

# The Costs of Different Vaccine Delivery Strategies to Reach Children Up to 18 Months in Rural and Urban Areas in Tanzania

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MINISTRY OF HEALTH AND SOCIAL  
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## EXECUTIVE SUMMARY

### Background

The United Republic of Tanzania is preparing to enter the Gavi Preparatory Transition Phase in 2020, meaning the Government of Tanzania will need to invest more funds to support the immunization program, both for vaccines and injection supplies as well as immunization delivery costs.<sup>1</sup> Reliable cost information is required to make a case to the Ministry of Finance and Planning to mobilize resources for the delivery of the existing schedule of vaccines and inform new vaccine introduction planning.

At the same time, the budgeting and planning processes and procedures are not always well understood by district-level government planners, some of whom may not be deeply familiar with immunization, leading to lower prioritization of the program. In turn, this may lead to shortages in financing to support the delivery of immunization services. Lack of sufficient funds for immunization delivery costs may force cancellation of outreach and mobile sessions, important in a country where 71% of the population lives in rural and hard to reach areas and 17% of the population is nomadic.

With this background in mind, the 2016-2020 Comprehensive Multi-Year Plan (cMYP) identified the need to conduct a study about the cost per

### Box 1. Research Question and Key Findings

Research question: What is the average delivery cost to immunize children up to 18 months in rural and urban areas at current coverage levels and using the current mix of delivery strategies (fixed facility delivery, outreach and mobile)?

Key findings:

- Vaccine delivery costs are estimated to total US\$21.8 million/year (exclusive of vaccine, injection supply and labor costs). By level of the health system, delivery costs are incurred at facility (72.4%), district (20.5%), regional (7.0%) and national (0.5%) levels. This equates to a cost per dose of US\$0.67 and a cost per capita of US\$0.38.
- Looking only at facility-level costs, delivery costs are an estimated US\$2,200 per year (facility average), equating to a cost per dose of US\$0.45 at rural facilities which include nomads in their catchment population, US\$0.48 per dose at urban facilities, and US\$0.56 per dose at rural facilities which do not include nomads. The main delivery cost drivers are cold chain equipment & energy, and per diem & travel allowances.
- The cost per fully immunized child (FIC) defined as Measles/Rubella 1st dose is US\$7.35 in rural areas without nomads, US\$8.33 in rural areas with nomads, and US\$8.89 in urban areas.
- Overall, outreach is more than three times as expensive as facility-based delivery (US\$1.47 versus US\$0.43), but the magnitude of the difference varies immensely by geography. Outreach is more expensive in rural areas than in urban areas, presumably due to the distances covered. None of the 51 sampled facilities conducted mobile sessions, reportedly due to a lack of sufficient funds for delivery. Mobile delivery is likely more expensive than outreach due to greater distances covered.

Use of findings: The timing of the release of these study findings is ideal for their use in both annual budgeting and planning processes as well as multi-year planning. At sub-national level, the development of the Comprehensive Council Health Plans (CCHPs) provides a key opportunity to use the delivery cost findings to better budget for immunization. At national level, guidelines that inform this process should be updated. Additionally, the five-year National Health Plan and comprehensive multi-year plan (cMYP) for 2021-2025 are currently being developed. Study findings can inform cost projections and budget impact analyses for national and/or district level delivery activities and new vaccine introductions.

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<sup>1</sup> Delivery costs are sometimes called operational costs, and are defined as those costs associated with delivering immunizations to target populations, exclusive of vaccine costs. In the context of Tanzania, we have also excluded injection supplies (e.g. safety boxes,

fully immunized child in Tanzania. Although several immunization program costing studies have been done in Tanzania, all previous studies were limited to specific antigens especially for new vaccines, such as Rotavirus and Human Papilloma Virus (HPV) vaccines, and also for oral cholera vaccine used to respond to a cholera outbreak. Prior to this work, there was no study on the cost of delivering the full schedule of vaccines offered as part of the national expanded program on immunization.

Our study therefore aimed to estimate the cost to immunize children up to 18 months in rural and urban areas at current coverage levels and using the current mix of delivery strategies (see Box 1 for research question). Our study looked at the three delivery strategies used as part of routine immunization:

- Fixed facility delivery
- Outreach
- Mobile clinics to reach nomadic and hard-to-reach communities

While the majority of immunization sessions occur via fixed facility delivery, outreach sessions are used to reach populations living a short distance from the facility, typically reached by motorcycle and without requiring an overnight stay. Mobile clinics are for further distances, typically requiring a vehicle for transport and an overnight stay.

The vaccines included in our study are those on the immunization schedule up to 18 months, including OPV (4 doses), BCG (1 dose), DTP/HepB/Hib (3 doses), Measles/Rubella (2 doses), PCV13 (3 doses) and Rotavirus (2 doses).

During the period 2016-2019, ThinkWell and JSI provided technical support to the costing study within the context of the Immunization Costing Action Network (ICAN), a research and learning community working to increase the visibility, availability, understanding, and use of immunization delivery cost information. ICAN supported three countries – Indonesia, Tanzania and Vietnam – to build country capacity to generate and use cost evidence to inform planning, budgeting and decision making for the immunization program.

## Methods

The study used ingredients-based costing from a government/provider perspective to retrospectively estimate the full, economic and financial immunization-related delivery costs<sup>2</sup> incurred at the facility, district, region and national levels during the period July 2016 to June 2017.

The sample included 4 regions randomly selected from the country's 7 mainland zones (excluding Zanzibar). Within each region, we randomly selected 2 districts (1 urban district and 1 rural district which does not include

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diluents, reconstitution syringes) and paid human resources (labor) from delivery costs as these items are funded centrally and undergo a different process for resource mobilization. Delivery costs may include any or all of the following recurrent and capital cost items: (1) volunteer human resources, (2) per diem and travel allowances, (3) cold chain equipment and their overheads (e.g. energy, maintenance, repairs), (4) vehicles, transport and fuel, (5) program management, (6) training and capacity building, (7) social mobilization and advocacy, (8) disease surveillance and activities related to adverse events following immunization (AEFI), (9) buildings, utilities, other overheads and shared costs, (10) waste management, (11) other supplies and recurrent costs, and (12) other non-vaccine costs. Definition adapted from Vaughan, et. al. (2019).

<sup>2</sup> Economic costs represent the value of all resources used to deliver the immunization program, i.e. financial outlays plus opportunity costs of volunteer time and any donated items such as vaccines. Financial costs are limited to financial outlays, usually with straight-line depreciation of capital assets (i.e., total cost of item divided by the number of years it will be used, without any discounting).

nomads in the catchment population ('rural without nomads')) and purposively selected 1 rural district which includes nomads in the catchment population ('rural with nomads'). Within each district, we randomly selected four or five health facilities, for a total sample of 4 regions, 12 districts and 54 facilities. Three facilities were later dropped from the sample due to poor data quality.

Because of small differences in economic and financial costs, we present only economic costs in this summary. We include average total facility costs and unit costs, calculated using inverse probability of sampling weights and volume-weights. Unit costs include cost per dose and per fully immunized child (FIC), defined as a child who has received the second dose of Measles/Rubella at 18 months. For international comparison purposes, we also calculate cost per FIC defined as DTP3. We analyze costs by delivery strategy (facility, outreach, mobile) and by geographic area (urban, rural without nomads, and rural with nomads). We also analyze the main cost-driving activities and line items. Finally, we project the costs of the program nationally based on the calibration technique, using auxiliary information about national delivery volumes.

All results are presented in 2016 US dollars using a conversion rate of 1 USD = 2,177 Tanzania shillings (World Bank official exchange rate, period average for 2016).

## Findings and discussion

This study found a very small difference in total delivery costs (facility average) by location, excluding the cost of vaccines, injection supplies and paid human resources (labor). The lowest costs were at facilities in rural areas without nomads (US\$2,138/year), followed by rural areas with nomads (US\$2,224) and then urban facilities (US\$2,427/year). Cold chain equipment & energy is the main cost driving line item at all facility types when excluding the vaccine, injection supply and labor costs.

Cost per dose delivered is lowest at rural facilities which include nomads in their catchment population (US\$0.45), followed by urban facilities (US\$0.48) and rural facilities without nomads (US\$0.56). Dividing total facility delivery costs by the number of fully immunized children (FICs), we estimate the cost per FIC overall to be US\$8.04, defining FIC in terms of Measles/Rubella 1<sup>st</sup> dose. However, the cost per FIC is lower in rural areas with nomads (US\$7.35) and higher in both rural areas without nomads (US\$8.33) and urban areas (US\$8.89).

By delivery strategy, this study confirmed that outreach is more expensive than facility-based delivery, but the magnitude of the difference varies immensely by geography. Overall, outreach is more than three times as expensive as facility-based delivery (US\$1.47 versus US\$0.43), but this is largely driven by the nearly five-fold difference between the unit cost of outreach and facility delivery in rural areas without nomads (US\$1.91 versus US\$0.43). In urban areas, outreach is slightly more expensive than facility-based delivery (US\$0.62 versus US\$0.48), whereas in rural areas with nomads the difference is about three-fold (US\$1.16 versus US\$0.40). Outreach is more expensive in rural areas than in urban areas, presumably due to the distances covered. Surprisingly, facility-based delivery is more expensive in urban areas as opposed to rural areas.

Planned mobile sessions were cancelled in all of the sampled facilities during the year of our study, an interesting finding in and of itself and reflective of challenges with funding for delivery costs at district level. Our estimation is that mobile would be more expensive than outreach or facility-based delivery due to the greater distances to be covered and use of motor vehicles (as opposed to motorcycles and buses/taxis for outreach). Allocating sufficient funding for delivery costs would help ensure mobile delivery can happen as scheduled, although increasing facility-based delivery at existing sites, particularly those in rural areas, may be preferable in

terms of cost implications for the immunization program. Coverage would need to be monitored to ensure nomads and other populations living in hard-to-reach areas continue to access services.

The total cost of the immunization program, including facility, district, regional and national level costs, is estimated to be US\$138.2 million, or US\$2.41 per capita based on a population of 57.31 million. These estimates include vaccine, injection supply and labor costs. This equates to a cost per dose of US\$3.99. By level of the health system, 87% of these costs are incurred at facility level, 4% at district level, 1% at regional level and 8% at national level. Delivery costs only (total costs minus the vaccine, injection supply and labor costs) totals US\$21.8 million, or 15.8% of the total program cost. By level of the health system, the delivery cost portion of total costs is comprised of facility-level costs (72.4%), district-level costs (20.5%), regional costs (7.0%) and national costs (0.5%). The immunization delivery cost per dose and per capita, including costs from all levels of the health system, equate to US\$0.67 and US\$0.38 respectively.

Overall our analysis found a high level of variability in the data and some surprising findings. These results may reflect the patient mix that came to certain facilities in the sample during the study period, and/or reflect unique characteristics of some of the sampled facilities which cause them to have higher or lower delivery volumes than usual, or higher or lower costs than usual. Examples of unique characteristics of our sampled sites include some sites that receive patients from nearby facilities where vaccination is not offered, leading to a higher than expected number of doses delivered, and sites that collected vaccines daily from the district because of lack of cold chain equipment, leading to higher vaccine collection/transport costs. These results could also be the result of errors in administrative and/or study data collection, or other data challenges. Notably, data related to the number of FICs was confusing. There were also a large number of facilities with missing data, requiring us to drop three facilities from the sample and leading us to impute to fill in some gaps, primarily in the number of doses delivered, for a number of other facilities. However, in a representative sample as large as ours, one would not expect these cases to have a large impact on the average results. Given the size of our sample we remain confident in the results.

Findings are largely in line with other Sub-Saharan Africa countries. In four recent studies from Benin<sup>3</sup>, Ghana<sup>4</sup>, Uganda<sup>5</sup> and Zambia<sup>6</sup>, the reported economic cost per dose delivered ranged from US\$0.75 to \$US3.18, including injection supply costs but excluding vaccine costs. This puts Tanzania's delivery cost per dose of US\$1.28 (also including injection supply costs but excluding vaccine costs) at the lower end of this range.

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<sup>3</sup> AMP. (2014). Costing and financing analyses of routine immunization and new vaccine introduction in Benin Final Report. and Suharlim, C. and Menzies, N. (2018). Personal communication.

<sup>4</sup> Le Gargasson, J. B., Nyonator, F. K., Adibo, M., Gessner, B. D., & Colombini, A. (2015). Costs of routine immunization and the introduction of new and underutilized vaccines in Ghana. *Vaccine*, 33(S1), A40–A46. and Suharlim, C. and Menzies, N. (2018). Personal communication. <https://doi.org/10.1016/j.vaccine.2014.12.081>

<sup>5</sup> Guthrie, T., Zikusooka, C., Kwesiga, B., Abewe, C., Lagony, S., Schutte, C., ... Kinghorn, A. (2014). Costing and Financing Analyses of Routine Immunization in Uganda. Retrieved from <https://static1.squarespace.com/static/556deb8ee4b08a534b8360e7/t/5596fa4ae4b07b7dda4dd04d/1435957834829/UGANDA+Immunization+Costing+Report+1+December+14+submitted+FINAL+update+15+12+14+errors.pdf>. and Suharlim, C. and Menzies, N. (2018). Personal communication.

<sup>6</sup> Schütte, C., Chansa, C., Marinda, E., Guthrie, T. A., Banda, S., Nombewu, Z., ... Kinghorn, A. (2015). Cost analysis of routine immunisation in Zambia. *Vaccine*, 33(S1), A47–A52. <https://doi.org/10.1016/j.vaccine.2014.12.040> and Suharlim, C. and Menzies, N. (2018). Personal communication.

## Opportunities for use of results

Developing sufficient budgets for vaccination activities in Tanzania has been challenging as baseline cost estimates have been unavailable and districts do not know their delivery costs. The amount of funds needed for outreach and other delivery strategies has been estimated primarily relying on historical expenditures. In this context, these findings can provide valuable insights into the cost of different delivery strategies across a range of urban, rural and nomad settings. Interviews carried out with immunization stakeholders in Tanzania identified several key opportunities with potential entry points for the presentation and use of the ICAN study results:

1. Annual budgeting and planning process: The findings can be used for planning at different levels to help determine efficiencies and maximize local resources. Tanzania's decentralized system for budgeting and planning presents a key opportunity to use ICAN findings at the facility and district levels. Funds for operational activities are included in the budget of the Comprehensive Council Health Plan (CCHP) that local governments prepare annually starting in October based on national guidelines that are revised every few years. The release of the study findings is timely for their inclusion in the budgets currently being developed, which will be approved by parliament in June 2020. At the national level, the next revision of the guidelines could be a key entry point for the use of ICAN findings.
2. National Health Plan and cMYP development: The next five-year National Health Plan, as well as the immunization comprehensive multi-year plan (cMYP), will run from 2021-2025. Plans and budgets will be drawn up for the next plan starting from mid-2019 until mid-2020, so the timing is opportune for the use of ICAN evidence for costing national and/or district level delivery activities and new vaccine introductions.
3. Directed Health Facility Funding (DHFF): DHFF is a payment directly to health facility bank accounts which is an output-based payment to facilities to better match payment to priority services and empower facilities to manage funds and procure inputs to deliver health services to their communities. It is used to strengthen basic financial management systems, PlanRep and Facility Financial Accounting and Reporting System (FFARS). The findings can now enable more targeted strategy considerations and potentially better predictability on operational costs.

The ICAN research team is working closely with the MoHCDGC and PO-RALG to ensure that the research findings are shared both at the national and regional/district levels, and with key stakeholders involved in the Health Plan development as well. Given the large sample designed to be nationally representative, these findings present an excellent opportunity for greater accuracy of planning and budgeting and potentially a more effective use of immunization resources in Tanzania.