 Feb 1. PMID: 38302338; PMCID: PMC10911079.

ⁱⁱⁱ World Bank. World Bank Country and Lending Groups. Accessed on 21/3/2024
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^{iv} World Bank. World development indicators: Population, total. Accessed on 21/3/2024
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^v World Bank. World development indicators: Official exchange rate (LCU per US\$, period average). Accessed on 21/3/2024 <https://data.worldbank.org/indicator/PA.NUS.FCRF>

^{vi} IMF World Economic Outlook database: October 2023. Accessed on 21/3/2024
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