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What have we learned on costs and financing of routine immunization from the comprehensive multi-year plans in GAVI eligible countries?

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ABSTRACT

Background: Immunization is one of the most cost-effective health interventions, but as countries introduce new vaccines and scale-up immunization coverage, costs will likely increase. This paper updates estimates of immunization costs and financing based on information from comprehensive multi-year plans (cMYPs) from GAVI-eligible countries during a period when countries planned to introduce a range of new vaccines (2008–2016).

Methods: The analysis database included information from baseline and 5-year projection years for each country cMYP, resulting in a total sample size of 243 observations. Two-thirds were from African countries. Cost data included personnel, vaccine, injection, transport, training, maintenance, cold chain and other capital investments. Financing from government and external sources was evaluated. All estimates were converted to 2010 US Dollars. Statistical analysis was performed using STATA, and results were population-weighted.

Results: Results pertain to country planning estimates. Average annual routine immunization cost was $62 million. Vaccines continued to be the major cost driver (51%) followed by immunization-specific personnel costs (22%). Non-vaccine delivery costs accounted for almost half of routine program costs (44%). Routine delivery cost per dose averaged $0.61 and the delivery cost per infant was $10. The cost per DTP3 vaccinated child was $27. Routine program costs increased with each new vaccine introduced. Costs accounted for 5% of government health expenditures. Governments accounted for 67% of financing.

Conclusion: Total and average costs of routine immunization programs are rising as coverage rates increase and new vaccines are introduced. The cost of delivering vaccines is nearly equivalent to the cost of vaccines. Governments are financing greater proportions of the immunization program but there may be limits in resource scarce countries. Price reductions for new vaccines will help reduce costs and the burden of financing. Strategies to improve efficiency in service delivery should be pursued.

1. Introduction

Immunization is one of the most cost-effective health interventions for achieving the Millennium Development Goal of reducing deaths among children less than 5 years of age (MDG4) by two-thirds [1,2]. Vaccines provide health benefits not only for the immunized child, but also for the community as a whole through herd immunity. In addition, studies have shown that immunization extends life expectancy and contributes to economic growth [3,4].

Studies show it costs between $17 and $25 to fully vaccinate a child with traditional vaccines. Variation in estimates is related to level of scale, type of delivery strategy, and prices [5–7].[1] Costs of immunization have increased with the addition of new and more expensive vaccines [8]. As of March 2014, almost all low- and middle-income GAVI-eligible countries have introduced pentavalent vaccine; 40 included pneumococcal vaccine; 34 launched rotavirus vaccine [9]. This paper evaluates total and unit cost and financing, of routine immunization based on country-level information from comprehensive multi-year plans (cMYPs) in GAVI-eligible countries.

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[1] The traditional vaccine schedule includes three doses each of oral polio vaccine, and combined diphtheria–pertussis–tetanus vaccine, and a single dose each of measles and Bacillus-Calmette Guerin (BCG) vaccine against tuberculosis.

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2. Methods

The cMYP is a planning tool for estimating current and future costs and financing of the national immunization program using a standard method [10]. Baseline year estimates are retrospective. Countries also estimate 5 years of future resource requirements and financing to achieve national immunization program goals, such as introducing new vaccines and ramping up coverage rates. The present analysis is based on 40 cMYPs from GAVI-eligible countries with a baseline year between 2008 and 2011 and projection years until 2016.[2] This timeframe more fully captures plans to introduce Hib-containing, pneumococcal and rotavirus vaccines as compared to earlier estimates [8].[3] These vaccines prevent the majority of preventable child deaths and the global community has coalesced around their widespread introduction through the GAVI Alliance.

The database was structured to evaluate baseline and projection year data, resulting in 6 years of data for each country. Costs included both immunization-specific and health system costs categorized into line items: shared and immunization-specific personnel and per diem; traditional and new vaccines; injection supplies; transport for fixed sites and outreach services; training; social mobilization and advocacy activities; disease surveillance; program management; operational costs (cold chain and other equipment maintenance, building operating costs and utilities); other recurrent costs; cold chain equipment; vehicles; other equipment, including construction of buildings. Delivery costs excluded vaccine and safe injection costs. Information on sources and uses of financing was incorporated. Data on doses utilized, DTP3 coverage rates, and total and target populations were derived from the cMYPs, and used to estimate unit costs.[4] The number of children receiving the third dose of DTP vaccine served as a proxy to estimate the cost per fully immunized child, or FIC [5,6,11,12].

The database contained categorical information on vaccination schedule for each country year: Hepatitis B vaccine (including tetravalent vaccine); Hib-containing vaccine (mostly pentavalent vaccine); Hib-containing and pneumococcal vaccine; or, Hib-containing vaccine, pneumococcal, rotavirus vaccines. No distinction was made for vaccine formulation. A novel approach to assessing the impact of different vaccine schedules on program costs was developed.

Macroeconomic data on gross domestic product, GNI per capita, and government health expenditures also were incorporated into the database [13,14]. Projections of GHE were based on real GDP growth rates. Regional affiliation and GAVI Alliance co-financing groupings were included [9]. As the median baseline year was 2010, all costs and financing was converted into 2010 USD equivalents using the consumer price index [15].

The database of 40 baseline country years and 203 projection country years, for a total of 243 total country years was statistically analyzed using STATA [16].[5] All estimates are population-weighted. This approach represents a small methodological advance over previous analyses of cMYPs.

Financing sources reflect the last source from which financing is allocated. For example, if a bilateral donor channels funds through a multi-lateral agency, the cMYP method attributes financing to the multi-lateral agency and not the bilateral donor. As a result, the cMYP estimate may under-represent some funding sources. In addition, sources of financing are not mutually exclusive, as pooled financing includes funds from the government, bilateral donor agencies, development banks, and other sources.

Table 1
Comparison of regional RI programs in sample cMYPs (baseline year, weighted average).

Region	% DTP3	Target infants	Doses (million)
AFRO ($n = 27$)	84.9%	899,588	12.2
EMRO ($n = 4$)	75.6%	4.7 million	88
EURO ($n = 4$)	86.4%	93,273	1.6
SEARO/WPRO ($n = 5$)	94.3%	3.8 million	107.2
Total ($n = 40$)	86.5%	2.9 million	92.7

Source: author's calculations.

3. Results

3.1. Sample data

The cMYP sample represents a population of 1.02 billion and 30.6 million surviving infants. Most countries are from the Africa region (66%), and 56% have a GNI/capita less than $975. Eighty-five percent of sample countries utilize Hib-containing vaccine in the baseline year. In the projection years, 82% of countries plan to introduce pneumococcal vaccine, and 58% expect to include rotavirus vaccines.

Table 1 summarizes routine immunization program outputs from the sample cMYPs by region for the baseline year. DTP3 coverage varies from 76% in AFRO countries to 94% in SEARO and WPRO countries, with an average of 86.5%. The average number of target infants is highest in EMRO countries, though the number of doses utilized per year is largest for countries in the SEARO and WPRO regions.

3.2. Costs of routine immunization programs

The population-weighted average annual RI cost was $62 million for the baseline year, increasing 86% to $114 million on average for the projection period. Countries in the EMRO Region had the highest average annual RI cost in the baseline year ($86 million), compared to countries in the AFRO region ($22 million). Regional RI cost variation may be related to differences in goals, size of the target population, coverage rates, health system configuration, delivery strategies, and prices.

Fig. 1 illustrates the distribution of RI costs by line item for the baseline year compared to the projection years for the sample. Vaccines are the main cost driver, accounting for more than half of RI cost, rising to 61% of RI cost in projection years. Personnel time represents 22% of RI cost, declining to 15% of RI cost in future years. Cold chain cost, maintenance, and safe injection supplies have relative shares of total cost at 3%, 6%, and 5%, respectively, which are maintained in the projection period.

[2] The sample included the following countries: Afghanistan, Angola, Armenia, Azerbaijan, Bangladesh, Benin, Cameroon, Central African Republic, Republic of Congo, Djibouti, Democratic People's Republic of Korea, Eritrea, Gambia, Ghana, Georgia, Guinea, Guinea Bissau, India, Kenya, Lesotho, Liberia, Mali, Moldova, Mozambique, Niger, Pakistan, Rwanda, Senegal, Sudan (north), Tanzania, Timor L'Este, Togo, Uganda, Yemen, and Zambia. Data from Ethiopia were excluded because of missing information on routine doses.

[3] Most sample countries have or will introduce pentavalent vaccine.

[4] Estimates of doses, coverage and population in the cMYP were used in the analysis to ensure internal consistency in the analysis, as costs reflected the coverage and program goals of the country. Utilizing other estimates, such as WHO–UNICEF Best Estimates would have introduced bias into the analysis and created inconsistencies between inputs and outputs. For the projection years, there are some differences between the cMYP projected coverage rates and those determined retrospectively by WHO and UNICEF.

[5] One outlier observation from Djibouti, Haiti, and Mali ($n = 3$) were removed from the dataset on the basis that total immunization cost was more than two-times the standard deviation.