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Costs of routine immunization and the introduction of new and underutilized vaccines in Ghana

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ABSTRACT

Background: Limited knowledge exists on the full cost of routine immunization in Africa. Ghana was the first African country to simultaneously introduce rotavirus, pneumococcal and measles second-dose vaccines. Given their high price, it would be beneficial to Ghanaian health authorities to know the true cost of their introduction.
Methods: The economic costs of routine immunization for 2011 and the incremental costs of new vaccines were assessed as part of a multi-country study on costing and financing of routine immunization known as the Expanded Program on Immunization Costing (EPIC). Immunization delivery costs were evaluated at the local facility, district, regional, and central levels. Stratified random sampling was used for district and facility selection. We calculated the allocation of nationwide costs to the four health-system levels.
Results: The total aggregated national costs for routine immunization – including vaccine costs – equaled US$ 53.5 million during 2011 (including central, regional, and district costs); this equated to US$ 60.3 per fully immunized child (FIC) when counting vaccine costs, or US$ 48.1 without. National immunization program delivery costs were allocated as follows: local facility level, 85% of total national cost; district, 11%; central, 2% and regional, 2%. Salaried labor represented 61% of total costs, and vaccines represented 17%. For new vaccine introduction, programmatic start-up costs amounted to US$ 3.9 million, primarily due to salaried labor (66%). The mean facility-level cost per vaccine dose administered in a routine immunization program was US$ 5.1 (with a range of US$ 2.4–7.8 depending on facility characteristics) and US$ 3.7 for delivery costs.
Discussion: We identified a high cost per fully immunized child, mostly due to non-vaccine costs at the facility level, which indicates that immunization program financing – whether national or donor-driven – must take a broad viewpoint. This substantial variation in overall costs emphasizes the additional effort associated with reaching children in various settings.

1. Introduction

Multiple additional vaccines are currently being introduced into routine immunization programs in countries that are eligible for funding from the Global Alliance for Vaccines and Immunization (GAVI). However, many countries are unable to raise sufficient resources, both domestic and external to achieve their objectives [1]. Furthermore, the full cost of new vaccines, plus their distribution and storage costs, remains high for many governments [2] and support for new vaccines in many developing countries remains overwhelmingly dependent on GAVI financing [3]. In addition, new vaccine introduction costings tend to overlook non-vaccine costs [4,5].

In the African region, Ghana has been a leader in introducing new vaccines into routine immunization programs, expanding from 7 vaccines in 2002 to 12 vaccines in 2013. Ghana was one of the first countries to introduce the pentavalent vaccine (in 2002). Most recently, it has simultaneously introduced pneumococcal conjugate vaccine (PCV), rotavirus vaccine, and measles second-dose (MSD). It has also made substantial investments to ensure new vaccine delivery such as cold chain capacity expansion.

Nevertheless, costs have not been fully assessed, and have focused mainly on resource requirement projections. The latest official information available can be extracted from the 2010–2014

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Table 1
Final sample selected by district and location.

District	Urban				Rural			
	Sampled urban facilities	% of total urban facilities sampled	Facility type and ownership	Catchment population (average)	Sampled rural facilities	Facility type and ownership	% of total rural facilities sampled	Catchment population (average)
Asante Akim South	2	100%	Government clinic; Government hospital	18,906	5	Government CHPS[a]; Government clinic; Government health center (3)	42%	9431
Atwima Mponua	1	100%	Government hospital	122,398	5	Government CHPS; Mission clinic; Mission health center; Government health center (2)	55%	15,325
Ga West	4	50%	Government hospital; Government CHPS; Government clinic (2)	16,011	4	Government CHPS (2); Government clinic (2)	44%	10,351
Bunkpurugu Yunyoo	1	100%	Mission hospital	31,074	5	Government CHPS (2); Mission health center; Government health center	55%	6958
Kassena Nankana	2	100%	Government hospital; Government health center	16,358	8	Government CHPS (6); Government clinic; Government health center	40%	4075
Wa Municipal	1	100%	Government clinic	63,673	12	Government CHPS (7); Government health center (4); Government clinic	43%	6123

[a] CHPS, community health-based planning and services facilities.

comprehensive multi-year plan (cMYP) [6]. The estimate of the projected cost for routine immunization in 2011 was US$ 32 million [6]. A costing study by Levin et al. [7] conducted in 2000 estimated the total cost for routine immunization at US$ 5.1 million, corresponding to US$ 9.7 for each fully immunized child (FIC) – i.e., three doses of diphtheria-tetanus-pertussis (DTP), hepatitis B, and *Haemophilus influenzae* type b (Hib) – and a cost of US$ 0.26 per capita, adjusted for inflation.

This study was part of the Expanded Program on Immunization Costing (EPIC), a multi-country analysis of the costs and financing of routine immunization programs and new vaccine introduction, which was supported by the Bill and Melinda Gates Foundation. The project encompassed Benin, Ghana, Honduras, Moldova, Uganda, and Zambia. This manuscript focuses exclusively on the costs of routine immunization and new vaccines introduction.

2. Methods

The study evaluated the national routine immunization program in 2011 and new vaccine introduction in Ghana from the perspective of the government health service. The following vaccines were part of Ghana's routine immunization schedule in 2011: Bacillus Calmette-Guerin (BCG), pentavalent DTP-hepatitis B-Hib, polio, measles first-dose, yellow fever, and tetanus toxoid (for pregnant women), which represent nine doses per FIC (see Appendix 1). With the introduction of pneumococcal conjugate vaccine, rotavirus, and measles second-dose in 2012, the number of doses increased to 15 per FIC.

A multi-stage, stratified random-sampling approach was used to select a representative sample of six districts and 50 primary healthcare facilities. Districts were classified according to their urban and rural location, the number of pentavalent doses administered in 2011, and population density.

Within selected districts, facilities were stratified based on facility type, ownership (non-government or government), and rural versus urban status (see Table 1). Four types of facilities were included in the analysis: (1) reproductive and child health (RCH) units of district hospitals, (2) health centers (HC), (3) clinics, and (4) community-based health planning and services facilities (CHPS) [8].

RCH units are located in urban areas within the district hospital compounds and focus on maternal and child curative and preventive care. HC provide basic curative care, disease-prevention services, and primary health care [9]. They are located in urban or rural areas, serve as the reference facility for the sub-district, and supervise the community-level facilities. Clinics provide similar services to HC. CHPS are the lowest level of service delivery and serve as first-line health facilities. CHPS provide interventions in small facilities and also provide outreach services to communities, mostly in rural areas. The sample size of 50 facilities corresponds to an error margin of 12% and a confidence level of 90% [5].

Methods were based on internationally accepted approaches [10,11], drawing upon a common methodological approach [5]. For each sample facility, total routine immunization facility costs were estimated by combining expenditure data and information on input quantities and unit prices. Recurrent and capital inputs, including shared and specific inputs, were allocated to immunization activities (see Table 2). Vaccine costs were estimated from records on doses utilized, including wastage.

The cost of vaccines and supplies was allocated to facility-based delivery or outreach, based on the proportion of doses administered in each strategy. New vaccine introduction costs were estimated through specific questions from the sample of facilities, districts, and regions, as well as from the central Expanded Programme on Immunization (EPI). Expenditure reports at the central level were reviewed to complement the data collection. For the different antigens in the schedule, the prices per dose were: US$ 0.07 for BCG, US$ 3 for pentavalent, US$ 0.13 for polio, US$ 0.19 for measles, and US$ 0.66 for yellow fever. For the new vaccines, the prices per dose were: US$ 7.00 for pneumococcal vaccine,[1] US$ 2.42 for rotavirus, and US$ 0.19 for measles second-dose. Vaccine prices were collected from the UNICEF supply division price datasets.

Personnel costs, estimated from the percentage of total working time spent on routine immunization activities, were collected in

[1] Source: http://www.unicef.org/supply/files/PCV.pdf.