Costing & Financing of Routine Immunization and New Vaccines Introduction in Ghana

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Final Report

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Abbreviations

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<th>Description</th>
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<tr>
<td>AD</td>
<td>Auto-destruct (syringe)</td>
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<tr>
<td>BCG</td>
<td>Bacillus Calmette-Guerin</td>
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<td>BMC</td>
<td>Budget Management Centers</td>
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<td>CC</td>
<td>Cold Chain</td>
</tr>
<tr>
<td>CHAG</td>
<td>Christian Health Association of Ghana</td>
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<tr>
<td>CHN</td>
<td>Community Health Nurse</td>
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<td>CHPS</td>
<td>Community-based Health Planning and Services</td>
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<td>CSO</td>
<td>Civil Society Organization</td>
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<tr>
<td>CWC</td>
<td>Child Welfare Clinics</td>
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<tr>
<td>DDHS</td>
<td>District Director of Health Services</td>
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<td>DDPH</td>
<td>Deputy Director Public Health</td>
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<tr>
<td>DHMT</td>
<td>District Health Management Team</td>
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<tr>
<td>DHIMS</td>
<td>District Health Information Management System</td>
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<tr>
<td>DP</td>
<td>Development Partners</td>
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<tr>
<td>DTP</td>
<td>Diphtheria, Tetanus, Pertussis (vaccine)</td>
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<tr>
<td>DVDMT</td>
<td>District Vaccine Distribution Management Tool</td>
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<td>EPI</td>
<td>Expanded programme on Immunization</td>
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<td>GAVI</td>
<td>Global Alliance for Vaccines and Immunization</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GDHS</td>
<td>Ghana Demographic and Health Survey</td>
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<tr>
<td>GHS</td>
<td>Ghana Health Service</td>
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<td>GIVS</td>
<td>Global Immunization Vision and Strategy</td>
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<td>GOG</td>
<td>Government of Ghana</td>
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<td>GPRS</td>
<td>Ghana Poverty Reduction Strategy</td>
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<td>GSS</td>
<td>Ghana Statistical Service</td>
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<tr>
<td>HC</td>
<td>Health Centre</td>
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<tr>
<td>HCW</td>
<td>Health Care Worker</td>
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<tr>
<td>HSMTDP</td>
<td>Health Sector Medium Term Development Plan</td>
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<tr>
<td>HepB</td>
<td>Hepatitis B vaccine</td>
</tr>
<tr>
<td>HF</td>
<td>Health Facility</td>
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<tr>
<td>Hib</td>
<td>Haemophilus Influenzae type b vaccine</td>
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<tr>
<td>HMIS</td>
<td>Health Management Information System</td>
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<tr>
<td>HSMTDP</td>
<td>Health Sector Medium Term Development Plan</td>
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<tr>
<td>ICC</td>
<td>Inter Agency Coordinating Committee</td>
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<tr>
<td>IDSR</td>
<td>Integrated Disease Surveillance and Response</td>
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<tr>
<td>IEC</td>
<td>Information, Education and Communication</td>
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<tr>
<td>ISS</td>
<td>Immunization Services Support</td>
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<tr>
<td>MCH</td>
<td>Maternal and Child Health</td>
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<tr>
<td>MCV-2</td>
<td>Measles Containing Vaccine 2\textsuperscript{nd} dose</td>
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<tr>
<td>MDG</td>
<td>Millennium Development Goal</td>
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<tr>
<td>M&amp;E</td>
<td>Monitoring and Evaluation</td>
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<tr>
<td>MNT</td>
<td>Maternal and Neonatal Tetanus</td>
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<tr>
<td>MoFEP</td>
<td>Ministry of Finance and Economic Planning</td>
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<tr>
<td>MoH</td>
<td>Ministry of Health</td>
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<tr>
<td>NID</td>
<td>National Immunization Day</td>
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<td>NIP</td>
<td>National Immunization Programme</td>
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<td>NT</td>
<td>Neonatal Tetanus</td>
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<tr>
<td>OPV</td>
<td>Oral Polio Vaccine</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>PCV</td>
<td>Pneumococcal Vaccine</td>
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<tr>
<td>Penta</td>
<td>Pentavalent vaccine</td>
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<tr>
<td>REC/RED</td>
<td>Reaching Every Child/Reaching Every District</td>
</tr>
<tr>
<td>PPME</td>
<td>Policy, Planning, Monitoring and Evaluation</td>
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<tr>
<td>RCH</td>
<td>Reproductive and Child Health</td>
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<tr>
<td>RHMT</td>
<td>Regional Health Management Team</td>
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<tr>
<td>RI</td>
<td>Rotary International</td>
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<td>SIAs</td>
<td>Supplemental Immunization Activities</td>
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<tr>
<td>SWAp</td>
<td>Sector-Wide Approach</td>
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<td>TT</td>
<td>Tetanus Toxoid</td>
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<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
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<td>USAID</td>
<td>United State Agency for International Development</td>
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<tr>
<td>VPD</td>
<td>Vaccine preventable Disease</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<td>WICR</td>
<td>Walk In Cold Room</td>
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1. Executive Summary

1.1. Introduction
This study is part of a larger project “Analyses of the Costs and Financing of Routine Immunization Programs and New Vaccine Introduction” which is funded by the Bill and Melinda Gates Foundation. The project encompassed six countries (Moldova, Uganda, Zambia, Honduras, Benin and Ghana).

The overall goal of the proposed project is to undertake analyses of the costs, funding flows of routine immunization programs and new vaccine introduction (NUVI) and determinants of costs and productivity at facility level in Ghana. The present report focuses on the Ghana study.

1.2. Objectives
The objectives of the study are the following:
- Calculate costs of routine National Immunization Program (NIP) in 2011 including total cost, cost structure, unit cost and delivery cost
- Evaluate financing flows of routine NIP
- Calculate incremental costs of new vaccine introduction including total cost, cost structure, unit cost and delivery cost
- Evaluate financing of new vaccine introduction activities
- Evaluate productivity of immunization service providers and its determinants

1.3. Methods
For the costing analysis, the scope of the analyses was a) the national routine immunization program and b) the new vaccine introduction from the central level to the vaccine delivery sites. We included in the study scope the health facilities that provide routine immunization services to children and their related sub-national administrative units at district and regional level. The chosen perspective for the study was the government health service.

For routine immunization we estimate annual costs for 2011, the last fiscal year for which data are available. National Immunization Days were outside the study scope. Both economic and financial costs were estimated. The main focus was on annual economic costs, i.e., the value of resources paid for by or owned by the MOH (and other funding sources). Financial costs correspond to the monetary payments (or expenditures) incurred by MOH for the EPI program.

For the NUVI costing, an incremental approach was adopted, i.e. additional activities and resources that would not have occurred if the new vaccines had not been introduced. The timeframe included the preparatory, start up and post introduction activities (August 2010 – October 2012 at central level; February 2012 – October 2012 at sub national levels). In addition, the additional time spent to administer the new vaccines at facility level was included as operational costs the year of introduction.

For the funding flow analysis, the focus was on financial and commodity flows for the routine immunization program from external, government, and other domestic sources. Specific financing questionnaires were developed to capture funding flows for routine
immunization. A methodology derived from the System Health Accounts 2011 methodology for coding financial flows was adopted. Each financial flow was allocated to a funding source, financing agent, health-care provider, health-care provision and health-care function and was sub categorized within these categories.

Three types of funding sources for the EPI program were identified for Ghana (1): Government of Ghana, Internally Generated Funds, and development partners (multilateral or bilateral donors). Donors that contributed to the Ghana EPI program during 2010 to 2011 included WHO, UNICEF, USAID, GAVI. Volunteers were not included as they do not receive any allowance for routine immunization activities. The fiscal years of 2010 and 2011 were included in the timeframe.

A stratified random sampling approach was used for the district and facility selection. We classified districts according to urban and rural location, number of pentavalent doses administered in 2011 and population density. As most districts were rural (106 rural and 32 urban) in Ghana, we selected four rural districts (high and low doses administered / population density) and two urban districts (high and low doses administered). Within selected districts, we stratified health facilities associated with immunization programs within the following categories: type (Reproductive and Child Health Units, Health Centers, Community-based Health Planning and Services, Clinics), ownership and area (urban or rural). Within strata, if only one facility met the stratification criteria, it was included; for strata with more than one facility, we randomly selected one for inclusion. All selected facilities (n=50) had to be identified in the Ghana Health Service information systems and be functional during 2011, otherwise a replacement facility was randomly selected.

Total national immunization costs were estimated by aggregating costs where the average weighted cost per facility was multiplied by the total number of facilities. The facility weighted average cost (without vaccines) was multiplied by the number of facilities in the study scope (n= 3,044). District and region weighted averages were multiplied by the number of districts and regions. Vaccines were included at central level for the aggregated cost calculation.

Routine dose administered are defined as the total number of doses administered in routine. Fully Immunized Child (FIC) are defined as the number of children who received the third dose of the DTP-HepB-Hib vaccine. Infant population is defined as the number of children under one year old. Capita refers to the total population.

The following vaccines are part of the routine immunization schedule in 2011: BCG, Pentavalent, Polio, Measles first dose, Yellow Fever and Tetanus Toxoid.

Ghana introduced in 2012 13-valent pneumococcal conjugate vaccine (Prevnar 13) using a three dose schedule with vaccine at 6-10-14 weeks, live oral monovalent G1P8 rotavirus vaccine (Rotarix) using a two dose schedule with vaccine at 6 and 10 weeks, and measles second dose vaccine (Biopharma) delivered at 18 months in their routine immunization schedule.
1.4. Routine immunization costs

The total costs for the national routine immunization program (nationwide) amounted to 53.49 million USD in 2011, representing 5.7% of government health expenditures in Ghana (2), and 0.13% of GDP (current US$ in 2011)\(^1\). The routine EPI cost per dose administered was 5.7 USD, the cost per FIC 60.3 USD, and the cost per infant population in the country 52.9 USD. The cost per capita was 2.1 USD. Recurrent line items accounted for 91% of the aggregated costs. Within recurrent costs, salaried labor was the main cost driver, accounting for 61% of total routine EPI costs, consistent with salaries and benefits accounting for more than 60% of total public health expenditure in Ghana (1). Vaccine and injection supplies costs were captured at the central level and accounted for 19% of total national aggregate costs. The remaining substantial recurrent cost items, as a percentage of total EPI costs, were: volunteer labor (4.2%), transport (3.4%) and overhead utilities and communication (2.0%). Finally minor costs include cold chain energy (0.4%), per diem (0.8%), vehicle maintenance (0.1%), printing (0.1%) and other recurrent costs (0.3%) which together accounted for less than 2% of total cost.

Within the sampled facilities (urban=11; rural=39), the weighted average unit cost per routine dose administered was 5.07 USD. The cost per Fully Immunized Child –FIC- (DTP3-HepB-Hib) was 51.26 USD. The cost per infant population in the catchment area was 36.11 USD. The cost per capita was 1.50 USD. The main cost driver was salaried labor with 60% of facility total cost. Vaccines and injection supplies were the second highest cost driver with 26% of the total facility cost. Vaccines were mostly delivered through outreach as 58% of the vaccine and supplies costs could be attributed to this strategy.

Almost half of the facility costs could be attributed to service delivery, with outreach service delivery representing one fourth (25%) of total facility costs and facility-based delivery accounting for 22%. The cost of support activities (53%) was mostly driven by record-keeping (12%), social mobilization (10%) and surveillance (10%). Vaccine management, supervision, training, program management and cold chain maintenance each represented less than 10% of facility costs.

The cost per dose was lower in urban (3.17 USD) than rural facilities (5.78 USD), due to the number of doses provided and variation in total cost. The cost profile also varied according to facility location. The percentage of total costs due to volunteer labor was higher in rural than urban settings as this labor source was mobilized more often in remote facilities or to target hard-to-reach populations. Similarly, the percentage of transportation and fuel in total costs was higher in rural settings. One reason being that the average distance travelled was systematically higher on average in rural areas for all facility types (2.5 higher in rural health centers for examples).

Distribution within capital costs varied between urban and rural settings: capital costs in rural settings were mostly driven by vehicle costs whereas in urban settings building costs predominated due to larger areas dedicated to vaccine administration and vaccine storage. The higher percentage of costs associated with fixed vaccine delivery in urban areas occurred because urban areas offered immunization services every day (in

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general) due to higher population density. By contrast, in rural areas, the percentage of costs due to outreach delivery was higher because of the more dispersed population.

The cost per FIC was lower in Reproductive and Child Health units of district hospitals (38.49 USD) or Health Centers (42.17 USD) compared to Community-based Health and Planning Services (CHPS) facilities (87.8 USD). Reproductive and Child Health units were located in district capitals and had a significantly higher catchment population and more health workers entirely dedicated to immunization. The higher unit cost of CHPS can be ascribed to a smaller catchment population that requires more effort to vaccinate (as outreach requires more manpower and fuel costs per vaccinated child).

This study also measured above-facility costs at the central, regional and district levels. These include administrative and management costs pertaining to the program. The average yearly routine costs of EPI administrative offices was 28,285 USD for District Health Administrations (DHA) and 92,858 USD for Regional Health Administrations (RHA); the total cost for routine EPI at central level was 702,727 USD. The capital versus recurrent costs distribution was similar between DHAs (74% recurrent / 26% capital) and RHAs (76% recurrent / 24% capital). For the central EPI, recurrent costs represented 62% of total costs and capital 38%; the higher percentage of capital costs at central level was mostly explained by the importance of cold chain equipment costs at central level. The percentage of total costs due to capital costs in district (26%), region (24%) and central administration (38%) was much higher than in facilities due to their role in EPI vaccine distribution (requiring vehicle and cold chain equipment) and storage (requiring buildings).

Routine immunization costs were significantly higher than previous comprehensive Multi-Year Plan or study estimates, indicating that the economic cost of routine immunization has been underestimated by MOH and the international community. Although some shared costs is included in cMYP (personnel…), the results of this study shows that they are have not been fully considered and highlights the importance of full costing approaches and covering shared costs at all levels.

In addition, the substantial percentage of total costs accounted for by volunteers (5%) emphasizes the critical role played by volunteers in expanding community-based health promotion and services, a facet not considered by other costing exercises.

1.5. New and underutilized vaccine introduction (NUVI) costs

According to the timeline of NUVI activities in the vaccine introduction plan, the analytic horizon starts in August 2010 with preparatory activities and ends approximately five months after introduction once most major additional activities (social mobilization, training, supervision, surveillance) have been performed.

The incremental economic cost of new vaccine introduction in Ghana was 26.7 million USD. Programmatic start-up costs (i.e., excluding the value of vaccines and injection supplies) amounted to 3.9 million USD. The delivery cost per dose administered amounted to US$ 2.42, with US$ 1.22 for start-up costs and US$1.23 for ongoing costs.

Overall, total costs (start-up and ongoing) were driven by vaccines (70%), salaried labor (18%), and cold chain (7%). We found that most significant ongoing incremental non-vaccine costs were related to salaried labor and cold chain utilization.
In the case of Ghana, when comparing the actual costs (fiscal cost) with the estimated new vaccine introduction plan costs, the following components of NUVI were underestimated: training (by 40 thousand USD), social mobilization (0.41 million USD), cold chain equipment (1.23 million USD), vehicles (84 thousand USD), record keeping & HMIS (134 thousand USD). In total there was a variance of 1.99 million USD between forecasted expenses in the NUVI plan and actual fiscal costs.

The difference between forecasted expenses and actual costs confirmed the higher costs for some line items identified in previous reviews where transportation, fuel, per diem, cold chain, equipment and maintenance costs had been underestimated (4). However, cold chain expansion had been planned in advance with purchase of walk in cold rooms several years in advance on the new vaccines introduction which was not supposed to be covered by the NUVI plan budget. In addition, some sub national (district, facility) expenses had not necessarily been planned in the new vaccine introduction plan. Some districts had assumed that regional and national levels would supply them with all inputs required for new vaccine introduction, which was not the case.

1.6. Determinants of routine immunization costs
Regarding determinants of costs, the number of fully immunized children, the amount of full time equivalent devoted to routine immunization activities, the availability of sufficient human resource capacity to perform immunization activities correctly, and the availability of cold chain equipment were all associated with total costs at facility level.

1.7. Financing
Routine immunization program received 50 million USD in 2011, including salaries and value of commodities. This funding was provided mostly through domestic sources, which accounted for 78% of the support. Of domestic sources, transfers were channeled through the central MOH, which accounted for 62% of total funds. Regional transfers to District Health Administrations represented 8.8% of total support. Internally Generated Funds (IGF) transferred to District Health Administrations accounted for 2.1% of total funds received. Within IGF, the national social insurance scheme represented 1.9% of total funding; out-of-pocket payments were marginal representing 0.2% of total support. External funding sources contributed 22% of total funding received. Most of the external financing (80%) is provided through the GAVI Alliance New Vaccine Support window through vaccines and supplies distributed by UNICEF supply division. The sources and levels of absolute external financial support distributed by the MOH included the GAVI Alliance (1.41 million USD), WHO (0.24 million USD), UNICEF (0.17 million USD) and USAID (0.15 million USD). GAVI support was channeled through the Ghana Health Service and part of GAVI support was directly disbursed to District Health Administrations. Minor in-kind support was provided by UNICEF (0.1%), WHO (0.1%) and World Vision (0.2%). Most funds spent for routine immunization were executed by the central level, with the central MOH executing 65% of total routine immunization expenditures (mostly driven by salaries). Central cold store (managing the vaccines) executed 22% and Ghana Health Service 1%. Funds executed at district level accounted for 11% of total spending. When excluding salaries and vaccines, expenditures executed at district level represented 61% of total funds, demonstrating the level of decentralization for the execution of funds.
The amount of financing during 2011 was higher than during 2010 by 8.1 million USD. The main factor is the value of vaccines which increased significantly between 2010 and 2011 (from 4.4 million USD in 2010 to 11.3 million USD in 2011). In particular, the cost of the pentavalent vaccine increased from 2.72 million USD (1.2 USD per dose) in 2010 to 7.40 million USD (2.9 USD per dose) in 2011. This increase is due to a switch in pentavalent vaccine presentation (from one dose per vial to ten doses per vial). Donor dependency decreased significantly compared to the costing and financing study conducted in 2000 (5). In 2000, development partners (mostly from DFID) supported 51% of routine immunization costs while the national government supported the remaining 49%. Currently, however, donor support accounts for 22% of total support and was mostly accounted for by GAVI support for vaccines.

A qualitative assessment of funding flows was conducted with the different institutional actors providing or executing funds for immunization. From central EPI perspective, funding was considered as insufficient particularly for routine immunization (as opposed to campaigns). There was a late release of funds from Ghana Health Service, Disease Control Department and development partners to EPI. Consequently, support for routine immunization activities was taken from the positive fund within other activities. According to regional EPI teams, no specific funding dedicated to routine immunization exists but rather funds are shared through a pool of funds transferred by the national government to regions. However, funding delays occur (not specific to immunization). When funds arrive, they often are insufficient and lower than approved budgets. Consequently, the regional MOH will take money allocated to other health programs to supplement EPI program budgets. District informants had a similar viewpoint as that express at the regional level, since they mostly use national government funds transferred by regions. As with the regions, funding arrives late, is insufficient to carry out all routine immunization activities in the sub districts, and lower than that allocated in the approved budget. Districts have no alternative funds to close the gap between the amount of approved funds and funds received, so funding gaps lead to reduction in services.

Most vaccine delivery facilities did not have financial data available. In the facilities where data was available financing amounts were not disaggregated for routine immunization. Identified funding sources included Internally Generated Funds (IGF) generated from user fees or sale of drugs which is supposed to be transferred to the district level. The survey in the fifty facilities found that 86% of facilities had collected user fees in 2011. Data on the amount collected through user fees was available in 64% of the facilities collecting user fees. The average sum collected (not weighted) through user fees was 1 156 USD. The portion supporting the operational costs of routine immunization services was not known. For urgent needs, health facilities may use IGF funds to pay for their expenses. In contrast to Ghanaian government workers, donors identified as their main concern the efficient spending of funds received by the recipients. Donors also indicated that delays in delivery of funds occur due to the failure of recipients to account in a timely way for fund disbursement.

NUVI was funded mostly through domestic sources; among external sources, GAVI support was the most significant representing 1.5 million USD (through the new vaccine introduction grant and Immunization Services Support). Of GAVI new vaccine introduction grant, 29% was transferred to the regions to support new vaccine introduction activities at lower administrative levels. This support was used for social mobilization for vaccine introduction – including launch (28%), surveillance related to
new vaccine introduction (16%), research (11%) and program management / meetings (8%).

1.8. Conclusion
Our study found a high cost of routine immunization compared to previous cMYP estimates in Ghana which include the pentavalent vaccine (6,7). The unit cost of immunization is even higher in hard to reach areas and small rural facilities, both for outreach delivery costs and associated support activities. Similarly, the unit cost per dose decreases with the facility type implying that RCH or Health Centers require fewer resources than CHPS to deliver one dose. In addition new vaccines introduction costs had been underestimated primarily cold chain equipment. The financing analysis outline the large proportion of financing by the national government, the substantial increase in 2011 versus 2010 and the lack of timely financing.

Considering these main findings, one of the key challenges ahead for EPI Ghana is to maintain the current level of performance 91% DTP3-HepB-Hib coverage (2011 WHO-UNICEF estimate) but also reaching additional children, most of whom will require outreach strategies.

At the same time, routine immunization programs are hampered by limited and delayed financing, in particular for outreach (1). Without changes, this situation may get worse as Ghana implements new vaccines such as rotavirus, pneumococcal conjugate vaccine and potentially others in the future.

One path taken by the Ghanaian health system is the expansion of community-based service delivery under the ‘Community-based Health Planning and Services initiative,’ which will address the lack of access in some areas.

CHPS had higher unit costs which shows that the higher the coverage, the more resources required. However, as Ghana is financing most of the program and a growing share of the program over time (through co-financing), there is scope to sustain the program if strong political commitment and resource allocation is maintained.

The challenge of this initiative will be to ensure financial sustainability by mobilizing more resources through MOH subsidies, the National Health Insurance Scheme and user fees. At a time when the Ghanaian health sector moves towards more demand-side financing, vaccines remain mostly supported by donors and immunization service delivery remains supported mostly through supply-side subsidies through MOH transfers to district level. These larger issues relate to the larger eventual goal of national immunization program self-sufficiency.
2. Purpose and scope of the study

2.1. Introduction
This study is part of a larger project “Analyses of the Costs and Financing of Routine Immunization Programs and New Vaccine Introduction” which is funded by the Bill and Melinda Gates Foundation. The project encompassed six countries (Moldova, Uganda, Zambia, Honduras, Benin and Ghana). The present report focuses on the Ghana study. The six countries used a common methodological approach developed by the Bill and Melinda Gates Foundation (8).

2.2. Goal and objectives
The overall goal of the proposed project is to undertake analyses of the costs, funding flows of routine immunization programs and new vaccine introduction (NUVI) and determinants of costs and productivity at facility level in Ghana.

The objectives of the study are the following:
- Calculate costs of routine National Immunization Program (NIP) in 2011 including total cost, cost structure, unit cost and delivery cost
- Evaluate financing flows of routine NIP
- Calculate incremental costs of new vaccine introduction including total cost, cost structure, unit cost and delivery cost
- Evaluate financing of new vaccine introduction activities
- Evaluate productivity of immunization service providers and its determinants

2.3. Study questions

2.3.1. Routine immunization costs
Regarding routine immunization costs, the following questions will be addressed:
- What is the total cost of the routine immunization program?
- What is the cost structure (i.e. cost by line item)?
- What is the delivery cost associated with the routine immunization program?
- What are the unit costs of the routine program at facility level, and what are the factors that drive the variation in total and unit costs?
- What are the determinants of routine program costs and levels of output (number of children immunized, facility attendance)?

2.3.2. New and Underutilized Vaccine Introduction (NUVI) costs
Regarding new vaccine introduction costs, the following questions will be addressed:
- What is the incremental cost of new vaccine introduction?
- What is the delivery cost for new vaccine introduction?

2.3.3. Routine immunization financing (including NU VI)
Regarding routine immunization financing, the following questions will be addressed:
- What are the main sources of financing of the routine immunization program?
- How much funding for routine immunization is disbursed from funder down to the district level?

What are the sources of funding for routine immunization at facility level?
2.4. Study scope
The scope of the analyses was a) the national routine immunization program and b) the new vaccine introduction from the central to the vaccine delivery sites. We include in the study scope the health facilities that provide routine immunization services to children except private for profit ones and their related sub-national administrative units at district and regional level. The cost and financing of dedicated immunization sessions (child days) implemented in facilities was included as well as outreach services provided from the facility. Supplementary immunization activities are outside the study scope.

2.5. Ethical issues
We collected institutional data only. The study protocol was submitted to the Ghana Health Service Ethical Review Committee and the study was authorized in December 2012. We implemented standard confidentiality procedures to protect the identity of study informants including password-protected computer entry and deletion of all individual identifiers from the database at the end of data collection.

3. Background

3.1. Country characteristics
Ghana is divided into ten administrative regions: Ashanti, Brong-Ahafo, Central, Eastern, Greater Accra, Northern, Upper East, Upper West, Volta and Western Regions. The country had 170 districts in 2011 and about 1000 sub-districts.

The data compiled from the 2010 census provides an estimated population of 24,658,823 (9). The projected population of the country for 2011 was 25,275,293 based on an annual average growth rate of 2.5% (9). Life expectancy at birth (2008) was 62 years old for the total population (60 for male and 64 for females). The infant mortality rate is 51 per living 1000 living birth (2008, DHS) and the under five mortality rate was 76. The under five children represent 18.5% of total population and under 1 year old children represent 4%. The proportion of women in child bearing age is 24% (CHIM, 2012).

Ghana was classified as a lower middle-income country in 2008. The poverty headcount ratio\(^2\) at national poverty line was 28.5% in 2006 (10) as opposed to 51.7% in 1992.

The Ghana Statistical Service estimated the country’s GDP at US$31,548.4 million and GDP per capita US$1,303 and it is estimated to grow to about $1,517 in 2014. Similarly total health expenditure per capita is expected to grow from $56 to $79 by 2014 (Table 1).

\[^2\] National poverty rate is the percentage of the population living below the national poverty line. National estimates are based on population-weighted subgroup estimates from household surveys (World Bank data).
Table 1: Macro-economic indicators in Ghana

<table>
<thead>
<tr>
<th>Macroeconomic Indicators</th>
<th>2010</th>
<th>2011</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per capita GDP ($)</td>
<td>1,302</td>
<td>1,341</td>
<td>1,516</td>
</tr>
<tr>
<td>Total health expenditure per capita ($)</td>
<td>56</td>
<td>61</td>
<td>79</td>
</tr>
<tr>
<td>Population</td>
<td>24,233,431</td>
<td>24,804,793</td>
<td>26,633,944</td>
</tr>
<tr>
<td>GDP ($) million</td>
<td>31,548</td>
<td>33,265</td>
<td>40,394</td>
</tr>
<tr>
<td>Total health expenditure ($)</td>
<td>1,346,962,957</td>
<td>1,513,775,200</td>
<td>2,095,360,971</td>
</tr>
<tr>
<td>Government health expenditure ($)</td>
<td>202,044,446</td>
<td>272,479,536</td>
<td>628,608,291</td>
</tr>
<tr>
<td>GDP growth (annual %)</td>
<td>4%</td>
<td>8%</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Source: Budget statement 2010 (MoFEP), National Accounts Rebase 2010 (GSS), Housing and Population Census 2010 (GSS) and Estimation based on initial sources

3.2. Health System and routine immunization program in Ghana

3.2.1. Ghana Health Service Delivery system

Ghana has a comprehensive health service delivery system (11) which follows an integrated delivery of health interventions. The delivery system includes Community Health Planning and Services (CHPS), sub district health centers and clinics, district general hospitals, regional general hospitals and specialized tertiary hospitals. Districts are divided into sub-districts3. Since 1997, the Ghana health system has undergone a reform that has decentralized funds and focused service improvements at the district level. Fiscal decentralization implies that district collect revenues and part of the execution of expenses is under their authority (as opposed to central level execution). District Health Management Teams (DHMT) plan, organize and manage services within the district. These teams provide support, supervision to the district and sub-district facilities. Ghana has also scaled up its community based health initiatives to reach rural and remote areas (11) with the expansion of Community-based Health Planning Services (CHPS) (cf. Graph 1).

3 Depending upon the size of the district, a district may have four, five, six or seven sub-districts
3.2.2. Immunization services delivery in Ghana

Routine Immunization is now a main focus for an integrated district service delivery approach (12). There are over 3,000 immunization centers in the country (1). Due to the decentralized nature of health system in Ghana, District Health Management Teams are responsible for planning and implementing routine immunization activities. Within districts, sub-districts look at the number of communities in each of them. Each sub-district health team meets the various communities to schedule immunization sessions with communities. The outreach and facility-based delivery of immunization services (vaccine administration) in relies on the Community Health Nurses.

3.2.3. Description of facility types delivering routine immunization

Four types of facilities are of interest for routine immunization delivery:

- **Reproductive and Child Health (RCH) units** (public): Reproductive and Child Health Units are one of the District Hospitals units (separate building) focusing on maternal and child curative and preventive care. District hospitals provide support to sub districts including referrals, emergencies and training (2). They have a large population in their catchment area as they are located in urban areas.

- **Health Centers (HC)** (public and private): health centers provide basic curative care, disease prevention services, and primary health care (2). HC serve as the reference facility for the sub district (and in this case the sub-district health management team is located in these health centers. They supervise the community level facilities (CHPS) and are located in urban or rural areas.
- **Clinics**: Clinics provide similar services than Health Centers. They can be owned by the Government or by NGOs.
- **Community-based Health Planning and Services (CHPS) (public)**: They are the lowest level of service delivery and serve as the first-line health facilities. They refer patients to Health Centers when required. They provide interventions in small facilities and also provide outreach services to communities. They are mostly located in rural areas.

All these facilities conduct outreach services in addition to facility-based delivery.

### 3.2.4. EPI structure in Ghana

The EPI in Ghana is organized in the following way by administrative level:

- At central level, the EPI Unit is under the Head of Disease Control Department that comes directly under the Directorate of Public Health.
- At the regional level, the EPI is integrated into the public health system under the Deputy Director Public Health (DDPH) and managed within the Regional Health Management Team. There are Regional EPI coordinators and Disease Control Officers who are responsible to the DDPH for the day-to-day management of immunization programs together with Regional Public Health Nurses.
- At district level, the District Health Management Team is led by the District Director of Health Services who implements integrated programs. There are Disease Control Technical Officers and District Public Health Nurses who are responsible for EPI activities in the districts. They do not administer the vaccines but focus on support activities (supervision, training, monitoring, program management....). They also collect activity reports from the sub-districts and summarize them for transmission to the regional level.

**Graph 2: EPI structure within MOH/GHS in Ghana at national, regional and district levels**

```
  Director General
       |                   |
       |   Dep. Dir. General   |
       |                   |
    Director PH | Reg. Dir. Health | Other Directors
                   |                   |
     Head, DCD. | DDPH | Dist. Dir. Hlth. S.
                   |       |
  EPI Manager | Public Health Unit | DHMT | Sub-District HT
                   |       |
      EPI team | EPI | EPI team
```

### 3.3. National immunization schedule and EPI performance in Ghana

In 1978, launch of EPI with six antigens: BCG, measles, diphtheria-pertussis-tetanus (DPT) oral polio for children under one year of age together with tetanus toxoid vaccination for pregnant women. In 1992, the yellow fever vaccine was introduced. In 2002, the pentavalent vaccine was introduced (including the DPT- Hepatitis B and the Haemophilus influenza type b antigens). In 2012, the following vaccines were
introduced: Rotavirus, pneumococcal, measles second dose, meningitis A (campaign in meningitis belt districts).
The updated immunization schedule is provided by antigen in the table below (table 2).

### Table 2: Immunization schedule by antigen in Ghana

<table>
<thead>
<tr>
<th>Vaccine/antigen</th>
<th>Dosage</th>
<th>Doses required</th>
<th>Minimum interval between doses</th>
<th>Minimum to start age</th>
<th>Mode of administration</th>
<th>Site of administration</th>
<th>Doses per vial</th>
<th>Presentation</th>
<th>Price per dose 2011 (source EPI Ghana)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCG</td>
<td>0.05ml up to 11 months, 0.10ml after 11 months</td>
<td>1 dose</td>
<td>None</td>
<td>None</td>
<td>At birth (or first contact)</td>
<td>Intra-dermal</td>
<td>Right Upper Arm</td>
<td>20</td>
<td>Lyophilized</td>
</tr>
<tr>
<td>Pentavalent</td>
<td>0.5 ml</td>
<td>3 doses 6, 10 and 14 weeks</td>
<td>4 weeks</td>
<td>At 6 weeks (or first contact after that age)</td>
<td>Intra-muscular</td>
<td>Outer Upper Aspect of Left Thigh</td>
<td>1</td>
<td>Liquid</td>
<td>2.96</td>
</tr>
<tr>
<td>Pneumo</td>
<td>0.5 ml</td>
<td>3 doses 6, 10 and 14 weeks</td>
<td>4 weeks</td>
<td>At 6 weeks (or first contact after that age)</td>
<td>Intra-muscular</td>
<td>Outer upper Aspect of Right Thigh</td>
<td>1</td>
<td>Liquid</td>
<td>7*</td>
</tr>
<tr>
<td>Polio</td>
<td>2 drops</td>
<td>4 doses At birth, 6, 10 and 14 weeks</td>
<td>4 weeks</td>
<td>At birth or within the first 2 weeks</td>
<td>Oral</td>
<td>Mouth</td>
<td>20</td>
<td>Liquid</td>
<td>0.13</td>
</tr>
<tr>
<td>Rotarix</td>
<td>1.2 ml</td>
<td>2 doses, 6 and 10 weeks</td>
<td>4 weeks</td>
<td>At 6 weeks (or first contact after that age)</td>
<td>Oral</td>
<td>Mouth</td>
<td>1</td>
<td>Liquid</td>
<td>2.42*</td>
</tr>
<tr>
<td>Measles first dose</td>
<td>0.5 ml</td>
<td>1 doses at 9 months</td>
<td>9 months</td>
<td>At 9 months</td>
<td>Sub-cutaneous</td>
<td>Left Upper Arm</td>
<td>10</td>
<td>Lyophilized</td>
<td>0.19</td>
</tr>
<tr>
<td>Measles second dose</td>
<td>0.5 ml</td>
<td>1 doses 18 months</td>
<td>At 18 months</td>
<td>Right Upper Arm</td>
<td>10</td>
<td>Lyophilized</td>
<td>0.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow Fever</td>
<td>0.5 ml</td>
<td>1 dose</td>
<td>None</td>
<td>At 9 months</td>
<td>Sub-cutaneous</td>
<td>Right Upper Arm</td>
<td>5</td>
<td>Lyophilized</td>
<td>0.66</td>
</tr>
<tr>
<td>Tetanus Toxoid</td>
<td>0.5 ml</td>
<td>2 doses</td>
<td>1 month</td>
<td>Pregnant Women</td>
<td>Inta-musucary</td>
<td>Upper Arm</td>
<td>10</td>
<td>Liquid</td>
<td>0.085</td>
</tr>
</tbody>
</table>

*2012 price = NUVI
<table>
<thead>
<tr>
<th>Year</th>
<th>Antigen</th>
<th>2006</th>
<th></th>
<th>2007</th>
<th></th>
<th>2008</th>
<th></th>
<th>2009</th>
<th></th>
<th>2010</th>
<th></th>
<th>2011</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doses</td>
<td>%</td>
<td></td>
<td>Doses</td>
<td>%</td>
<td>Doses</td>
<td>%</td>
<td>Doses</td>
<td>%</td>
<td>Doses</td>
<td>%</td>
<td>Doses</td>
<td>%</td>
</tr>
<tr>
<td>2006</td>
<td>BCG</td>
<td>888,556</td>
<td>100</td>
<td>938,488</td>
<td>102</td>
<td>967,579</td>
<td>103</td>
<td>1,008,183</td>
<td>104</td>
<td>1,019,676</td>
<td>102</td>
<td>1,070,080</td>
<td>105</td>
</tr>
<tr>
<td>2007</td>
<td>OPV 3</td>
<td>746,792</td>
<td>84</td>
<td>803,243</td>
<td>88</td>
<td>812,630</td>
<td>86</td>
<td>861,220</td>
<td>89</td>
<td>867,350</td>
<td>87</td>
<td>884,615</td>
<td>87</td>
</tr>
<tr>
<td>2008</td>
<td>Penta 3</td>
<td>751,000</td>
<td>84</td>
<td>805,079</td>
<td>88</td>
<td>817,154</td>
<td>87</td>
<td>867,652</td>
<td>89</td>
<td>869,670</td>
<td>87</td>
<td>887,086</td>
<td>87</td>
</tr>
<tr>
<td>2009</td>
<td>Measles</td>
<td>759,222</td>
<td>85</td>
<td>812,083</td>
<td>89</td>
<td>815,617</td>
<td>86</td>
<td>861,967</td>
<td>89</td>
<td>875,449</td>
<td>88</td>
<td>894,546</td>
<td>88</td>
</tr>
<tr>
<td>2010</td>
<td>YF</td>
<td>749,233</td>
<td>84</td>
<td>807,807</td>
<td>88</td>
<td>811,012</td>
<td>86</td>
<td>865,472</td>
<td>89</td>
<td>873,904</td>
<td>88</td>
<td>888,802</td>
<td>87</td>
</tr>
<tr>
<td>2011</td>
<td>TT2+</td>
<td>608,843</td>
<td>68</td>
<td>651,704</td>
<td>71</td>
<td>719,811</td>
<td>76</td>
<td>763,284</td>
<td>79</td>
<td>761,440</td>
<td>76</td>
<td>773,092</td>
<td>76</td>
</tr>
</tbody>
</table>

Data of doses administered in routine is compiled from immunization monitoring charts completed in Ghana facilities. The number of third doses of pentavalent vaccine administered followed a significant increase from 751,000 in 2006 to 887,086 in 2011 (table 3) (1). The pentavalent 3 coverage rate went from 84% in 2006 to 87% in 2011. For the pentavalent vaccine, the program has no yet reach the operational target of 90% of vaccine coverage in 2011 (1).
3.4. Current knowledge on costs and financing of immunization in Ghana and globally

There is limited up-to-date knowledge on the full economic cost of routine immunization in Ghana. Some data exist but are mainly focused on resource requirements and financial projections. The latest official information available can be extracted from the comprehensive Multi Year Plan (cMYP) from 2010-2014 which is an immunization financial planning and budgeting tool (3). These estimates will serve as a reference point to discuss the present study results on costing and financing. The estimated projected cost for routine immunization in 2011 was US$ 32,293,328 (7), corresponding to (table 4).

<table>
<thead>
<tr>
<th>Input</th>
<th>cMYP 2010 projection (USD)</th>
<th>cMYP 2011 projection (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaccines and injection supplies (traditional and underused vaccines)</td>
<td>13,474,512</td>
<td>14,317,285</td>
</tr>
<tr>
<td>includes DTP-HepB-Hib, excluding PCV, Rotavirus and MSD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel (salaries and per diems – shared and specific)</td>
<td>8,918,560</td>
<td>12,880,520</td>
</tr>
<tr>
<td>Maintenance and overhead</td>
<td>2,735,974</td>
<td>3,751,821</td>
</tr>
<tr>
<td>Specific Transportation</td>
<td>22,254</td>
<td>22,699</td>
</tr>
<tr>
<td>Shared transportation cost (fuel, taxi)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Short-term training, IEC/social mobilization, Disease surveillance, Programme management</td>
<td>810,900</td>
<td>728,280</td>
</tr>
<tr>
<td>Capital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold Chain Equipment</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vehicles</td>
<td>117,957</td>
<td>592,524</td>
</tr>
<tr>
<td>Buildings</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other capital items</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total routine immunization costs</strong></td>
<td><strong>28,978,657</strong></td>
<td><strong>32,293,328</strong></td>
</tr>
</tbody>
</table>

A costing study Levin et Al. (5) conducted in 2000, estimated total cost for routine EPI was 4,026,905 USD (in nominal value and 5,074,703 USD in real value) corresponding to 9.74 USD per FIC (n=478,719) and a cost of 0.26 USD per capita⁴.

⁴ Average costs are presented adjusted for inflation
4. Cost analysis of routine immunization

4.1. Methods

4.1.1. Perspective and key methodological assumptions

4.1.1.1. Perspective
The chosen perspective for the study is the government health service.

4.1.1.2. Analytic horizon
For routine, the last fiscal year available being year 2011, the costs were assessed over this period.

4.1.1.3. Definitions of activities and inputs
We organized our data collection and analysis to capture routine immunization costs by activity and inputs.

The following activities related to routine immunization were included: routine facility based vaccine administration, outreach vaccine administration, record-keeping, surveillance, supervision, training, vaccine collection/distribution/storage, cold chain maintenance.

Capital (cold chain equipment, vehicles, and buildings) as well as recurrent inputs (vaccines, salaried labor, volunteer labor, fuel, overheads) were included.

Appendix 2 and 3 for provides the definitions of activities (A2) and inputs (A3).

4.1.2. Sampling
The sampling of districts and primary health care facilities was conducted in collaboration with EPI manager, deputy EPI manager and PPME division of the Ghana Health Service.

4.1.2.1. Rationale for district selection
A stratified random sampling approach was used for the district selection. First, we developed a complete list of the 170 urban and rural districts in Ghana based on GHS listings. The rural/urban classification of localities was population based, with a population size of 5,000 or more being urban and less than 5,000 being rural. An urban community was a settlement with 5000 or more inhabitants, while a rural community was a settlement with less than 5000 inhabitants. Therefore, by definition, a district with most communities having less than 5000 inhabitants was classified as a rural district; and a district with most communities having more than 5000 inhabitants was classified as an urban district.

We then classified urban and rural district lists within the following categories:
- Number of doses administered (Pentavalent) in 2011
- Inhabitants per square kilometer (population density)

This information was arrayed in an Excel file. This spreadsheet served as the basis for district sample selection. We grouped the district between the different categories (combinations) and performed a randomized sampling within these stratification variables in order to have diversity in terms of immunization performance and population density.

As most districts were rural (106 rural and 32 urban) in Ghana, we randomly selected four rural districts and two urban districts.

We randomly selected four rural districts in the following strata:
- High Population density and high doses administered: Asante Akim South (Ashanti region)
- High Population density and low doses administered: Bunkpurugu Yunyoo (Northern region)

5 We excluded Volta region as pre test was performed in this region and also 8 districts from Western region, 2 from Ashanti region, 2 from Eastern region, 1 from Brong Ahafo and 1 from Northern region for which the urban / rural information was not available at the GHS.
We randomly selected two urban districts in the following strata:
- High doses administered Ga West (Greater Accra)
- Low doses administered Wa Municipal (Upper West region)

4.1.2.2. Facility selection

We stratified the facilities through the following categories:
- Area (urban or rural)
- Facility type (Health Center, CHPS, RCH units of district hospitals, Clinics)
- Ownership (Government, NGO/Mission)

For a margin of error of 12%; and a confidence level of 90% with a total number of facilities of 2668, the recommended sample size was 50\(^6\). In order to have 50 facilities, we selected in each district approximately 50% of the total of health facilities (107). The rule applied to select the number of facilities within each district for each strata is the following: if there was only one facility in the strata, we selected one facility (automatically selected). If there was more than one facility in the strata, we selected approximately 50% of the facilities of the same strata.

Within strata, we randomly selected the facilities for which there was more than one facility. We used the software, random sorter for Excel. All selected facilities could be verified and were captured in the Ghana Health Service information systems. Some of the facilities initially selected were not functional in 2011. Therefore in some of the districts, replacement facilities were selected. Table 5 lists the six districts that were included in the study and the number and rural facilities per district. See Appendix table A.2 for a list of facilities.

<table>
<thead>
<tr>
<th>District</th>
<th>Sampled Urban facilities</th>
<th>Total Urban Facilities in a District</th>
<th>% of Total Urban Facilities Sampled</th>
<th>Sampled Rural facilities</th>
<th>Total Rural Facilities in a District</th>
<th>% of Total Rural Facilities Sampled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asante Akim South</td>
<td>2</td>
<td>2</td>
<td>100%</td>
<td>5</td>
<td>12</td>
<td>42%</td>
</tr>
<tr>
<td>Atwima Mponua</td>
<td>1</td>
<td>1</td>
<td>100%</td>
<td>5</td>
<td>9</td>
<td>55%</td>
</tr>
<tr>
<td>Ga West</td>
<td>4</td>
<td>8</td>
<td>50%</td>
<td>4</td>
<td>9</td>
<td>44%</td>
</tr>
<tr>
<td>Bunkpurugu Yunyoo</td>
<td>1</td>
<td>1</td>
<td>100%</td>
<td>5</td>
<td>9</td>
<td>55%</td>
</tr>
<tr>
<td>Kassena Nankana</td>
<td>2</td>
<td>2</td>
<td>100%</td>
<td>6</td>
<td>20</td>
<td>30%</td>
</tr>
<tr>
<td>Wa Municipal</td>
<td>1</td>
<td>1</td>
<td>100%</td>
<td>12</td>
<td>28</td>
<td>43%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11</strong></td>
<td><strong>15</strong></td>
<td><strong>73%</strong></td>
<td><strong>37</strong></td>
<td><strong>87</strong></td>
<td><strong>42%</strong></td>
</tr>
</tbody>
</table>

4.1.3. Data collection and entry

4.1.3.1. Survey units

The different sites for data collection included:
- At central level: EPI located within the Diseases Control Department at the Public Health Division of the Ghana Health Service, Ghana Health Service transport, finance, human resource units, MoH administrative and financial directorate, Human Resource department at the MoH, Ministry of Finance and Development partners office (WHO country office, UNICEF country office), Central Cold Store.
- At regional level: EPI administrative units within the regional health services (Regional Health Administrations)

\(^6\) [http://www.raosoft.com/samplesize.html](http://www.raosoft.com/samplesize.html)
4.1.3.2. Training of interviewers and pre-test of questionnaires

The questionnaire was adapted from a generic questionnaire developed as part of the common approach (8) to the Ghana context. The interviewers received six day training on the questionnaires in Accra. The deputy EPI manager provided inputs on the questionnaires during the training. The objectives were to:

- Present the study to the interviewers
- Discuss and adjust the different questionnaires of the study
- Perform a pre-testing of the questionnaires on the field
- Finalize operational planning of the data collection

The pre-test of the questionnaires was performed in the Volta Region (which was therefore not part of the study sample). The different facility types were visited as well as the district and regional administrative offices. Based on the pre-test feedback from interviewed individuals, the questionnaires were finalized during a one day debrief session.

4.1.3.3. Field data collection

Directed interviews and document review has been performed to collect data on the inputs used by the routine immunization program and for vaccine introduction activities. The data collection at facility, district and region levels was conducted by the interviewers. A National Team Leader was in charge of data collection implementation and supervision at the sub national levels. The Health Economist conducted the central level data collection.

4.1.3.4. Supervision of data entry

The supervisors conducted the following activities:
Review of first surveys completed followed by random selection out of all final surveys
Sending feedback for corrections to interviewers
Support the interviewers when issues arise by proposing corrections to resolve them (through a dedicated document).

4.1.3.5. Sharing of the files by interviewers

Interviewers sent by email to supervisors the data entry files completed on an on-going basis. Interviewers uploaded the data entry files in a dedicated shared folder created for the study that allowed close monitoring of the data entry. The folders were organized by district and there was one excel file created for each survey.

4.1.3.6. Identification and correction of data entry mistakes and issues

A document “Identification of mistakes and issues” has been developed for each survey. This document was completed during data entry by the interviewer when issues were identified. Corrections were proposed by the supervisors and for action (if required) by interviewers. Frequent telephone exchange between interviewers and supervisors were set up to exchange on the problems identified and on the review of the initial surveys competed.

4.1.4. Cost analysis

Given the government perspective chosen for the costing, both specific immunization program and shared health system costs were included. The recurrent as well as the capital line item were also within the cost analysis scope.
For each facility in the sample, we estimated total routine immunization facility costs combining expenditure data and information on quantities and their prices for the activities and inputs described in section above.

For each facility, we estimated unit costs by dividing the total routine immunization costs by (1) the annual number of EPI doses delivered in routine schedule; (2) the annual number of fully immunized children who receive DTP3-HepB-Hib; (3) the annual number of infants (under 1 years of age); and (4) the annual total population of the catchment. In sum, the following costs are provided for the facility analysis: facility total cost, cost per dose, unit cost per fully immunized child (DTP3-HepB-Hib), cost per infant, and cost per capita.

Costs were weighted based on their respective sampling weights.

For the facilities in the sample, we estimated the average weighted total and unit cost by facility type (RCH unit, Clinic, Health Center and CHPS) and by area (urban or rural). For each district and regional administrative unit, we estimated the additional costs related to management, supervision, and vaccine supply chain management. We then estimated a weighted average cost for the sampled districts and regions.

The average weighted costs for facility, district and region were then used as inputs into estimating Ghana’s national routine immunization costs for the whole country through an aggregation method described below (Section 3.1.5). Our final set of cost metrics represent national level estimates for total routine immunization costs and cost per dose, cost per FIC, cost per infant and cost per capita, where total costs are divided by national level estimates for the total number of doses delivered, the total number of fully immunized children, the total infant population and the total population, respectively. We present these costs by administrative level (facility, region, district and central levels).

### 4.1.5. Cost calculation by input classification

#### 4.1.5.1. Paid labor

Paid labor was estimated based on the percentage of total working time spent on routine immunization activities. Staff salaries were extracted from the MOH payroll by position and grade of staff in each facility. In Ghana, benefits are embedded in the salary and were collected together with the annual salary.

#### 4.1.5.2. Volunteer labor

As volunteers are not paid for their activities in routine EPI, the daily allowance given to them for the National Immunization Days was collected in each facility and served as proxy salary for their work on routine immunization activities. The average number of hours spent by volunteers was also collected.

#### 4.1.5.3. Per-diem and travel allowances

The amount of per diem received for routine immunization activities implying overnight (training, supervision, surveillance, vaccine distribution or collection, outreach) were directly reported by respondents in the survey.

#### 4.1.5.4. Vaccines and injection supplies

Vaccine costs are based on the stock position at the end of 2011 (based on reported stock records of doses utilized at the facilities). The stock of doses utilized being assessed; doses wasted were implicitly included in the stock position, in addition to the doses administered. Vaccine costs were allocated to outreach or facility-based service delivery level based on the number of dose administered in each strategy in the facility. Table on vaccine price is available page 26 (table 2).
4.1.5.5. Transport and fuel
Transportation costs were estimated based on the number of kilometers of each vehicle in 2011. The number of kilometers was collected in the log books for vehicles or estimated by respondents7. This figure was apportioned by the share of use for routine immunization also estimated by respondents. Within the use for routine immunization the share of use for each activity was distributed based on the number of trips conducted, the frequency and travel time for a given activity. The pump gasoline price was US$ 0.82 per liter and was uniform across facilities (13).

4.1.5.6. Cold chain energy costs
Expenditures on cold chain energy costs were collected at regional level. At national and regional level, expenses were estimated based on the power consumption of the different cold chain equipments and electricity cost in the forecasting tool of 2011 (GHC 0.245 per kiloW/h) (14).

4.1.5.7. Printing costs
Specific printing of immunization support documents or tools is performed at central level and the related expenditures for printing were collected at this level.

4.1.5.8. Overheads, utilities and communication
Overheads, utilities and communication were estimated based on the facility or administration total overhead expense. A tracing factor was applied based on the number of patients and the number of children who received the third dose of DTP8. Cold chain energy costs were not counted at facility level to avoid double counting of the expense.

4.1.5.9. Cold chain equipment
The useful life years of cold chain equipment used for the costing are detailed in the table below (table 6) and were provided by EPI cold chain manager. Prices of cold chain equipment were extracted from the forecasting tool (14) or UNICEF supply database (15). The percentage of use for routine immunization was estimated by cold chain focal point. Cold chain equipment costs were allocated to the activity of vaccine storage.

<table>
<thead>
<tr>
<th>Cold Chain equipment type</th>
<th>Useful life years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk In Cold Room (WICR)</td>
<td>15</td>
</tr>
<tr>
<td>Refrigerator / freezer</td>
<td>8</td>
</tr>
<tr>
<td>Cold Box</td>
<td>5</td>
</tr>
<tr>
<td>Vaccine Carrier</td>
<td>3</td>
</tr>
</tbody>
</table>

4.1.5.10. Buildings
The estimated useful life years of buildings were 25 years (6). The price per square meter of buildings was extracted from the UN population and housing census (9) and varied between facilities and administrative offices (appendix 3).

4.1.5.11. Vehicles
The useful life years of vehicles used for the costing are detailed in the table below (table 7).

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Useful life years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pick up</td>
<td>8</td>
</tr>
<tr>
<td>Saloon car</td>
<td>8</td>
</tr>
<tr>
<td>Motorbike</td>
<td>5</td>
</tr>
</tbody>
</table>

When this data was not available for a given vehicle, the estimated number of km from the last cMYP costing tool was used as a replacement variable.

The following formula for the tracing factor was applied: factor = FIC / (outpatient visits + r * inpatient admissions);
4.1.5.12. Other capital items
The estimated useful life year of incinerator was five years (16).

4.1.5.13. Other
For surveillance, the focus was on activities related to case detection and outbreak response. We estimated the proportion of time and value of time spent at the facility, district, regional and central levels on surveillance activities related to routine immunization. At district, regional and national level, expenditure information has been obtained on integrated disease surveillance (such as operating costs and overhead expenses) to be allocated to routine immunization on the basis of the proportion of time spent on EPI surveillance and VPD cases to total investigations.

4.1.6. Aggregation of costs
In order to provide an estimate of total routine immunization costs for the full country, we aggregated total routine immunization costs at each level of the system as shown in Graph 3 below. The aggregation was made through the averaging method. Sampling weights were applied to each facility (appendix 4). The sampling weights correspond to the inverse probability of a facility and its associated district of being selected. The facility weighted average cost (without the vaccines) was multiplied by the number of facilities in the study scope (n= 3,044). District and region weighted averages costs were multiplied by the number of districts (n=170) and regions (n=10). Vaccines were included at central level for the aggregation cost calculation.

4.1.7. Economic and financial costs
Both economic costs have been estimated, though the main focus was on economic costs (table 8). Financial costs correspond to the monetary payments (or expenditures) incurred by MOH for the EPI program. Financial costs focused on financial outlays for the EPI program and are defined as “measure of loss of monetary value when a resource is acquired or consumed” in order to carry out an activity (17). Financial costs are reported in the annex 13. Economic costs correspond to the value of resources used to implement routine immunization activities. Economic costs included a valuation of all inputs needed for the routine immunization

<table>
<thead>
<tr>
<th>Total annual facility cost of routine immunization</th>
<th>Total annual district cost of routine immunization</th>
<th>Total annual region cost of routine immunization</th>
<th>Central level cost (including vaccines)</th>
<th>Total Aggregated routine immunization cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighted average region cost</td>
<td>Number of regions</td>
<td>Total annual region cost of routine immunization</td>
<td>Total annual district cost of routine immunization</td>
<td>Total annual facility cost of routine immunization</td>
</tr>
</tbody>
</table>

Graph 3: Schematic illustration of the aggregation process by averaging
Number of facilities = 3,044; Number of districts=170; Number of regions=10
program including valuation of time, supplies, equipment; and annualization of costs that adjusts for a discount rate.
For financial cost evaluation, capital costs are divided by the number of years of useful life without discounting (straight line depreciation)(8).

**Table 8: Economic and financial costs included**

<table>
<thead>
<tr>
<th>Economic</th>
<th>Financial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaried labor</td>
<td>Included</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>Included</td>
</tr>
<tr>
<td>Per diems</td>
<td>Included</td>
</tr>
<tr>
<td>Transport and fuel</td>
<td>Included</td>
</tr>
<tr>
<td>Vaccines</td>
<td>Included</td>
</tr>
<tr>
<td>Building overheads</td>
<td>Included</td>
</tr>
<tr>
<td>Cold Chain equipment</td>
<td>Included (discounting)</td>
</tr>
<tr>
<td>Vehicles</td>
<td>Included (discounting)</td>
</tr>
<tr>
<td>Buildings</td>
<td>Included</td>
</tr>
</tbody>
</table>

4.1.8. **Limitations of the approach**

4.1.8.1. **Paid labor**
The estimation of time spent was provided by the staff themselves during interviews.

Inconsistent answers (e.g. percentage of staff time superior to 100%, figure not expressed in percentage…) were verified with interviewers and corrected accordingly in order to minimize bias.

4.1.8.2. **Volunteers**
The NIDs daily allowance was used to estimate volunteer labor costs. This may overestimate the volunteer labor costs when compared to local wages.

4.1.8.3. **Surveillance**
We did not estimate the costs of laboratory or the cost of capital equipment for surveillance due to the heavy data collection implied. This may result in surveillance costs being underestimated. This would have required a separate study. Focus was on the most relevant aspects of surveillance.

4.1.8.4. **Vehicles and cold chain equipment**
The data collected did not allow an estimation of actual useful life years of vehicles or cold chain equipment by district or facility as the estimates were not available at this level. Consequently, useful life years were based on national estimates verified by cold chain manager. This approach may not reflect the different settings where actual life years can vary depending on the environment or frequency of use and maintenance.

4.1.8.5. **Cold Chain maintenance**
Expenses for cold chain were collected at national level. Cost related to staff time spent on cold chain and vehicle maintenance was assessed at all levels.
4.2. Nationwide Routine immunization costs

4.2.1. National costs by line item

The total nationwide costs for Ghana’s routine immunization program amounted to 53,492,285 USD in 2011. This represented 5.21% of general government expenditure on health and 0.14% of Gross Domestic Product\(^9\). The cost per dose was US $ 5.65 USD. The cost per FIC (DTP3-HepB-Hib)\(^10\) was US $ 60.30. The cost per infant was US $ 52.91. The cost per capita was US $ 2.12.

Recurrent costs are the largest component at 91% of total national costs. Within recurrent costs, salaried labor was the main cost driver, accounting for 60.81% of total routine cost. This result is consistent with the fact that currently, salaries and benefits account for more than 60% of total public health expenditure in Ghana (3). Vaccine and injection supplies costs were captured at the central level and accounted for 18.62% of total costs. The remaining recurrent items of the total aggregated costs were, in order of importance: volunteer labor (4.20%), transport (3.37%) and overhead utilities and communication (2.02%). Finally, minor costs drivers concerned cold chain energy costs (0.36%), per diem (0.75%), vehicle maintenance (0.13%), printing (0.11%) and other recurrent costs (0.31%) which together account for less than 2% of total cost (Graph 4).

Graph 4: Distribution of total national routine immunization cost by line item

Regarding programmatic costs (i.e excluding the vaccines), most of the routine immunization (85%) were supported at facility level (table 10). The share of district was also substantial (11%) considering their critical role in the service provision in Ghana. The table below provides the main cost drivers at the different levels by line items for each administrative level (table 9). Administrative office levels (district, region and central) focus on support activities and facilities on service delivery.

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\(^9\) General Government Health Expenditure and gross domestic product data are extracted from ‘Health Expenditure Series’, WHO 

\(^10\) FIC = number of children who received third dose of DTP3 in 2011
Table 9: Distribution of routine immunization programmatic costs by administrative level and main cost drivers by activity and input

<table>
<thead>
<tr>
<th>Level</th>
<th>Distribution of costs</th>
<th>Input (four highest in %)</th>
<th>Activities (four highest in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility</td>
<td>85%</td>
<td>Salaried labor (82%)</td>
<td>Record-keeping &amp; HMIS (17%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volunteer labor (6%)</td>
<td>Facility-based delivery (15%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vehicles (5%)</td>
<td>Outreach service delivery (15%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transport/fuel (3%)</td>
<td>Social mobilization (14%)</td>
</tr>
<tr>
<td>District</td>
<td>11%</td>
<td>Salaried labor (38%)</td>
<td>Program management (18%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overheads, utilities (15%)</td>
<td>Surveillance (17%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Buildings (13%)</td>
<td>Supervision (14%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vehicles (13%)</td>
<td>Social mobilization (12%)</td>
</tr>
<tr>
<td>Region</td>
<td>2%</td>
<td>Salaried Labor (39%)</td>
<td>Vaccine coll., dist. &amp; storage (38%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cold Chain Energy costs (18%)</td>
<td>Program management (17%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vehicles (13%)</td>
<td>Supervision (11%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cold Chain equipment (8%)</td>
<td>Surveillance (9%)</td>
</tr>
<tr>
<td>Central</td>
<td>2%</td>
<td>Cold chain equipment (25%)</td>
<td>Vaccine coll., dist. &amp; storage (38%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Salaried labor (18%)</td>
<td>Social mobilization (22%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overheads, utilities (13%)</td>
<td>Program management (15%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other recurrent (12%)</td>
<td>Supervision (10%)</td>
</tr>
</tbody>
</table>

Table 10 provides insights into the main cost drivers by presenting costs by inputs for administrative and health service delivery levels (table 10). The magnitude of cost differences between facilities, regions and district is explained by (1) the difference average costs at each level; (2) the larger number of health facilities compared to the number of administrative offices at the district and regional level; and (3) different budgetary responsibilities at each level of the system. For instance, districts directly pay for utilities, communications and overheads (table 10). Specific cold chain energy costs are supported by central and regional levels (which are the two critical levels for vaccine storage). Per diems are mostly provided at administrative office levels (district, region, central) and are relatively much lower at facility level. Most of the salaried labor was captured by the facility level due to the number of staff involved at facility level and their critical role in service delivery. The cost of transport of fuel was mostly captured by the facility (60%) and district level (37%) and the central and regional levels have a much lower share. Vehicle maintenance and printing costs were supported by the central level.
## Table 10: Summary of aggregated economic costs and unit costs by input and administrative level (USD 2011)

<table>
<thead>
<tr>
<th>Line item</th>
<th>Total Cost</th>
<th>Share</th>
<th>Facilities</th>
<th>District Health Administration</th>
<th>Regional Health Administration</th>
<th>Central EPI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recurrent costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building overhead, utilities &amp; communication</td>
<td>953,099</td>
<td>2.02%</td>
<td>83,470</td>
<td>723,089</td>
<td>52,326</td>
<td>94,215</td>
</tr>
<tr>
<td>Cold chain energy costs</td>
<td>196,677</td>
<td>0.36%</td>
<td>0</td>
<td>0</td>
<td>169,510</td>
<td>27,167</td>
</tr>
<tr>
<td>Other recurrent</td>
<td>169,377</td>
<td>0.31%</td>
<td>0</td>
<td>75,899</td>
<td>8,028</td>
<td>85,450</td>
</tr>
<tr>
<td>Per diems &amp; travel allowances</td>
<td>355,483</td>
<td>0.75%</td>
<td>125,788</td>
<td>167,067</td>
<td>55,790</td>
<td>6,838</td>
</tr>
<tr>
<td>Salaried labor</td>
<td>32,566,697</td>
<td>60.81%</td>
<td>30,231,147</td>
<td>1,850,881</td>
<td>358,054</td>
<td>126,615</td>
</tr>
<tr>
<td>Transport/fuel</td>
<td>1,795,528</td>
<td>3.37%</td>
<td>1,069,759</td>
<td>661,529</td>
<td>43,225</td>
<td>21,016</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>2,267,997</td>
<td>4.20%</td>
<td>2,267,997</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vaccines</td>
<td>9,278,187</td>
<td>17.18%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9,278,187</td>
</tr>
<tr>
<td>Vaccine injection &amp; safety supplies</td>
<td>779,738</td>
<td>1.44%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>779,738</td>
</tr>
<tr>
<td>Vehicle maintenance</td>
<td>13,516</td>
<td>0.03%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>13,516</td>
</tr>
<tr>
<td>Printing</td>
<td>58,279</td>
<td>0.11%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>58,279</td>
</tr>
<tr>
<td><strong>subtotal recurrent</strong></td>
<td>48,434,577</td>
<td>91%</td>
<td>33,778,159</td>
<td>3,478,465</td>
<td>686,932</td>
<td>10,491,020</td>
</tr>
<tr>
<td><strong>Capital costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>1,174,019</td>
<td>2.11%</td>
<td>726,026</td>
<td>203,467</td>
<td>71,106</td>
<td>173,417</td>
</tr>
<tr>
<td>Vehicles</td>
<td>2,432,026</td>
<td>4.52%</td>
<td>1,742,250</td>
<td>497,118</td>
<td>124,373</td>
<td>68,285</td>
</tr>
<tr>
<td>Buildings</td>
<td>1,431,615</td>
<td>2.65%</td>
<td>748,149</td>
<td>613,628</td>
<td>41,908</td>
<td>27,930</td>
</tr>
<tr>
<td>other capital</td>
<td>20,048</td>
<td>0.05%</td>
<td>0</td>
<td>15,785</td>
<td>4,263</td>
<td>0</td>
</tr>
<tr>
<td><strong>subtotal capital</strong></td>
<td>5,057,708</td>
<td>9%</td>
<td>3,216,426</td>
<td>1,330,001</td>
<td>241,651</td>
<td>269,631</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>53,492,285</td>
<td>100%</td>
<td>36,994,586</td>
<td>4,808,466</td>
<td>928,582</td>
<td>10,760,651</td>
</tr>
</tbody>
</table>

| Cost per routine dose administered; n=9,464,165                 | 5.65       | -      | 3.91       | 0.51                          | 0.10                          | 1.14        |
| Cost per FIC (DTP3); n=887,086                                  | 60.30      | -      | 41.70      | 5.42                          | 1.05                          | 12.13       |
| Cost per infant population; n= 1,011,012                        | 52.91      | -      | 36.59      | 4.76                          | 0.92                          | 10.64       |
| Cost per capita; n= 25,275,293                                  | 2.12       | -      | 1.46       | 0.19                          | 0.04                          | 0.43        |

*Cold chain maintenance, review meeting, social mobilization expenses / **expenses for electricity, water
4.2.2. Aggregated costs by activity

The main cost drivers of aggregated cost are linked to the activity of vaccine collection, distribution and storage (Graph 5). This is linked to the aggregation methods that counted vaccines at central level (and therefore allocated their cost to the activity of vaccine collection, distribution and storage). The other main cost drivers were surveillance (11%), social mobilization & advocacy (11%), routine facility-based service delivery (11%), record keeping (12%) and outreach service delivery (10%).

Graph 5: Distribution of aggregated cost for routine immunization by activity (USD, 2011)
4.3. Administrative offices costs for routine immunization (central, region, district)

The EPI routine total costs of administrative offices were:
- 702,727 USD at central level
- 92,858 USD by Regional Health Administration (RHA) (weighted average)
- 28,285 USD by District Health Administrations (DHA)

Regions play a critical role in administration, supervision and sub-national vaccine supply chain, where they are the hub for regional vaccine storage. Districts have a more critical role in EPI operational support to sub district facilities but also store vaccines and injection supplies.

The cost at district office level varies from 12,067 USD (Bunkpurugu Yunyoo district) to 50,425 USD (Wa Municipal). When comparing the number of pentavalent doses administered in these two districts, the Bunkpurugu Yunyoo district has a lower cost per FIC than the Wa Municipal district office. One explanation could be that the superficial of Wa Municipal is three times the one of Bunkpurugu Yunyoo implying a much more dispersed population in Wa Municipal.

The cost at regional level varies from 57,650 USD (Greater Accra) to 145,520 USD (Upper West). Greater Accra has a lower cost per FIC than the Upper West region.

4.3.1. Economic costs by line items (DHA, RHA, Central EPI)

The capital versus recurrent costs distribution was similar between DHA (74% recurrent / 26% capital) and RHA (76% recurrent / 24% capital). For central EPI, recurrent costs represented 62% of total costs and capital represented 38%. This is mostly explained by the importance of cold chain equipment costs at central level. The proportion of capital costs in district (26%), region (24%) and central administration (38%) was much higher than in facilities due to their vaccine supply chain distribution role (implying vehicle and cold chain equipment costs) and storage (buildings) in the EPI system (9).

The distribution of costs between line items varied importantly depending on the administrative level of interest. Salaried labor represented a significant share of total cost in DHA (38.49%) and RHA (38.59%) but was lower at central level (18.02%). The lower share of salaried labor costs at central level is accounted by the fact that many expenses are executed at the central level (such as the cold chain energy costs). The share transport and fuel cost in DHA (13.76%) was much higher than in RHA (4.65%) and at central EPI (2.99%). Most of the supervisory, surveillance and operational activities for routine immunization take place at DHA level (9).
Table 11: Total routine immunization district and national health office immunization economic costs by line item (USD, 2011)

<table>
<thead>
<tr>
<th>Line item</th>
<th>Administrative level</th>
<th>District Health Administration (weighted average) N=6</th>
<th>Regional Health Administration (weighted average) N=5</th>
<th>Central EPI N=1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost (USD) Range (Min-Max)</td>
<td>28,285 (12,067 – 50,425)</td>
<td>92,858 (57,650 – 145,520)</td>
<td>702,727</td>
<td></td>
</tr>
<tr>
<td>Building overhead, utilities &amp; communication</td>
<td>4,253</td>
<td>5,233</td>
<td>94,215</td>
<td></td>
</tr>
<tr>
<td>Cold chain energy</td>
<td>0</td>
<td>16,951</td>
<td>27,167</td>
<td></td>
</tr>
<tr>
<td>Other recurrent</td>
<td>446</td>
<td>803</td>
<td>85,450</td>
<td></td>
</tr>
<tr>
<td>Per diems &amp; travel allowances</td>
<td>983</td>
<td>5,579</td>
<td>6,838</td>
<td></td>
</tr>
<tr>
<td>Salaried labor</td>
<td>10,888</td>
<td>35,805</td>
<td>126,615</td>
<td></td>
</tr>
<tr>
<td>Transport &amp; fuel</td>
<td>3,891</td>
<td>4,322</td>
<td>21,016</td>
<td></td>
</tr>
<tr>
<td>Subtotal recurrent</td>
<td>20,462</td>
<td>68,693</td>
<td>433,096</td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td>3,610</td>
<td>4,191</td>
<td>27,930</td>
<td></td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>1,197</td>
<td>7,111</td>
<td>173,417</td>
<td></td>
</tr>
<tr>
<td>other capital</td>
<td>93</td>
<td>426</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>2,924</td>
<td>12,437</td>
<td>68,285</td>
<td></td>
</tr>
<tr>
<td>Subtotal capital</td>
<td>7,824</td>
<td>24,165</td>
<td>269,631</td>
<td></td>
</tr>
</tbody>
</table>

4.3.2. **Economic costs by activity (DHA, RHA, Central EPI)**

Program management, surveillance, supervision and vaccine supply chain management and distribution were the most important activities in terms of costs at the district health administration level. At regional level, vaccine supply chain management and distribution (collection, distribution and storage) had the highest share in total cost (37.54%) as this activity is one of their prerogatives (Walk in cold rooms at regional level, Trucks to distribute the vaccines). Program management was the second highest activity in terms of share of total costs, followed by supervision (table 12). At central level, the main cost drivers are vaccine collection/distribution/storage, social mobilization and program management.

Table 12: Total Routine Immunization District and National Level Economic Costs by Activity (USD, 2011)

<table>
<thead>
<tr>
<th>Line Items</th>
<th>DHA Cost (USD)</th>
<th>RHA Cost (USD)</th>
<th>Central EPI Cost (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record-keeping/HMIS</td>
<td>2,666</td>
<td>3,932</td>
<td>13,545</td>
</tr>
<tr>
<td>Supervision</td>
<td>3,900</td>
<td>10,166</td>
<td>72,534</td>
</tr>
<tr>
<td>Social mobilization &amp; advocacy</td>
<td>3,292</td>
<td>4,554</td>
<td>156,756</td>
</tr>
<tr>
<td>Cold chain maintenance</td>
<td>654</td>
<td>1,810</td>
<td>46,500</td>
</tr>
<tr>
<td>Vaccine coll., dist. &amp; storage</td>
<td>3,843</td>
<td>34,862</td>
<td>266,498</td>
</tr>
<tr>
<td>Program management</td>
<td>5,178</td>
<td>15,897</td>
<td>102,229</td>
</tr>
<tr>
<td>Training</td>
<td>1,506</td>
<td>7,637</td>
<td>19,790</td>
</tr>
<tr>
<td>Surveillance</td>
<td>4,749</td>
<td>7,898</td>
<td>8,905</td>
</tr>
<tr>
<td>Other</td>
<td>2,407</td>
<td>6,102</td>
<td>15,971</td>
</tr>
<tr>
<td>Total immunization economic cost</td>
<td>28,285</td>
<td>92,858</td>
<td>702,727</td>
</tr>
</tbody>
</table>
4.4. Results at facility level for routine immunization economic costs

4.4.1. Total and unit costs at facility level

The weighted average facility cost for routine immunization was 16,460 USD in 2011 within the sampled facilities. The weighted average unit costs were US$ 5.07 per dose, US$ 51.26 per FIC (DTP3-HepB-Hib)\textsuperscript{11}, US$ 36.11 per infant and US$ 1.50 per capita.

4.4.1.1. Total and unit cost by facility type

Reproductive and Child Health Units of District Hospitals and Health Centers have the highest total cost compared to Clinics and CHPS (table 13). One explanation is that Health Center serves as a reference point for sub districts (for vaccine storage in particular). The highest cost per FIC (DTP3-HepB-Hib) was in the Community-based Health and Planning Services (CHPS) facilities (US$ 87.78). This is due to the lower population level in catchment area of CHPS facilities and the lower number of children that were fully immunized (5,831 total population and 146 fully immunized children). This result outlines the higher cost of immunizing children in hard-to-reach communities and health facilities which occurs more frequently in CHPS zones (table 13).

Table 13: Annual total costs, total outputs and unit costs at facility level by facility type (US$ 2011)

<table>
<thead>
<tr>
<th>Outputs and Unit Costs</th>
<th>RCH N=4</th>
<th>Clinic N=9</th>
<th>Health Center N=17</th>
<th>CHPS N=20</th>
<th>All N=50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total routine doses administered</td>
<td>11,119</td>
<td>3,628</td>
<td>4,432</td>
<td>1,647</td>
<td>3,245</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1,241</td>
<td>409</td>
<td>157</td>
<td>75</td>
<td>53</td>
</tr>
<tr>
<td>Total DTP3 Vaccinated Children (FIC)</td>
<td>695</td>
<td>330</td>
<td>545</td>
<td>146</td>
<td>321</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>84</td>
<td>33</td>
<td>21</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Infant population (catchment area)</td>
<td>1,402</td>
<td>552</td>
<td>573</td>
<td>261</td>
<td>513</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>192</td>
<td>66</td>
<td>22</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Total population (catchment area)</td>
<td>56,547</td>
<td>8,875</td>
<td>13,809</td>
<td>5,831</td>
<td>12,398</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>11,537</td>
<td>646</td>
<td>573</td>
<td>221</td>
<td>222</td>
</tr>
</tbody>
</table>

Routine immunization costs (vaccines & delivery cost)

<table>
<thead>
<tr>
<th>Outputs and Unit Costs</th>
<th>RCH N=4</th>
<th>Clinic N=9</th>
<th>Health Center N=17</th>
<th>CHPS N=20</th>
<th>All N=50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighted average facility total cost</td>
<td>26,743</td>
<td>12,885</td>
<td>22,989</td>
<td>12,778</td>
<td>16,460</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>3,692</td>
<td>712</td>
<td>612</td>
<td>564</td>
<td>217</td>
</tr>
<tr>
<td>Cost per routine dose administered</td>
<td>2.41</td>
<td>3.55</td>
<td>5.19</td>
<td>7.76</td>
<td>5.07</td>
</tr>
<tr>
<td>Cost per FIC</td>
<td>38.49</td>
<td>39.07</td>
<td>42.17</td>
<td>87.78</td>
<td>51.26</td>
</tr>
<tr>
<td>Cost per infant population</td>
<td>19.08</td>
<td>23.33</td>
<td>40.11</td>
<td>48.89</td>
<td>36.11</td>
</tr>
<tr>
<td>Cost per capita</td>
<td>0.47</td>
<td>1.45</td>
<td>1.66</td>
<td>2.19</td>
<td>1.50</td>
</tr>
</tbody>
</table>

Delivery cost (excluding vaccines and supplies)

<table>
<thead>
<tr>
<th>Outputs and Unit Costs</th>
<th>RCH N=4</th>
<th>Clinic N=9</th>
<th>Health Center N=17</th>
<th>CHPS N=20</th>
<th>All N=50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighted average delivery cost</td>
<td>16,425</td>
<td>10,526</td>
<td>14,515</td>
<td>10,891</td>
<td>12,154</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>2,330</td>
<td>461</td>
<td>440</td>
<td>381</td>
<td>146</td>
</tr>
<tr>
<td>Cost per routine dose administered</td>
<td>1.48</td>
<td>2.90</td>
<td>3.27</td>
<td>6.61</td>
<td>3.75</td>
</tr>
<tr>
<td>Cost per FIC</td>
<td>23.64</td>
<td>31.91</td>
<td>26.62</td>
<td>74.82</td>
<td>37.85</td>
</tr>
<tr>
<td>Cost per infant population</td>
<td>11.72</td>
<td>19.06</td>
<td>25.32</td>
<td>41.67</td>
<td>26.66</td>
</tr>
<tr>
<td>Cost per capita</td>
<td>0.29</td>
<td>1.19</td>
<td>1.05</td>
<td>1.87</td>
<td>1.10</td>
</tr>
</tbody>
</table>

Larger catchment facilities have both higher total costs and relatively higher numbers of children they are immunizing.

The unit cost per dose decreased with the facility type and size of catchment area implying that larger like the RCH and health centers have a more efficient use of resources per dose administered (Graph 6), and they may require more total resource

\textsuperscript{11} FIC = number of children who received third dose of DTP3 in 2011
compared to smaller facilities (who have lower total costs). This also suggest economies of scale according to facility type, identified in other studies (18). Within the same facility types, urban facilities appear to have a lower cost per dose (Graph 6).

**Graph 6: Cost per dose, by facility type and location (USD, 2011)**

![Unit cost per dose, by type and area (USD)](image)

4.4.1.2. Total and unit economic cost by area

Although the total cost was higher in urban areas (18,750 USD) than rural areas (16,061 USD) the unit cost was substantially lower in urban areas as larger catchment areas reduce unit costs (Graph 6, table 14).
Table 14: Unit costs in urban and rural settings (sampled facilities, average), USD

<table>
<thead>
<tr>
<th></th>
<th>CHPS rural</th>
<th>CHPS urban</th>
<th>Health center rural</th>
<th>Health center urban</th>
<th>Clinic rural</th>
<th>Clinic urban</th>
<th>RCH urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average cost</td>
<td>12,833</td>
<td>11,017</td>
<td>23,098</td>
<td>22,238</td>
<td>13,501</td>
<td>11,413</td>
<td>26,743</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>593</td>
<td>679</td>
<td>4953</td>
<td>1023</td>
<td>2418</td>
<td>3692</td>
<td></td>
</tr>
<tr>
<td>Average delivery cost</td>
<td>11,030</td>
<td>6,429</td>
<td>14,537</td>
<td>14,364</td>
<td>11,000</td>
<td>9,393</td>
<td>16,425</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>394</td>
<td>510</td>
<td>2,973</td>
<td>579</td>
<td>1,841</td>
<td>2,330</td>
<td></td>
</tr>
<tr>
<td>Outputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routine dose</td>
<td>1,604</td>
<td>3,024</td>
<td>4,195</td>
<td>6,078</td>
<td>3,925</td>
<td>5,276</td>
<td>11,119</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>79</td>
<td>196</td>
<td>581</td>
<td>720</td>
<td>1452</td>
<td>1241</td>
<td></td>
</tr>
<tr>
<td>FIC</td>
<td>136</td>
<td>443</td>
<td>545</td>
<td>549</td>
<td>365</td>
<td>245</td>
<td>695</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>5</td>
<td>26</td>
<td>62</td>
<td>55</td>
<td>52</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Infant</td>
<td>263</td>
<td>562</td>
<td>650</td>
<td>607</td>
<td>422</td>
<td>1,402</td>
<td></td>
</tr>
<tr>
<td>Standard deviation</td>
<td>12</td>
<td>27</td>
<td>25</td>
<td>109</td>
<td>147</td>
<td>192</td>
<td></td>
</tr>
<tr>
<td>Total population</td>
<td>5,842</td>
<td>5,468</td>
<td>13,457</td>
<td>16,246</td>
<td>8,009</td>
<td>10,949</td>
<td>56,547</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>232</td>
<td>722</td>
<td>632</td>
<td>679</td>
<td>3,526</td>
<td>11,537</td>
<td></td>
</tr>
<tr>
<td>Unit costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>per dose</td>
<td>8.00</td>
<td>3.64</td>
<td>5.51</td>
<td>3.66</td>
<td>3.44</td>
<td>2.16</td>
<td>2.41</td>
</tr>
<tr>
<td>per FIC</td>
<td>94.16</td>
<td>24.87</td>
<td>42.41</td>
<td>40.50</td>
<td>36.94</td>
<td>46.66</td>
<td>38.49</td>
</tr>
<tr>
<td>per infant</td>
<td>48.85</td>
<td>41.09</td>
<td>34.24</td>
<td>22.25</td>
<td>27.06</td>
<td>19.08</td>
<td></td>
</tr>
<tr>
<td>per total population</td>
<td>2.20</td>
<td>2.01</td>
<td>1.72</td>
<td>1.37</td>
<td>1.69</td>
<td>1.04</td>
<td>0.47</td>
</tr>
<tr>
<td>Unit delivery costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>per dose</td>
<td>6.88</td>
<td>2.13</td>
<td>3.47</td>
<td>2.36</td>
<td>2.80</td>
<td>1.78</td>
<td>1.48</td>
</tr>
<tr>
<td>per FIC</td>
<td>80.94</td>
<td>14.51</td>
<td>26.69</td>
<td>26.16</td>
<td>30.10</td>
<td>38.41</td>
<td>23.64</td>
</tr>
<tr>
<td>per infant</td>
<td>41.99</td>
<td>29.36</td>
<td>25.86</td>
<td>22.11</td>
<td>18.13</td>
<td>22.27</td>
<td>11.72</td>
</tr>
<tr>
<td>per total population</td>
<td>1.89</td>
<td>1.18</td>
<td>1.08</td>
<td>0.88</td>
<td>1.37</td>
<td>0.86</td>
<td>0.29</td>
</tr>
</tbody>
</table>
In order to better understand these patterns, we need to look at the distribution of costs by inputs and activities to identify the cost drivers at the facility level and location.

4.4.2. Economic costs at facility level, by input

Across all facilities, the main cost driver was salaried labor with 60% (Graph 7). Salaried labor was mostly absorbed by support activities (68%) and service delivery (outreach and fixed administration) represented 32% of average facility cost. Vaccines and injection supplies were the second highest cost driver with 26% of the total facility cost. Vaccines and supplies are mostly delivered through outreach as 58% of the vaccine and supplies cost can be attributed to this strategy.

The relatively high share of volunteer labor at 7% of total labor costs (labor cost = volunteer + salaried labor costs) highlights their critical role for delivering and supporting immunization in Ghana and in particular for the activities of social mobilization, record-keeping & HMIS for the referral facility, and surveillance. In most districts, active support of community volunteers in the routine EPI is essential in mobilizing the communities. Some CSOs (Coalition of Health NGO’s) are also active in mobilizing communities and provide locations within the communities for EPI outreach (1).

Transportation (fuel costs) represented 2% of facility costs and mostly served outreach (33% of transport costs), surveillance (25%), supervision (15%) and vaccine collection and distribution (11%). Regarding capital line items, vehicles accounted for 3.55% of facility costs, buildings for 1.52% and cold chain equipment for 1.48%. This distribution of depreciation cost share is explained by the methodology of allocating vehicle depreciation costs across health service activities based on the number of trips and frequency to support immunization activities and based on vehicle type used.
4.4.2.1. Economic costs at facility level, by input and facility type

Distribution of costs by line items follows important variations depending on the facility type (table 15). The range of cost per facility was USD 12,778 (CHPS) to USD 26,743 (table 15), with the average weighted cost of USD 16,460.

Labor accounted for the majority of costs in all facilities except the health center. In CHPS facilities and clinics, salaried labor costs represented respectively 71% and 74% of total facility cost, which is higher than the weighted average share of salaried labor cost across facilities (60%). In turn, in Health Centers and RCH units, the proportion of salaried labor costs was lower at 47%; and 57%, respectively. The low share of salaried labor in Health Centers and RCH is explained by the higher cost shares for vaccines (37%) and capital depreciation compared to the other facilities. The cost of vaccines is higher in RCH units than Health Centers. However, differences of vaccines costs in relation to vaccine doses administered implies higher wastage rates in Health Centers compared to RCH units of district hospitals.

The proportion of volunteer labor cost was higher in CHPS (6.34%) as these facilities are in the first line of immunization delivery within communities which requires support from volunteers. Similarly, the share of transport and fuel costs was also the highest in CHPS and due to the number of communities in remote areas (for outreach delivery).

The share of capital items in the facility total cost was much higher in Health Centers (9.73%) as they often serve as the sub-district reference center for EPI activities (operations and coordination). Therefore, they have the capacity to store vaccines (more cold chain equipment) and also have a bigger vehicle fleet available and dedicated to immunization activities (including for supervision and surveillance). CHPS and Clinics had a lower share in capital costs (5.19%; 2.93%) compared to Health Centers.

The low cost of per diem can be explained by the fact that they are only provided for overnight missions (which are more frequent at district and regional EPI) and not for one-day duties out of health centers.
Table 15: Total Routine Immunization Economic Costs by input and Facility Type (USD, 2011)

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>RCH Unit n=4</th>
<th>Clinic n=9</th>
<th>Health Center n=17</th>
<th>CHPS n=20</th>
<th>All n=50</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost (USD)</td>
<td>%</td>
<td>Cost (USD)</td>
<td>%</td>
<td>Cost (USD)</td>
</tr>
<tr>
<td>Salaried Labor</td>
<td>15,331</td>
<td>57.33%</td>
<td>9,545</td>
<td>74.08%</td>
<td>10,752</td>
</tr>
<tr>
<td>Volunteer Labor</td>
<td>553</td>
<td>2.07%</td>
<td>321</td>
<td>2.49%</td>
<td>908</td>
</tr>
<tr>
<td>Per Diems</td>
<td>22</td>
<td>0.08%</td>
<td>22</td>
<td>0.17%</td>
<td>99</td>
</tr>
<tr>
<td>Vaccines</td>
<td>10,318</td>
<td>38.58%</td>
<td>2,359</td>
<td>18.31%</td>
<td>8,474</td>
</tr>
<tr>
<td>Transport &amp; fuel</td>
<td>183</td>
<td>0.68%</td>
<td>267</td>
<td>2.07%</td>
<td>467</td>
</tr>
<tr>
<td>Building overheads</td>
<td>0</td>
<td>-</td>
<td>6</td>
<td>0.05%</td>
<td>81</td>
</tr>
<tr>
<td>Subtotal recurrent</td>
<td>26,407</td>
<td>98.74%</td>
<td>12,127</td>
<td>97.16%</td>
<td>20,474</td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>157</td>
<td>0.59%</td>
<td>117</td>
<td>0.91%</td>
<td>477</td>
</tr>
<tr>
<td>Vehicles</td>
<td>155</td>
<td>0.58%</td>
<td>209</td>
<td>1.62%</td>
<td>1,322</td>
</tr>
<tr>
<td>Buildings</td>
<td>24</td>
<td>0.09%</td>
<td>41</td>
<td>0.31%</td>
<td>409</td>
</tr>
<tr>
<td>Subtotal capital</td>
<td>336</td>
<td>1.26%</td>
<td>366</td>
<td>2.84%</td>
<td>2,208</td>
</tr>
<tr>
<td>Total Facility Immunization Cost</td>
<td>26,743</td>
<td>100%</td>
<td>12,885</td>
<td>100%</td>
<td>22,989</td>
</tr>
</tbody>
</table>
4.4.2.2. Economic cost at facility level, by line item and location

Table 16: Total routine immunization economic costs by input and location (USD, 2011)

<table>
<thead>
<tr>
<th>Input</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building overheads, utilities &amp; communication</td>
<td>0.20%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Buildings</td>
<td>1.06%</td>
<td>3.61%</td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>1.56%</td>
<td>0.90%</td>
</tr>
<tr>
<td>Per diems &amp; travel allowances</td>
<td>0.28%</td>
<td>0.12%</td>
</tr>
<tr>
<td>Salaried labor</td>
<td>60.95%</td>
<td>57.31%</td>
</tr>
<tr>
<td>Transport / fuel</td>
<td>2.46%</td>
<td>0.55%</td>
</tr>
<tr>
<td>Vaccines</td>
<td>24.69%</td>
<td>33.41%</td>
</tr>
<tr>
<td>Vehicles</td>
<td>3.88%</td>
<td>1.48%</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>4.91%</td>
<td>2.63%</td>
</tr>
<tr>
<td><strong>Total général</strong></td>
<td><strong>100.00%</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>

The total facility average cost was higher in urban settings due to larger facility size and the higher catchment population on average and the increased impact on vaccine and injections supply costs (table 16).

The cost shares between urban and rural remained almost similar for salaried labor, per diem and cold chain equipment but were different for vaccines, transport, volunteer, vehicles and building. Salaried labor represented 65.41% of total cost in urban facilities and 66.02% in rural ones. The share of volunteer labor was substantially higher in rural settings (5.32%) than in urban settings (3.00%) as they are more mobilized by remote facilities and to target hard to reach population. Similarly, the share of transportation and fuel was higher in rural settings due to the frequency of use of vehicles for the different immunization activities (outreach, vaccine collection, supervision). In addition, the average distance travelled was systematically higher on average in rural areas for all facility types (2.5 higher in rural health centers for examples).

The proportion of capital depreciation costs was almost similar between urban and rural facilities (6.83% for urban and 7.05% for rural). However, the distribution within capital costs varied between urban and rural settings. The main difference being that, in rural settings, capital costs were mostly driven by vehicle costs (4.21% in rural; 1.69% in urban); whereas, in urban settings, capital costs were driven by building costs of (4.11% in urban; 1.15% in rural).

This difference is explained by the fact that urban facilities tend to have a bigger surface dedicated to vaccine delivery and vaccine storage (because they administer and store more vaccines on average). Similarly, the need to use vehicles more frequently and for longer distances for outreach and other activities in rural settings impacted on the share of use of vehicles and their associated costs.
When excluding salaried labor costs, CHPS had the highest unit cost per dose, per child and per FIC. On the opposite, RCH units had the lowest cost per dose, per child and per FIC. These findings are consistent with the total and delivery costs per unit of output (table 17).

**Table 17: total and delivery costs (excluding human resources)**

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Unit cost</th>
<th>Non-HR unit cost</th>
<th>Delivery unit cost</th>
<th>Non-HR Delivery unit cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Per dose administered</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHPS</td>
<td>7.76 USD</td>
<td>2.25 USD</td>
<td>6.61 USD</td>
<td>1.11 USD</td>
</tr>
<tr>
<td>Clinic</td>
<td>3.55 USD</td>
<td>0.92 USD</td>
<td>2.90 USD</td>
<td>0.27 USD</td>
</tr>
<tr>
<td>Health Center</td>
<td>5.19 USD</td>
<td>2.76 USD</td>
<td>3.27 USD</td>
<td>0.85 USD</td>
</tr>
<tr>
<td>RCH</td>
<td>2.41 USD</td>
<td>1.03 USD</td>
<td>1.48 USD</td>
<td>0.10 USD</td>
</tr>
<tr>
<td>All facilities</td>
<td>5.07 USD</td>
<td>2.01 USD</td>
<td>3.75 USD</td>
<td>0.68 USD</td>
</tr>
<tr>
<td><strong>Per infant population</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHPS</td>
<td>48.96 USD</td>
<td>14.22 USD</td>
<td>41.73 USD</td>
<td>6.99 USD</td>
</tr>
<tr>
<td>Clinic</td>
<td>23.34 USD</td>
<td>6.05 USD</td>
<td>19.07 USD</td>
<td>1.78 USD</td>
</tr>
<tr>
<td>Health Center</td>
<td>40.12 USD</td>
<td>21.36 USD</td>
<td>25.33 USD</td>
<td>6.57 USD</td>
</tr>
<tr>
<td>RCH</td>
<td>19.07 USD</td>
<td>8.14 USD</td>
<td>11.72 USD</td>
<td>0.78 USD</td>
</tr>
<tr>
<td>All facilities</td>
<td>32.09 USD</td>
<td>12.73 USD</td>
<td>23.69 USD</td>
<td>4.33 USD</td>
</tr>
<tr>
<td><strong>Per Fully Immunized Child (FIC)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHPS</td>
<td>87.52 USD</td>
<td>25.43 USD</td>
<td>74.59 USD</td>
<td>12.50 USD</td>
</tr>
<tr>
<td>Clinic</td>
<td>39.05 USD</td>
<td>10.12 USD</td>
<td>31.90 USD</td>
<td>2.97 USD</td>
</tr>
<tr>
<td>Health Center</td>
<td>42.18 USD</td>
<td>22.45 USD</td>
<td>26.63 USD</td>
<td>6.90 USD</td>
</tr>
<tr>
<td>RCH</td>
<td>38.48 USD</td>
<td>16.42 USD</td>
<td>23.63 USD</td>
<td>1.57 USD</td>
</tr>
<tr>
<td>All facilities</td>
<td>51.28 USD</td>
<td>20.34 USD</td>
<td>37.86 USD</td>
<td>6.92 USD</td>
</tr>
</tbody>
</table>
Almost half of the facility costs (48%) can be attributed to service delivery with outreach services representing one fourth of total facility costs (26%) and facility-based delivery accounting for 22%. The cost of service delivery (facility-based or outreach) was mostly driven by the value of the vaccines, salaried labor, fuel, vehicles and volunteer labor. Record-keeping (12%), social mobilization (10%) and surveillance (10%) were the remaining activities driving facility-level costs. Salaried and volunteer labor were the main inputs of these activities which seemed consistent with the nature of these activities and the fact that costs associated with laboratory surveillance were not included. Surveillance also involves transportation costs to a minor extent. The activities of vaccine collection/distribution/storage, supervision, training, program management and cold chain maintenance each represent less than 10% of facility costs. Cold chain maintenance and social mobilization is limited to salaried labor as no expense is borned at facility level. Supervision is not a major cost driver at facility level (4%) as it is mostly conducted by the district level. The higher proportion of support activities in some facilities did not seem to influence the cost per dose of a given facility.
4.4.3.1. Economic costs at facility level, by activity and facility type

Health centers and clinics have the highest share of outreach services in total facility cost. This is partly explained by the higher value of vaccines (for health centers in particular that store more vaccines). The highest share of facility-based delivery is in RCH due to a larger catchment population in RCH units on average (56,547) compared to the average total population across facilities (12,398) and higher population density. The share of social mobilization costs is relatively higher in the CHPS and clinics (12.41%; 14.94%) and relatively lower in the HC and RCH (7.62%; 3.97%) outlining that more time is spent on mobilizing communities in smaller facilities.
## Table 18: Total routine immunization economic costs by activity and facility type (USD, 2011)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Facility type</th>
<th>RCH n=4</th>
<th>Clinic n=9</th>
<th>HC n=17</th>
<th>CHPS n=20</th>
<th>All</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility-based delivery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record-keeping/HMIS</td>
<td>4,271</td>
<td>1.97%</td>
<td>1,399</td>
<td>10.86%</td>
<td>2,160</td>
<td>9.40%</td>
<td>1,920</td>
</tr>
<tr>
<td>Supervision</td>
<td>754</td>
<td>2.82%</td>
<td>889</td>
<td>6.90%</td>
<td>701</td>
<td>3.05%</td>
<td>461</td>
</tr>
<tr>
<td>Outreach services</td>
<td>5,428</td>
<td>20.30%</td>
<td>3,434</td>
<td>26.65%</td>
<td>7,485</td>
<td>32.56%</td>
<td>2,574</td>
</tr>
<tr>
<td>Social mobilization</td>
<td>905</td>
<td>3.38%</td>
<td>1,867</td>
<td>14.49%</td>
<td>1,729</td>
<td>7.52%</td>
<td>1,586</td>
</tr>
<tr>
<td>Cold chain maintenance</td>
<td>246</td>
<td>0.92%</td>
<td>157</td>
<td>1.22%</td>
<td>536</td>
<td>2.33%</td>
<td>291</td>
</tr>
<tr>
<td>Vaccine coll. &amp; dist.</td>
<td>471</td>
<td>1.76%</td>
<td>785</td>
<td>6.10%</td>
<td>1,823</td>
<td>7.93%</td>
<td>818</td>
</tr>
<tr>
<td>Program management</td>
<td>597</td>
<td>2.23%</td>
<td>159</td>
<td>1.24%</td>
<td>515</td>
<td>2.24%</td>
<td>121</td>
</tr>
<tr>
<td>Training</td>
<td>344</td>
<td>1.29%</td>
<td>233</td>
<td>1.80%</td>
<td>689</td>
<td>3.00%</td>
<td>250</td>
</tr>
<tr>
<td>Surveillance</td>
<td>1,369</td>
<td>5.12%</td>
<td>1,069</td>
<td>8.29%</td>
<td>1,280</td>
<td>5.57%</td>
<td>1,991</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>0.06%</td>
<td>31</td>
<td>0.24%</td>
<td>823</td>
<td>3.58%</td>
<td>667</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>26,743</strong></td>
<td><strong>100%</strong></td>
<td><strong>12,885</strong></td>
<td><strong>100%</strong></td>
<td><strong>22,989</strong></td>
<td><strong>100%</strong></td>
<td><strong>12,778</strong></td>
</tr>
</tbody>
</table>
In all facility types, facility based and outreach were among the three main cost drivers (table 19). In RCH units, record-keeping was the second activity cost driver. This is explained by the higher activity volume for vaccine administration in RCH units, implying higher personnel time for reporting (high share of record-keeping and HMIS). Outreach is the first activity cost drivers in Health Centers (32%), Clinics (26%) and CHPS (20.15%) as most of them are located in rural areas where outreach is the favored delivery mode. See table 21 for the number of FTE by facility type and how their time is allocated across activities.

Table 19: Main cost drivers (activities) by facility type

<table>
<thead>
<tr>
<th>Facility type</th>
<th>Three main cost drivers</th>
</tr>
</thead>
</table>
| RCH units; n=4 | Facility-based delivery (46.15%)  
Outreach services (20.30%)  
Record-Keeping & HMIS (15.97%) |
| Health centers; n=17 | Outreach delivery (32.56%)  
Facility-based delivery (22.83%)  
Record-keeping & HMIS (9.40%) |
| Clinics; n=9 | Outreach delivery (26.65%)  
Facility-based delivery (22.21%)  
Social mobilization (14.49%) |
| CHPS; n=20 | Outreach delivery (20.15%)  
Facility-based delivery (16.42%)  
Surveillance (15.58%) |

Table 20: Total FTEs and staff time allocation by type of facility by line item (weighted averages)

<table>
<thead>
<tr>
<th>Line Items</th>
<th>RCH</th>
<th>Health Center</th>
<th>Clinic</th>
<th>CHPS</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample (n)</td>
<td>4</td>
<td>9</td>
<td>17</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Total FTEs per facility</td>
<td>3.00</td>
<td>1.57</td>
<td>1.99</td>
<td>1.69</td>
<td>1.76</td>
</tr>
<tr>
<td>Range of FTE</td>
<td>(1.19-8.38)</td>
<td>(0.44-5.60)</td>
<td>(0.56-4.90)</td>
<td>(0.53-3.85)</td>
<td>(0.44-8.38)</td>
</tr>
<tr>
<td>Doses</td>
<td>11,119</td>
<td>3,628</td>
<td>4,432</td>
<td>1,647</td>
<td>3,245</td>
</tr>
<tr>
<td>Doses per FTE</td>
<td>1,241</td>
<td>409</td>
<td>157</td>
<td>75</td>
<td>53</td>
</tr>
<tr>
<td>Doses per FTE</td>
<td>3,706</td>
<td>2,311</td>
<td>2,227</td>
<td>975</td>
<td>1,843</td>
</tr>
<tr>
<td>FTE per dose delivered</td>
<td>0.0010</td>
<td>0.0004</td>
<td>0.0004</td>
<td>0.0003</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Table 21: Staff time allocation and distribution of salaried costs by facility type by activity

<table>
<thead>
<tr>
<th>Facility type</th>
<th>RCH</th>
<th>Health Center</th>
<th>Clinic</th>
<th>CHPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTE for routine immunization</td>
<td>3.00</td>
<td>1.57</td>
<td>1.99</td>
<td>1.69</td>
</tr>
<tr>
<td>Range (Min-Max)</td>
<td>(1.19-8.38)</td>
<td>(0.44-5.60)</td>
<td>(0.56-4.90)</td>
<td>(0.53-3.85)</td>
</tr>
<tr>
<td>Distribution of salaried labor costs by activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold chain maintenance</td>
<td>1.60%</td>
<td>4.99%</td>
<td>1.65%</td>
<td>3.21%</td>
</tr>
<tr>
<td>Other</td>
<td>0%</td>
<td>3.73%</td>
<td>0.09%</td>
<td>6.75%</td>
</tr>
<tr>
<td>Outreach delivery</td>
<td>12.47%</td>
<td>12.66%</td>
<td>25.10%</td>
<td>15.07%</td>
</tr>
<tr>
<td>Program management</td>
<td>3.90%</td>
<td>4.76%</td>
<td>1.66%</td>
<td>1.18%</td>
</tr>
</tbody>
</table>
4.4.3.2. Economic costs at facility level, by activity, location and area

Table 22: Total Routine Immunization Economic Costs by Activity by Location (USD, 2011)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine Facility-based Service Delivery</td>
<td>6,152</td>
<td>3,187</td>
</tr>
<tr>
<td>Outreach Service Delivery</td>
<td>4,773</td>
<td>4,773</td>
</tr>
<tr>
<td>Record-Keeping &amp; HMIS</td>
<td>2,598</td>
<td>1,903</td>
</tr>
<tr>
<td>Supervision</td>
<td>729</td>
<td>601</td>
</tr>
<tr>
<td>Social Mobilization &amp; Advocacy</td>
<td>688</td>
<td>1,814</td>
</tr>
<tr>
<td>Surveillance</td>
<td>1,342</td>
<td>1,635</td>
</tr>
<tr>
<td>Cold Chain Maintenance</td>
<td>425</td>
<td>324</td>
</tr>
<tr>
<td>Vaccine Collection, Distribution, &amp; Storage</td>
<td>711</td>
<td>1,163</td>
</tr>
<tr>
<td>Program Management</td>
<td>268</td>
<td>266</td>
</tr>
<tr>
<td>Training</td>
<td>263</td>
<td>402</td>
</tr>
<tr>
<td>Other</td>
<td>803</td>
<td>534</td>
</tr>
<tr>
<td><strong>Weighted total average</strong></td>
<td>18,750</td>
<td>16,061</td>
</tr>
</tbody>
</table>

Rural and urban facilities had a similar cost structure by activity, but the cost of fixed-based service delivery in urban area was significantly higher than in rural areas. The higher proportion of fixed-based delivery cost in urban area was explained by the fact that immunization services are offered everyday in urban locations (19) (20) due to higher population density, whereas it is not always provided on a daily basis in rural areas (20). In turn, in rural areas, the share of outreach delivery cost is higher than in urban areas as rural areas rely heavily on outreach (20) due to more a dispersed population.

The share of social mobilization is higher in rural settings (as communities are more spread-out than in urban areas which involves more staff time). Social mobilization methods and tools to mobilize communities include mobile phones, “Gong-Gong” beater and face to face communication (1).

The share of vaccine collection is also higher (due to the higher frequency that small rural facilities need to collect vaccines as some of them do not cold chain equipment to store the vaccines). On the opposite, urban facilities have higher costs for record-keeping and HMIS due to the volume of activity (higher number of doses administered).

Table 23: Staff time allocation and distribution by location and area

<table>
<thead>
<tr>
<th>% FTE for routine immunization (weighted average)</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaried labor cost by activity</td>
<td>Cost (USD)</td>
<td>%</td>
</tr>
<tr>
<td>Cold Chain Maintenance</td>
<td>324 (11)</td>
<td>3.31%</td>
</tr>
<tr>
<td>Other</td>
<td>352</td>
<td>3.59%</td>
</tr>
<tr>
<td>Service Delivery</td>
<td>Rural</td>
<td>Urban</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Total</td>
<td><em>(53)</em></td>
<td><em>(239)</em></td>
</tr>
<tr>
<td>Outreach Service Delivery</td>
<td>1,590</td>
<td>1,442</td>
</tr>
<tr>
<td></td>
<td><em>(39)</em></td>
<td><em>(128)</em></td>
</tr>
<tr>
<td></td>
<td>16,24%</td>
<td>13,42%</td>
</tr>
<tr>
<td>Program Management</td>
<td>257</td>
<td>266</td>
</tr>
<tr>
<td></td>
<td><em>(11)</em></td>
<td><em>(35)</em></td>
</tr>
<tr>
<td></td>
<td>2,63%</td>
<td>2,47%</td>
</tr>
<tr>
<td>Program Management</td>
<td>1,701</td>
<td>2,546</td>
</tr>
<tr>
<td></td>
<td><em>(43)</em></td>
<td><em>(248)</em></td>
</tr>
<tr>
<td></td>
<td>17,37%</td>
<td>23,69%</td>
</tr>
<tr>
<td>Routine Facility-based Service Delivery</td>
<td>1,456</td>
<td>2,402</td>
</tr>
<tr>
<td></td>
<td><em>(47)</em></td>
<td><em>(248)</em></td>
</tr>
<tr>
<td></td>
<td>14,87%</td>
<td>22,35%</td>
</tr>
<tr>
<td>Social Mobilization &amp; Advocacy</td>
<td>1,531</td>
<td>496</td>
</tr>
<tr>
<td></td>
<td><em>(48)</em></td>
<td><em>(55)</em></td>
</tr>
<tr>
<td></td>
<td>15,64%</td>
<td>4,62%</td>
</tr>
<tr>
<td>Supervision</td>
<td>500</td>
<td>718</td>
</tr>
<tr>
<td></td>
<td><em>(17)</em></td>
<td><em>(86)</em></td>
</tr>
<tr>
<td></td>
<td>5,11%</td>
<td>6,68%</td>
</tr>
<tr>
<td>Surveillance</td>
<td>1,241</td>
<td>998</td>
</tr>
<tr>
<td></td>
<td><em>(42)</em></td>
<td><em>(86)</em></td>
</tr>
<tr>
<td></td>
<td>12,67%</td>
<td>9,29%</td>
</tr>
<tr>
<td>Training</td>
<td>332</td>
<td>234</td>
</tr>
<tr>
<td></td>
<td><em>(21)</em></td>
<td><em>(17)</em></td>
</tr>
<tr>
<td></td>
<td>3,39%</td>
<td>2,17%</td>
</tr>
<tr>
<td>Vaccine Collection, Distribution, &amp; Storage</td>
<td>507</td>
<td>428</td>
</tr>
<tr>
<td></td>
<td><em>(16)</em></td>
<td><em>(50)</em></td>
</tr>
<tr>
<td></td>
<td>5,18%</td>
<td>3,99%</td>
</tr>
<tr>
<td>Total</td>
<td>9,790</td>
<td>10,746</td>
</tr>
</tbody>
</table>
4.5. Economic and financial costs

4.5.1. Comparison economic vs. financial

For planning of expenses, a financial costing should be favored whereas for broader health system analysis, an economic costing should be preferred.

Difference between economic and financial cost is explained by the methodological assumptions to define these costs. Vaccines and supplies financial costs are procured and paid for at central level and not included in the facility-level financial costs. For financial costs, capital items were annualized on straight line depreciation but annualized and discounted for economic costs (cf. paragraph 3.1.7).

4.5.2. Economic and financial costs at central, district and regional levels, by line item and location

Table 24: Total routine immunization district, region and central level financial costs by activity (USD, 2011)

<table>
<thead>
<tr>
<th>Activity</th>
<th>DHA</th>
<th>RHA</th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold chain maintenance</td>
<td>653</td>
<td>1,808</td>
<td>46,500</td>
</tr>
<tr>
<td>Other</td>
<td>2,380</td>
<td>6,026</td>
<td></td>
</tr>
<tr>
<td>Outreach service delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program management</td>
<td>2,914</td>
<td>12,984</td>
<td>98,703</td>
</tr>
<tr>
<td>Record-keeping &amp; HMIS</td>
<td>2,653</td>
<td>3,882</td>
<td>12,781</td>
</tr>
<tr>
<td>Facility-based delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social mobilization</td>
<td>3,291</td>
<td>4,492</td>
<td>155,993</td>
</tr>
<tr>
<td>Supervision</td>
<td>1,707</td>
<td>10,043</td>
<td>66,731</td>
</tr>
<tr>
<td>Surveillance</td>
<td>4,545</td>
<td>7,486</td>
<td>8,466</td>
</tr>
<tr>
<td>Training</td>
<td>1,504</td>
<td>7,584</td>
<td>18,674</td>
</tr>
<tr>
<td>Vaccine collection, distribution, &amp; storage</td>
<td>2,234</td>
<td>27,900</td>
<td>10,282,184</td>
</tr>
<tr>
<td>Vehicle maintenance</td>
<td></td>
<td></td>
<td>15,832</td>
</tr>
<tr>
<td>Total général</td>
<td>21,880</td>
<td>82,204</td>
<td></td>
</tr>
</tbody>
</table>

At district level, the highest financial costs are for the activities of surveillance, social mobilization and vaccine collection, distribution and storage. For the regional level, the highest financial costs were for vaccine collection distribution and storage, followed by program management. There is no cost for service delivery (in outreach or fixed) as these levels do not administer any vaccines.

In conclusion, budget estimate only show a one portion of routine immunization costs for the health system.

4.5.3. Analysis of financial costs at facility level

In addition to salaried labor, transportation is the single highest item of expenditure for recurrent costs at facility level (and to a minor extent, per diems and general expenses). Regarding capital costs, key factors of expenditures at facility level are the availability of cold chain equipment and whether facilities have their own means of transport or if nurses have motor-cycles for their outreach services. These are the most important factors which impinge on the financial cost of immunization in Ghana (table 25).

The higher share of vaccine collection and distribution was explained by the value of cold chain equipment. For outreach services it is explained by the expenses for transportation and the value of
vehicles. In Ghana, social mobilization at facility-level is limited to Gong Gong beating and town criers and involves mostly staff time (1). Social mobilization expenses are executed by the higher levels and there are no financial costs at this level. The same is true for cold chain maintenance.

4.5.4. Economic and financial costs at facility level, by line item and facility type

Table 25: Comparison of Economic and Financial Costs by Line Item by Facility Type (USD, 2011)

<table>
<thead>
<tr>
<th>Facility type \ Line item</th>
<th>Economic</th>
<th>Financial</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHPS; n=20</td>
<td>12,778</td>
<td>9,701</td>
</tr>
<tr>
<td>Building overheads, utilities, communication</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Buildings</td>
<td>240</td>
<td>-</td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>143</td>
<td>126</td>
</tr>
<tr>
<td>Per diems &amp; travel allowances</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Salaried labor</td>
<td>9,066</td>
<td>9,066</td>
</tr>
<tr>
<td>Transport &amp; fuel</td>
<td>326</td>
<td>326</td>
</tr>
<tr>
<td>Vaccines</td>
<td>1,887</td>
<td>-</td>
</tr>
<tr>
<td>Vehicles</td>
<td>280</td>
<td>163</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>816</td>
<td>-</td>
</tr>
<tr>
<td>Waste disposal</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Clinic; n=9</td>
<td>12,885</td>
<td>10,056</td>
</tr>
<tr>
<td>Building overheads, utilities, communication</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Buildings</td>
<td>41</td>
<td>-</td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>117</td>
<td>97</td>
</tr>
<tr>
<td>Per diems &amp; travel allowances</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Salaried labor</td>
<td>9,545</td>
<td>9,545</td>
</tr>
<tr>
<td>Transport &amp; fuel</td>
<td>267</td>
<td>267</td>
</tr>
<tr>
<td>Vaccines</td>
<td>2 359</td>
<td>-</td>
</tr>
<tr>
<td>Vehicles</td>
<td>209</td>
<td>120</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>321</td>
<td>-</td>
</tr>
<tr>
<td>Waste disposal</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Health Centre; n=17</td>
<td>22,989</td>
<td>12,573</td>
</tr>
<tr>
<td>Building overheads, utilities, communication</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Buildings</td>
<td>409</td>
<td>-</td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>477</td>
<td>417</td>
</tr>
<tr>
<td>Per diems &amp; travel allowances</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>Salaried labor</td>
<td>10,752</td>
<td>10,752</td>
</tr>
<tr>
<td>Transport &amp; fuel</td>
<td>467</td>
<td>467</td>
</tr>
<tr>
<td>Vaccines</td>
<td>8,474</td>
<td>-</td>
</tr>
<tr>
<td>Vehicles</td>
<td>1,322</td>
<td>756</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>908</td>
<td>-</td>
</tr>
<tr>
<td>Waste disposal</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>RCH; n=4</td>
<td>26,743</td>
<td>15,755</td>
</tr>
<tr>
<td>Building overheads, utilities, communication</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Buildings</td>
<td>24</td>
<td>-</td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>157</td>
<td>130 USD</td>
</tr>
<tr>
<td>Per diems &amp; travel allowances</td>
<td>22</td>
<td>22 USD</td>
</tr>
<tr>
<td>Salaried labor</td>
<td>15,331</td>
<td>15,331 USD</td>
</tr>
<tr>
<td>Transport &amp; fuel</td>
<td>183</td>
<td>183 USD</td>
</tr>
<tr>
<td>Vaccines</td>
<td>10,318</td>
<td>-</td>
</tr>
<tr>
<td>Vehicles</td>
<td>155</td>
<td>89 USD</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>553</td>
<td>-</td>
</tr>
<tr>
<td>Waste disposal</td>
<td>0 USD</td>
<td>-</td>
</tr>
</tbody>
</table>
4.5.5. Comparison of aggregated results

Table 26: comparison of comprehensive multi-year plan projection for 2011 and costing study results

<table>
<thead>
<tr>
<th>Input</th>
<th>cMYP 2011 projection</th>
<th>Costing study (2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recurrent costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaccines and injection supplies (traditional and underused vaccines)</td>
<td>14,317,285</td>
<td>10,057,923</td>
</tr>
<tr>
<td>Personnel (salaries and per diems – shared and specific)</td>
<td>12,880,520</td>
<td>32,922,179</td>
</tr>
<tr>
<td>Maintenance and overhead</td>
<td>3,751,821</td>
<td>1,390,948</td>
</tr>
<tr>
<td>Specific Transportation</td>
<td>22,699</td>
<td>21,016</td>
</tr>
<tr>
<td>Shared transportation cost (fuel, taxi)</td>
<td>0</td>
<td>1,774,512</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>n/a</td>
<td>2,432,026</td>
</tr>
<tr>
<td>Activities from cMYP (Short-term training, IEC / social mobilization, Disease surveillance, programme management)</td>
<td>728,280</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Capital costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>0</td>
<td>1,174,019</td>
</tr>
<tr>
<td>Vehicles</td>
<td>592,524</td>
<td>2,432,026</td>
</tr>
<tr>
<td>Buildings</td>
<td>0</td>
<td>1,431,615</td>
</tr>
<tr>
<td>Other capital items</td>
<td>0</td>
<td>20,048</td>
</tr>
</tbody>
</table>

There are important differences between cMYP and costing study (table 26). There are several factors that explain this substantial difference mainly driven by personnel and volunteer labor costs. Firstly, the cMYPs underestimate the shared personnel costs compared to this costing study. In the cMYP costing tool, the shared staff involved in immunization at facility level is limited to two staff. However in the costing study the number of staff involved in routine immunization was much more significant. The shared transportation costs at sub national are not estimated which significantly underestimates the true cost of transportation. Secondly, when comparing the last two cMYP data, they either provide very high costs for some line items and no cost for the other. These differences can be explained by the fact that cMYP is used as a planning tool and is not meant to be an evaluation tool and therefore can vary depending on needs at a given period (which could explain the absence of cold chain cost in the cMYP for example).

The baseline 2008 cMYP tool estimates that there is no cost for maintenance (7). On the contrary, the same cost is estimated at 3,258,422 USD in 2011 CMYP (6). The 2008 cMYP tool estimates the cost of per diems at 3,636,667 USD (7) whereas the 2011 estimate is of 14,251 USD (6). In the 2010 cMYP costs, the transportation costs are only estimated at central EPI.

Thirdly, the comparison between cMYP and study estimates can be questioned for different reasons. First the cMYP provides a mix of line items and activities whereas the costing study is disaggregated by line items and activities. Therefore, some line items of the costing study can be allocated to activities of the cMYP (a portion of per diems and personnel costs could be allocated to training for example).

In general, routine immunization costs are significantly higher than previous cMYP or study estimates (3,5,6) which confirms that the true cost of routine immunization is under estimated. Regarding cMYPs, the main explanation is that the cost of human resources is not considered or is underestimated in Ghana cMYP. The study results show that the economic costs based on the actual time spent on routine immunization activities by health workers and other staff is substantial. However, it could also be linked with potential over estimation of time spent (self reported time spent on activities) by the study itself.

Regarding the costing study conducted in 2000 (5), the higher costs from the present study are explained by several factors: the increase in the number and value of vaccines, the increase in the
volume of activity of the immunization program and the significant increase in MOH salaries for staff (11). In addition, the significant proportion of volunteers in total costs (5%) outlines their critical role in expanding community-based health promotion and services. High personnel costs for record keeping (due to important time spent on this activity) could explain the fact that immunization register have been considered as well kept (20) and consequently used for tracking defaulting children. A lack of investment in capital items has been identified in CHPS and Clinics in a recent review of health sector in Ghana (11). Investments for capital items in these facilities have been below target (11). This is confirmed for immunization as capital costs are lower in CHPS compared to Health Centers.

4.6. Sensitivity analysis

A sensitivity analysis was conducted to test the impact of different scenarios on the weighted average facility cost (table 27).

### Table 27: Sensitivity analysis of facility cost

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Weighted Average (USD)</th>
<th>Change from Baseline (USD)</th>
<th>% Change from Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline estimate</td>
<td>16,460</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Scenario 1:</strong> Provision of allowance to volunteers by Government of Ghana based on the daily minimum wage (3.39 USD per day)</td>
<td>16,460</td>
<td>16,124</td>
<td>-2%</td>
</tr>
<tr>
<td><strong>Scenario 2:</strong> Increase of 10% in wastage rate for all vaccines</td>
<td>16,460</td>
<td>16,890</td>
<td>+2.6%</td>
</tr>
<tr>
<td><strong>Scenario 3:</strong> Decrease of 5% in wastage rate for all vaccines</td>
<td>16,460</td>
<td>16,029</td>
<td>-1.3%</td>
</tr>
<tr>
<td><strong>Scenario 4:</strong> Assumption of occupancy rate = 50% of cold chain equipment costs in 2011</td>
<td>16,460</td>
<td>16,340</td>
<td>-0.7%</td>
</tr>
<tr>
<td><strong>Scenario 5:</strong> labor time allocation higher by 10%</td>
<td>16,460</td>
<td>17,453</td>
<td>+6.03%</td>
</tr>
<tr>
<td><strong>Scenario 6:</strong> labor time allocation lower by 5%</td>
<td>16,460</td>
<td>15,963</td>
<td>-3.02%</td>
</tr>
</tbody>
</table>

Although volunteers do not receive any allowance for their contribution on routine immunizations support.

#### 4.6.1. Scenario 1: Reevaluation of volunteers allowance

One of the key finding of this study is the critical economic contribution of volunteers in the routine immunization costs at facility level. In our analysis, the economic contribution of volunteers was valued based on the per diem provided to them for National Immunization Days (Polio). In the first scenario of the sensitivity analysis, we assumed a new policy that would compensate the contribution of volunteers with the daily minimum wage of Ghana (3.39 USD per day). The facility cost in this scenario was 16,124 USD, representing a decrease of 2% compared to the baseline (45% decrease of volunteer labor costs).

#### 4.6.2. Scenario 2 & 3: Reevaluation of wastage rate

In order to assess the sensitivity of facility costs to the variations in wastage rates, scenario 3 and 4 looked at wastage variations. An increase of 10% in the wastage rate (for all vaccines) increased the total facility cost of 2.6%. A decrease of 5% of all vaccines implies a decrease of 1.3% of facility costs.
4.6.3. Scenario 4: Inclusion of cold chain occupancy rate for cold chain costs calculation

Cold chain equipment costs take into account the percentage of use for routine immunization. However this may not always reflect the actual occupancy rate of cold chain equipment (fridges, vaccine carriers…) at the facility level. Therefore it was necessary to evaluate the sensitivity of cold chain equipment costs in regards this occupancy rate. In this respect, an occupancy rate of 50% decreased the facility of 0.7%.

4.6.4. Staff time allocation variation for all staff

Considering that personnel cost was the most important cost driver at facility level, the sensitivity of facility costs to the variations in staff costs was analyzed in scenarios 5 and 6. With a 10% increase of staff labor time allocation, the facility cost was 17 453 USD, representing a 6% increase in facility cost. On the opposite, a 5% decrease of staff labor time allocation the facility cost was 15 963 USD, representing a 3% decrease in facility cost.

5. New vaccines introduction costs and financing

5.1. Analytic horizon.

As the new vaccines were introduced in 2012, NUVI start-up costs and ongoing costs in 2012 were not included in the 2011 routine costs estimate (facility, district and region levels). Similarly, NUVI vaccines costs are not included in the 2011 routine costs estimates.

According to the timeline of NUVI activities in the vaccine introduction plan, at central level, the analytic horizon starts in August 2010 with preparatory activities (cMYP update, preparation of GAVI application documents) and introduction planning activities for most of 2011 and goes through September 2012, approximately five months after introduction of the first doses of (rota and pneumo) have been introduced in all facilities, Surveillance establishment and assessment of cold chain needs) and the end approximately five months after introduction once major most additional activities have been performed for NUVI and once first doses are introduced in all facilities. Specific investment related to new vaccines introduction before this timeframe were also included in the analysis (cold chain capacity expansion).

Results presented in this analysis combine the three vaccines into one total and unit cost.

5.2. Multiple introduction of new vaccines in Ghana

Ghana was the first African country to introduce rotavirus, PCV and measles second dose vaccines simultaneously in their routine immunization program in 2012. Diarrhea and pneumonia were the leading cause of death in children under five (21). This analysis presents the incremental program costs for introducing or increasing coverage of new and underutilized vaccines, which are rotavirus, pneumococcal, and measles second dose).

Table 28 provides the number of NUVI doses (pneumococcal, rotavirus and measles second dose) administered the year of introduction (2012). In particular, the coverage for the first dose of the PCV was 81% and the coverage for the first dose of the rotavirus vaccine was 75%.

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Doses administered</th>
<th>Denominator</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV first dose</td>
<td>667,237</td>
<td>821,185</td>
<td>81%</td>
</tr>
<tr>
<td>PCV second dose</td>
<td>524,458</td>
<td>739,067</td>
<td>71%</td>
</tr>
<tr>
<td>PCV third dose</td>
<td>419,715</td>
<td>656,948</td>
<td>64%</td>
</tr>
</tbody>
</table>

Table 28: Doses administered the year of introduction
<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Doses administered</th>
<th>Denominator</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>rotavirus vaccine first dose</td>
<td>613,983</td>
<td>821,185</td>
<td>75%</td>
</tr>
<tr>
<td>rotavirus vaccine second dose</td>
<td>483,105</td>
<td>739,067</td>
<td>65%</td>
</tr>
<tr>
<td>measles vaccine second dose</td>
<td>523,891</td>
<td>903,304</td>
<td>58%</td>
</tr>
</tbody>
</table>

Source: EPI Ghana, 2013

5.3. Background knowledge on NUVI costs

The cost of new vaccines (plus their distribution and storage costs) remains unaffordable to many governments (4). There is a lack of information on the cost of vaccine introduction and even more for simultaneous introductions. The full range of non-vaccine costs, especially in decentralized systems such as the Ghana one, are often overlooked and underestimated (central perspective of planning and budgeting approaches). New vaccines with much higher price are becoming main drivers of introduction costs, before human resources even.

Therefore, the availability and consistency of costing and financing is a key challenge in not only planning properly introduction of new vaccines, but ensuring the most efficient and successful introduction of NUVI in Ghana.

Additionally, NUVI is usually introduced one at a time, rather than simultaneously. The Ghana study allows us to examine the incremental cost of simultaneous NUVI—to determine if there is an economic basis for simultaneous introduction from an economies of scope rationale.

Economic and fiscal costs were assessed. Economic represents incremental opportunity cost of NUVI while fiscal represents the additional financial requirement for the new vaccines. Economic costs included both start-up costs (additional activities and investment) and on-going (incremental costs of routine activities) the year of introduction.

5.4. New vaccines introduction costs results (economic and fiscal)

NUVI costs presented here are for the 3 vaccines together (PCV and rotavirus and MSD).

The total NUVI incremental economic costs of for the three new vaccines introduction was 3.9 million USD for start-up activities and 22.8 million USD for ongoing costs the year of introduction.

The total economic cost (start-up and ongoing) per NUVI dose administered represented 6.9 USD with programmatic representing 1.7 USD per dose. The cost per infant amounted to 26.9 USD with 4.0 for start-up programmatic costs (graph 9).
The delivery cost per dose administered amounted to US$ 2.42, with US$ 1.22 for start-up costs and US$1.23 for ongoing costs (Graph 10).

**Graph 10: New and underutilized vaccines introduction total and delivery costs (start-up, ongoing) per dose and per child in Ghana, US$$

At the aggregated level, excluding cost of vaccines and supplies, the following activities are capturing most of NUVI incremental cost for the start-up costs (Graph 11):

- Social mobilization and advocacy for the introduction (33%)
- Surveillance for the introduction (25%)
- Training (14%)
- Program management (14%)
Regarding ongoing costs, the most important ongoing incremental non-vaccine costs related to cold chain expansion (based on new vaccine volume increase (see Appendix 28: Volume Vaccine Calculator). The value of time spent (one year) by personnel on activities for NUVI introduction is substantial and new vaccines were mostly delivered through outreach with US$ 0.9 million for facility based and US$ 1.2 million for outreach delivery (table 29) which is similar vaccine administration costs for routine costing in 2011 for other vaccines.

Table 29: New Vaccine Introduction economic costs by activity (USD)

<table>
<thead>
<tr>
<th>Type of cost</th>
<th>Cost (USD)</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-going</td>
<td>22,762,790</td>
<td>85.19%</td>
</tr>
<tr>
<td>Fixed based delivery</td>
<td>914,416</td>
<td>3.42%</td>
</tr>
<tr>
<td>Outreach delivery</td>
<td>1,202,935</td>
<td>4.50%</td>
</tr>
<tr>
<td>Vaccine collection distribution and storage</td>
<td>20,645,440</td>
<td>77.27%</td>
</tr>
<tr>
<td>Start up</td>
<td>3,956,321</td>
<td>14.81%</td>
</tr>
<tr>
<td>Cold chain maintenance</td>
<td>5,806</td>
<td>0.02%</td>
</tr>
<tr>
<td>Other</td>
<td>61,891</td>
<td>0.23%</td>
</tr>
<tr>
<td>Outreach service delivery</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Program management</td>
<td>581,871</td>
<td>2.18%</td>
</tr>
<tr>
<td>Record-keeping &amp; HMIS</td>
<td>143,026</td>
<td>0.54%</td>
</tr>
<tr>
<td>Facility-based delivery</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Social mobilization &amp; advocacy</td>
<td>1,321,657</td>
<td>4.95%</td>
</tr>
<tr>
<td>Supervision</td>
<td>66,301</td>
<td>0.25%</td>
</tr>
<tr>
<td>Surveillance</td>
<td>975,036</td>
<td>3.65%</td>
</tr>
<tr>
<td>Training</td>
<td>571,888</td>
<td>2.14%</td>
</tr>
<tr>
<td>Vaccine collection, distribution, &amp; storage</td>
<td>228,845</td>
<td>0.86%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26,719,111</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>
Table 30: New vaccine introduction economic costs by Line Item (USD, 2011)

<table>
<thead>
<tr>
<th>On-going</th>
<th>Total Cost (2011$)</th>
<th>Percent of Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>cold chain energy cost</td>
<td>296,204</td>
<td>1.11%</td>
</tr>
<tr>
<td>cold chain equipment</td>
<td>1,549,177</td>
<td>5.80%</td>
</tr>
<tr>
<td>Salaried Labor</td>
<td>2,117,351</td>
<td>7.92%</td>
</tr>
<tr>
<td>vaccines</td>
<td>18,800,058</td>
<td>70.36%</td>
</tr>
<tr>
<td>Start up</td>
<td>3,956,321</td>
<td>14.81%</td>
</tr>
<tr>
<td>Building overhead, utilities, communication</td>
<td>164,461</td>
<td>0.62%</td>
</tr>
<tr>
<td>Cold Chain equipment</td>
<td>149,853</td>
<td>0.56%</td>
</tr>
<tr>
<td>Other</td>
<td>52,723</td>
<td>0.20%</td>
</tr>
<tr>
<td>other capital</td>
<td>27,021</td>
<td>0.10%</td>
</tr>
<tr>
<td>Other recurent</td>
<td>552,413</td>
<td>2.07%</td>
</tr>
<tr>
<td>Per diem &amp; travel allowances</td>
<td>101,403</td>
<td>0.38%</td>
</tr>
<tr>
<td>Salaried Labor</td>
<td>2,634,785</td>
<td>9.86%</td>
</tr>
<tr>
<td>Transport &amp; fuel</td>
<td>69,130</td>
<td>0.26%</td>
</tr>
<tr>
<td>Vehicles</td>
<td>90,073</td>
<td>0.34%</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>89,231</td>
<td>0.33%</td>
</tr>
<tr>
<td>Printing</td>
<td>25,229</td>
<td>0.09%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26,719,111</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>
Table 31: New vaccine introduction fiscal costs by line item (USD, 2011)

<table>
<thead>
<tr>
<th>Line item</th>
<th>Cost (USD)</th>
<th>Distribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building overhead, utilities, communication</td>
<td>157 007</td>
<td>0.48%</td>
</tr>
<tr>
<td>Cold chain equipment</td>
<td>1 531 426</td>
<td>4.64%</td>
</tr>
<tr>
<td>Other</td>
<td>52 723</td>
<td>0.16%</td>
</tr>
<tr>
<td>Other capital</td>
<td>100 000</td>
<td>0.30%</td>
</tr>
<tr>
<td>Other recurrent</td>
<td>552 413</td>
<td>1.67%</td>
</tr>
<tr>
<td>Per diem &amp; travel allowances</td>
<td>101 356</td>
<td>0.31%</td>
</tr>
<tr>
<td>Additional staff hired (NUVI coordinator)</td>
<td>28 389</td>
<td>0.09%</td>
</tr>
<tr>
<td>Transport/fuel</td>
<td>92 191</td>
<td>0.28%</td>
</tr>
<tr>
<td>Vehicles</td>
<td>584 000</td>
<td>1.77%</td>
</tr>
<tr>
<td>Vaccines</td>
<td>27 883 815</td>
<td>84.40%</td>
</tr>
<tr>
<td>Vaccine injection &amp; safety supplies</td>
<td>1 929 605</td>
<td>5.84%</td>
</tr>
<tr>
<td>Printing</td>
<td>25 229</td>
<td>0.08%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>33 038 153</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

The total fiscal cost amounted to US$ 33 million and the cost per dose of new vaccine purchased represented US$ 5.13. The cost of new vaccines purchased for introduction represents a three-fold increase in vaccine costs (compared to EPI vaccine costs in 2011), mostly driven by pneumococcal vaccine (87%) and rotavirus (12%). The additional cold chain equipment for new vaccines represented 5% of total fiscal costs (table 33) and was mostly supported by external support.
Table 32: Summary table: start-up costs, ongoing costs and fiscal costs for new vaccine introduction in Ghana

<table>
<thead>
<tr>
<th>Line Item</th>
<th>Economic costs US$</th>
<th>Fiscal costs US$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start-up costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaried labor for introduction-related activities</td>
<td>2,634,785</td>
<td>28,389*</td>
</tr>
<tr>
<td>Other recurrent expenses**</td>
<td>552,413</td>
<td>552,413</td>
</tr>
<tr>
<td>Building overheads, utilities, communication</td>
<td>164,461</td>
<td>157,007</td>
</tr>
<tr>
<td>Per diem &amp; travel allowances</td>
<td>101,403</td>
<td>101,356</td>
</tr>
<tr>
<td>Volunteer labor</td>
<td>89,231</td>
<td>89,231</td>
</tr>
<tr>
<td>Transport/fuel</td>
<td>69,130</td>
<td>92,191</td>
</tr>
<tr>
<td>Printing</td>
<td>25,229</td>
<td>25,229</td>
</tr>
<tr>
<td>New cold chain equipment</td>
<td>149,853</td>
<td>1,531,426</td>
</tr>
<tr>
<td>Vehicles</td>
<td>90,073</td>
<td>584,000</td>
</tr>
<tr>
<td>other capital</td>
<td>27,021</td>
<td>100,000</td>
</tr>
<tr>
<td>Other</td>
<td>52,723</td>
<td>52,723</td>
</tr>
<tr>
<td><strong>On-going costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaried labor for new vaccines delivery</td>
<td>2,117,351</td>
<td>-</td>
</tr>
<tr>
<td>Vaccines and supplies</td>
<td>18,800,058</td>
<td>29,813,420</td>
</tr>
<tr>
<td>Cold chain energy cost</td>
<td>296,204</td>
<td>-</td>
</tr>
<tr>
<td>Cold chain equipment utilization</td>
<td>1,549,177</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total start-up economic costs per doses administered</strong></td>
<td>3,956,321</td>
<td>14.81%</td>
</tr>
<tr>
<td><strong>Total on-going economic costs (delivery) per doses administered</strong></td>
<td>3,962,732</td>
<td>85.19%</td>
</tr>
<tr>
<td><strong>Total economic delivery cost per doses administered</strong></td>
<td>7,919,053</td>
<td>2.45</td>
</tr>
<tr>
<td><strong>Total fiscal costs</strong></td>
<td>-</td>
<td>33,038,153</td>
</tr>
</tbody>
</table>

*Hiring of coordinator for new vaccine introduction
**Studies, new vaccines pilot, launch, AEFI surveillance
<table>
<thead>
<tr>
<th>Number</th>
<th>Type of equipment (specify)</th>
<th>Brand name</th>
<th>Make year</th>
<th>Vaccine storage Capacity (m³)</th>
<th>Funding sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>91</td>
<td>Refrigerator</td>
<td>TCW2000</td>
<td>2009</td>
<td>99 Liters</td>
<td>USAID, UNICEF, GAVI</td>
</tr>
<tr>
<td>98</td>
<td>Refrigerator</td>
<td>TCW3000</td>
<td>2009</td>
<td>126.5 Liters</td>
<td>USAID, UNICEF, GAVI</td>
</tr>
<tr>
<td>21</td>
<td>Freezers</td>
<td>TFW800</td>
<td>2009</td>
<td>247 Liters</td>
<td>USAID, UNICEF, GAVI</td>
</tr>
<tr>
<td>8</td>
<td>WICR</td>
<td>Dayard Europer</td>
<td>2006</td>
<td>30 m³</td>
<td>JICA</td>
</tr>
<tr>
<td>1</td>
<td>WICR</td>
<td>Dayard Europer</td>
<td>2006</td>
<td>40 m³</td>
<td>UNICEF</td>
</tr>
<tr>
<td>1</td>
<td>WICR</td>
<td>Dayard Europer</td>
<td>2006</td>
<td>40 m³</td>
<td>JICA</td>
</tr>
</tbody>
</table>
Table 34: Comparison of full needs and expenses for the new vaccine introduction (USD)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>40,000</td>
<td>79,668</td>
<td>-39,668</td>
</tr>
<tr>
<td>Social mobilization, IEC and advocacy</td>
<td>60,000</td>
<td>472,478</td>
<td>-412,478</td>
</tr>
<tr>
<td>Cold chain equipment &amp; maintenance</td>
<td>300,000</td>
<td>1,531,426</td>
<td>-1,231,426</td>
</tr>
<tr>
<td>Vehicles and transportation</td>
<td>500,000</td>
<td>584,000</td>
<td>-84,000</td>
</tr>
<tr>
<td>Program management</td>
<td>50,000</td>
<td>62,495</td>
<td>-12,495</td>
</tr>
<tr>
<td>Surveillance</td>
<td>150,000</td>
<td>164,560</td>
<td>-14,560</td>
</tr>
<tr>
<td>Technical assistance</td>
<td>45,000</td>
<td>0</td>
<td>45,000</td>
</tr>
<tr>
<td>Injection safety and waste management</td>
<td>100,000</td>
<td>100,000</td>
<td>0</td>
</tr>
<tr>
<td>Total NUVI plan</td>
<td>1,245,000</td>
<td>2,994,627</td>
<td>-1,749,627</td>
</tr>
<tr>
<td>Additional staff hired (NUVI coordinator)</td>
<td></td>
<td>28,389</td>
<td></td>
</tr>
<tr>
<td>Record-keeping and HMIS</td>
<td></td>
<td>134,880</td>
<td>-134,880</td>
</tr>
<tr>
<td>Supervision</td>
<td></td>
<td>24,957</td>
<td>-24,957</td>
</tr>
<tr>
<td>Vaccine collection</td>
<td></td>
<td>13,047</td>
<td>-13,047</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>28,533</td>
<td>-3,244</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,245,000</td>
<td>3,224,733</td>
</tr>
</tbody>
</table>

Regarding, the investment cost for expanding the cold chain capacity: the actual cost was higher than the provisional amount in new vaccine introduction plan (21). In the case of Ghana, when comparing fiscal costs and the new vaccine introduction plan costs, the following were below in the NUVI plan: training (by 40 K USD), social mobilization (by 0.41 M USD), cold chain equipment (by 1.23 M USD), vehicles (by 84 K USD), record keeping & HMIS (134 K USD). In total a variance of 1.99 M USD between forecasted expenses in NUVI plan and actual fiscal costs.

However, we should keep in mind that NUVI plan is not supposed to cover all resources and activities of the new vaccine introduction. In addition, the cold chain expansion had been planned years in advance (table 34).

5.5. NUVI funding sources
When excluding the value of vaccines and supplies, NUVI was mostly funded by domestic funding (68%) GAVI support was the most significant external source for NUVI (table 32).
GAVI financial support for NUVI represents 1.5 M USD (table 35) and a significant share of ISS funds received where used for NUVI activities or investments.

<table>
<thead>
<tr>
<th>Donor</th>
<th>Amount (USD)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GAVI</strong>:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value Vaccines shipped (UNICEF estimate)</td>
<td>27,700,000</td>
<td>93.05%</td>
</tr>
<tr>
<td>Vaccine Introduction Grant :</td>
<td>915,000</td>
<td>3.07%</td>
</tr>
<tr>
<td>ISS funds - start-up activities (launch, per diem, fuel) capital investment (Cold chain equipment, vehicles, mobile incinerators)</td>
<td>574,000</td>
<td>1.93%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>29,189,000</td>
<td>98.05%</td>
</tr>
<tr>
<td><strong>WHO</strong> :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Rotavirus surveillance sites</td>
<td>46,000</td>
<td>0.15%</td>
</tr>
<tr>
<td>- EPI / Program Management</td>
<td>41,000</td>
<td>0.14%</td>
</tr>
<tr>
<td>- HR from country Office</td>
<td>47,000</td>
<td>0.16%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>134,000</td>
<td>0.45%</td>
</tr>
<tr>
<td><strong>UNICEF</strong> :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- HR from country Office</td>
<td>11,000</td>
<td>0.04%</td>
</tr>
<tr>
<td>- Walk-in Cold Room</td>
<td>29,000</td>
<td>0.10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>40,000</td>
<td>0.14%</td>
</tr>
<tr>
<td><strong>JICA</strong> :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Walk in Cold Rooms</td>
<td>406,000</td>
<td>1.36%</td>
</tr>
<tr>
<td><strong>Total donor financing</strong></td>
<td>29,769,000</td>
<td>100%</td>
</tr>
</tbody>
</table>

5.6. Utilization of NUVI introduction grant
Specific funding for NUVI was provided by GAVI (New vaccine introduction grant) and were first used in January 2012. 29% of this support was transferred to the regions to support new vaccine introduction activities at the lower levels. This support was mostly used for social mobilization for NUVI – including the launch (28%), Surveillance related to new vaccine introduction (16%), Research (11%) and program management / meetings (8%) (22)(Graph 12).
The difference between forecasted expense and actual costs confirms the higher costs for some line items identified in previous reviews where transport, fuel, per diem, cold chain, equipment and maintenance costs had been underestimated (1). In particular, some sub national (district, facility) expenses had not necessarily been planned in the new vaccine introduction plan. Some districts had assumed that regional and national levels would supply them with all inputs required for new vaccine introduction which was not the case (1). They were able to perform the activities but no dedicated funding was provided for the full range of costs.

Simultaneous introduction of two new vaccines have a potential for cost-savings due to the shorter overall time for training compared with two individual trainings. Simultaneous introduction also reduces the loss of productivity caused by removing staff from their posts to be trained on separate subjects (1).

One of the challenges reported in the last EPI review was that there was no budget line for cold chain equipment which limits the potential investments that can be made to invest in new equipment. The lack of capital equipment in small facilities was identified in other reports (11). One of the recommendations from last EPI review (1) was to “make provision in the national budget for purchasing cold chain equipment including funds for preventive maintenance as the portfolio of vaccines is expanded”.

Graph 12: Use of GAVI Vaccine Introduction Grant

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>3%</td>
</tr>
<tr>
<td>Transport/Fuel</td>
<td>2%</td>
</tr>
<tr>
<td>M&amp;E, HMIS</td>
<td>3%</td>
</tr>
<tr>
<td>Program management</td>
<td>8%</td>
</tr>
<tr>
<td>Surveillance</td>
<td>16%</td>
</tr>
<tr>
<td>Social Mobilization</td>
<td>28%</td>
</tr>
<tr>
<td>Research</td>
<td>11%</td>
</tr>
<tr>
<td>Regional transfer</td>
<td>29%</td>
</tr>
<tr>
<td>Surveillance</td>
<td>16%</td>
</tr>
<tr>
<td>Social Mobilization</td>
<td>28%</td>
</tr>
<tr>
<td>Research</td>
<td>11%</td>
</tr>
<tr>
<td>Regional transfer</td>
<td>29%</td>
</tr>
</tbody>
</table>
7. Determinant of costs and productivity analysis at facility level

7.1. Introduction

This analysis aims at identifying the determinants of routine immunization costs, as well as performing the productivity analysis of health facilities. Ultimately, the determinants analysis intends to come up with sound analyses and compelling results that will be used to simulate various scenarios and fine tune immunization management system with regard to the planning of activities, the management process, and the decision-making approach, where the binding constraints and enablers could be pretty well known and foreseen prior undertaking further activities. Concerning the productivity analysis, it will allow well classifying facilities through quadrant analysis.

In all, beyond a simplest analysis exercise, the study findings might be considered as full-fledged performance management tools, useful to designing and implementing actions with high impact in terms of effectiveness.

The independent variables of the determinant analysis are the total cost for providing routine immunization services. The potential explanatory characteristics are both continuous and categorical variables. They range from intrinsic factors related to children features (coverage doses) to extrinsic characteristics associated to facilities setting, vaccines supply and management system, as well as some variables of the catchment area of the facilities.

For this analysis, further identification and correction of persistent discrepancies and errors have been performed during the data management process prior the data analysis stage. For this purpose, additional routine on Visual Basic Excel have been developed to capture some lingered issues.

7.2. Productivity analysis

The productivity analysis consists in ranking health facilities according to their cost-effective performance. The productivity analysis has been performed in computing different productivity indicators such as the total doses administered per FTE, the total doses per total facility staff and working day, the total doses per fully immunized child, the total wastage doses of pentavalent and the total wastage doses of polio. The analysis of these figures is completed by the quadrant exploration, which helps to graphically assess the performance of the facilities.

Productivity is thought of as the relationship between units of output per unit of input. In that vein, the following productivity indicators are explored and evaluated and summarized. These are:

- Total doses administered/The total time spent in the facility for immunization per week divided by the number of working hours per week (FTE)
- Total doses/Total facility staff/working day
- Doses/FIC, (FIC here measured as DTP3 covered children);
- Wastage rates
7.3. Determinant analysis

The determinants Analysis of Immunization costing is a cross-country study with the 50 health facilities in our sample. It consists to identifying factors that are driving routine immunization costs, as well as their magnitude. The independent variables of the determinant analysis are the total costs for providing Routine Immunization services. The potential explanatory characteristics are both continuous and categorical variables. They range from intrinsic factors related to children features (coverage doses) to extrinsic characteristics associated to facilities’ setting, vaccines supply and management system, as well as some variables of the catchment area of the facilities.

The study aims to identifying the determinants of routine immunization cost, as well as performing the productivity analysis of health facilities. Ultimately, the determinants analysis intends to come up with sound analyses and compelling results that will be used to simulate various scenarios and fine tune immunization management system at all levels with regard to the planning of activities, the management process, and the decision-making approach, where the binding constraints and enablers could be pretty well known and foreseen prior undertaking further activities. Concerning the productivity analysis, it will allow well classifying facilities through quadrant analysis.

In all, beyond a simplest analysis exercise, the study findings might be considered as full-fledged performance management tools, useful to designing and implementing actions with high impact in terms of effectiveness.

Two stages sampling approach has been used for samples drawing.

**Stage One**

The determination of the sample size was made in using the formula of SCWARTZ below:

Equation 1:

\[ n_0 = \frac{Z^2 \cdot p \cdot q}{\epsilon^2} \]

Where a normal distribution is assumed, and:

- \( n_0 \) = Sample size;
- \( Z^2 \) = Area under the normal curve (1.96 for 95% CI);
- \( p \) = Estimated proportion of an attribute that is present in the population (assume 0.5);
- \( q = 1 - p = 0.5 \);
- The resulting sample size is \((1.96)^2(0.5)(0.5)/(0.1)^2= 96\)

**Stage Two**

Assume that the population of facilities is small. Then the sample size can be adjusted, because a given sample size provide proportionately more information for a small population than for a large population.

Equation 2

\[ n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} \]

Where

- \( n_0 \) = initial sample size and \( N \) = population size.
If we assume approximately 100 primary care facilities in the geographical areas that have been sampled, the resulting sample size will be \( \frac{96}{1 + (96-1)/100} = 50 \) health facilities to be sampled in total.

Data analysis and regressions were performed under Stata version 12.0 software. To run the regression analysis, a descriptive analysis of the sample characteristics was performed. Means, standard deviations, minimum, maximum and the number of observations were computed for all continuous variables, while percentage distributions were displayed for categorical variables.

Then, prior to the regression analysis step, we worked out the correlation tables of core continuous variable candidates for the determinant analysis. We also performed one-way ANOVA testing to calculate the homogeneity of the sample (comparison of the mean cost per stratum of categorical variables), and tested the equality of variances amongst stratum by using the Bartlett test. For instance, we compared the mean of total cost per region, type of area and type of health facility. Similarly, Box and Whiskers plots were used to ascertain the normality feature of the total economic cost, as per the same covariates. Scatter plots of the total economic cost, and then of the delivery cost (cost without vaccines), were plotted against the characteristic number of Fully Immunized Child (FIC). This was to capture the rough trend of the economic cost (or delivery cost) compared to the variable FIC, and eye-catch potential outliers. For the variable total economic cost, the best-fitted functional shape was checked by using Stata commands “ladder” and “gladder”.

We used the cost function to build our determinant model. We conducted all analyses with Stata Version 12 software. An initial model, called the “theoretical model”, was built based on the following formula:

\[
\log(CQ_i) = \beta_0 + \beta_1 \log(FIC_i) + \beta_2 \log(FTE_i) + \beta_3 \log(P_i) + \beta_4 Z_i.
\]

In this linear model, \( CQ_i \) is the total facility immunization cost (including vaccine cost); \( FIC_i \) the Fully Immunized Child number expressed as a measure of production outcome; \( FTE_i \) the proportion of time dedicated to immunization by immunization staff as a quantity input measure judged likely to be a key driver of facility cost; \( P_i \) the average wage of staff as a price measure; and \( Z_i \) a measure of quality based on a yes or no answer to the question, “Do you have enough staff to conduct routine immunization well?”. Log transformation was performed for quantitative variables because this allowed these variables to have a normal distribution. The coefficients of the explanatory variables in log transformation indicated the elasticity of the vaccination cost relative to the corresponding explanatory variables.

Using the above as the base model, we developed several linear regression models, starting from the theoretical model and adding control variables one by one (all categorical), and assessed the behavior of the model. The control variables used were the ‘urban or rural location’, ‘type of health facility’, and ‘region’. The covariates ‘existence of users’ fees’, ‘existence of volunteers supporting immunization’, and ‘existence of cold chain equipment’ are not included in the regression model because their terms were invariant. After performing each model, post estimation diagnostics were computed to check the validity of each model. The various tests computed were the Linktest test to ascertain whether the model was well specified; the Ramsey RESET ovttest to verify if there were omitted variables; the sktest test for the normality of residual; the Breush-Pagan test for heteroskedasticity to verify the assumption of the equality of variance; and the VIF multicollinearity test for covariates. Finally, the endogeneity test of Hausman was also performed for the output covariate ‘FIC’ upon the dependent ‘total immunization cost’ variable in order
to validate the exogeneity of the output variable, which is an important condition for model validation. The retained models were those that meet all the post-estimation test requirements.

7.4. Results

7.4.1. Description of samples
Sample distributions are described in the tables 36 for categorical variables and table 37 for continuous variables. It is notable that the completeness rates are satisfying for surveys in the two countries and for almost all the variables. 95% of facilities are owned by government while 78% of surveyed facilities belong to rural settlement. Cold chain equipment existed in 68% of facilities. 54% of facilities surveyed declared that they had collected user fees. 58% of facilities interviewees have declared to burn the waste in a pit. Grid electricity was used as source of energy in 58% of facilities. 84% of facilities interviewees confirmed the existence of volunteers supporting immunization activities.

Table 36: Percent distribution of some core categorical characteristics of the surveyed health facilities in Ghana

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>District (n = 50)</strong></td>
<td></td>
</tr>
<tr>
<td>Asante Akim South</td>
<td>14.0%</td>
</tr>
<tr>
<td>Atwima Mponua</td>
<td>12.0%</td>
</tr>
<tr>
<td>Bunkpurugu Yunyoo</td>
<td>12.0%</td>
</tr>
<tr>
<td>Ga West</td>
<td>16.0%</td>
</tr>
<tr>
<td>Kassena Nankana</td>
<td>20.0%</td>
</tr>
<tr>
<td>Wa Municipal</td>
<td>26.0%</td>
</tr>
<tr>
<td><strong>Region (n = 50)</strong></td>
<td></td>
</tr>
<tr>
<td>Ashanti</td>
<td>26.0%</td>
</tr>
<tr>
<td>Greater</td>
<td>16.0%</td>
</tr>
<tr>
<td>Northern</td>
<td>12.0%</td>
</tr>
<tr>
<td>Upper East</td>
<td>20.0%</td>
</tr>
<tr>
<td>Upper West</td>
<td>26.0%</td>
</tr>
<tr>
<td><strong>Type of facility (n = 50)</strong></td>
<td></td>
</tr>
<tr>
<td>CHPS</td>
<td>40.0%</td>
</tr>
<tr>
<td>Health Center</td>
<td>34.0%</td>
</tr>
<tr>
<td>Clinic</td>
<td>18.0%</td>
</tr>
<tr>
<td>RCH</td>
<td>8.0%</td>
</tr>
<tr>
<td><strong>Ownership (n = 50)</strong></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>94.0%</td>
</tr>
<tr>
<td>Christian Health Association Of Ghana (CHAG)</td>
<td>6.0%</td>
</tr>
<tr>
<td><strong>Type of area (n = 50)</strong></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>78.0%</td>
</tr>
<tr>
<td>Urban</td>
<td>22.0%</td>
</tr>
<tr>
<td><strong>State of roads from this facility to the outreach sites (n = 50)</strong></td>
<td></td>
</tr>
<tr>
<td>Tarred</td>
<td>10.0%</td>
</tr>
<tr>
<td>Graveled</td>
<td>26.0%</td>
</tr>
<tr>
<td>Not tarred</td>
<td>64.0%</td>
</tr>
<tr>
<td><strong>Existence of Volunteers supporting immunization (n = 50)</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>84.0%</td>
</tr>
<tr>
<td>No</td>
<td>16.0%</td>
</tr>
<tr>
<td><strong>Cold chain equipment in facility (n = 50)</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>68.0%</td>
</tr>
<tr>
<td>No</td>
<td>32.0%</td>
</tr>
<tr>
<td>Characteristics</td>
<td>Percentage</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Way of disposing (n = 50)</td>
<td></td>
</tr>
<tr>
<td>burning in a pit</td>
<td>58.0%</td>
</tr>
<tr>
<td>Transferred to / collected by DHMT</td>
<td>22.0%</td>
</tr>
<tr>
<td>sent to / collected by hospital or other health center</td>
<td>6.0%</td>
</tr>
<tr>
<td>Other</td>
<td>2.0%</td>
</tr>
<tr>
<td>Incinerator</td>
<td>8.0%</td>
</tr>
<tr>
<td>Not Applicable</td>
<td>4.0%</td>
</tr>
<tr>
<td>Users' fees (n = 50)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>54.0%</td>
</tr>
<tr>
<td>No</td>
<td>46.0%</td>
</tr>
<tr>
<td>Flood in the year (n = 50)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>34.0%</td>
</tr>
<tr>
<td>No</td>
<td>66.0%</td>
</tr>
<tr>
<td>Availability of public transportation (n = 50)</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>48.0%</td>
</tr>
<tr>
<td>Medium</td>
<td>34.0%</td>
</tr>
<tr>
<td>High</td>
<td>18.0%</td>
</tr>
<tr>
<td>Energy supply for cold chain (n = 50)</td>
<td></td>
</tr>
<tr>
<td>Grid electricity</td>
<td>48.0%</td>
</tr>
<tr>
<td>Bottled gas</td>
<td>4.0%</td>
</tr>
<tr>
<td>Solar energy</td>
<td>8.0%</td>
</tr>
<tr>
<td>Not applicable</td>
<td>40.0%</td>
</tr>
<tr>
<td>Enough staff to perform RI well? (50)</td>
<td></td>
</tr>
<tr>
<td>Strongly agree &amp; Agree</td>
<td>64.0%</td>
</tr>
<tr>
<td>Others responses</td>
<td>32.0%</td>
</tr>
<tr>
<td>Missing</td>
<td>4.0%</td>
</tr>
</tbody>
</table>

The indicators were all weighted and provided with their standard deviation values. The weighted average total economic cost per facility was US$ 16,459.38 (ET = US$ 1,624.02). The weighted average delivery economic cost per facility was US$ 12,153.01 (ET US$ 1,041.89). The average number of Full Immunization Children (number of children having received third dose of DTP3) per facility was 321.09 (ET =40.76). The average Full Time Equivalent (FTE) representing the time spent by facility staff on routine immunization activities was 1.76 ± 0.16 by facility. The average total routine dose administered by facility was 3,244.52 (ET = 411.47). The average number of staff per facility in Ghana was 12.2 (ET = 11.97). The average number of campaign per facility organized in 2011 was 2.21 (ET = 0.31). On average, routine Immunization activities have been interrupted in 2011 during 6.86 (ET = 3.2) days in Ghana due to floods.

Table 37: Distribution of facilities as per some core continuous variables surveyed in Ghana

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Weighted Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total routine immunization costs (USD)</td>
<td>16,459.38</td>
<td>1,624.02</td>
</tr>
<tr>
<td>Total routine immunization cost, excluding vaccine costs (USD)</td>
<td>12,153.01</td>
<td>1,041.89</td>
</tr>
<tr>
<td>Children having received DTP-HepB-Hib dose 3 (defined as a fully immunized child)</td>
<td>321.09</td>
<td>40.76</td>
</tr>
</tbody>
</table>
We performed graphical analysis of data that also helped to see the trends of the total cost per the number of children having received the third dose of pentavalent vaccine (FIC). The depicted graph (Graph 13) showed upward trends. Some outliers stand out from the set of facility scatter points. The same findings were made on quadrant scatter plots where outliers identified previously are confirmed.

**Graph 13: Total economic routine immunization Costs in USD (x axis) vs DTP3 vaccinated children (x axis), Ghana**

When using the median as a threshold for statistical comparison of both economic cost and the number of fully immunized children, one clearly sees that, for Ghana, only 7 facilities out of 50 fell in the southern-east area of cost-effectiveness; the same
number fell in the northern-west area of ‘counter-performance’. The vast majority of facilities fell in the intermediary northern-east and southern-west zones considered as neither performing nor counter-performing (Graph 14).

Graph 14: Quadrant analysis of Total Economic Cost (y axis) vs DTP3 Vaccinated Children (x axis), Ghana

Various Whiskers plots of total economic costs, broken down by variables such as region, area type and facility type are presented (Graphs 15 to 18). These plots show the total economic cost is not normally distributed, because its means differ from medians and also the 25 and 75 percentiles are not located at the same distance from the beginning and end of the distribution. It is worth noting also that the means of the total economic cost differ from one region to another, from urban area to rural settlement and from one type of health facility to another. These graphical findings are confirmed by the ANOVA tests of comparison of means.
Table 38: Analysis of variances of Total cost, broken down as per some core categorical variables, Ghana

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Freq.</th>
<th>ANOVA</th>
<th>Bartlett Test for equal variances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F</td>
<td>chi2(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prob &gt; F</td>
<td>Prob &gt; B</td>
</tr>
<tr>
<td>1. Type of facility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHPS</td>
<td>11,881.84</td>
<td>8,048.84</td>
<td>20</td>
<td>5.36</td>
<td>13.0205</td>
</tr>
<tr>
<td>Health Center</td>
<td>26,455.30</td>
<td>14,512.31</td>
<td>17</td>
<td>0.0030**</td>
<td>0.005**</td>
</tr>
<tr>
<td>Clinic</td>
<td>17,414.46</td>
<td>15,997.45</td>
<td>9</td>
<td>1.16</td>
<td>7.2677</td>
</tr>
<tr>
<td>RCH</td>
<td>36,501.16</td>
<td>28,476.34</td>
<td>4</td>
<td>3.05</td>
<td>0.0188*</td>
</tr>
<tr>
<td>Total</td>
<td>19,802.23</td>
<td>15,814.30</td>
<td>50</td>
<td>0.3425</td>
<td>0.122</td>
</tr>
<tr>
<td>2. Region</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ashanti</td>
<td>21,178.14</td>
<td>17,378.58</td>
<td>13</td>
<td>1.16</td>
<td>7.2677</td>
</tr>
<tr>
<td>Greater Accra</td>
<td>16,529.47</td>
<td>20,276.02</td>
<td>8</td>
<td>3.05</td>
<td>0.0188*</td>
</tr>
<tr>
<td>Northern Region</td>
<td>30,554.87</td>
<td>14,141.94</td>
<td>6</td>
<td>0.0188*</td>
<td>0.002**</td>
</tr>
<tr>
<td>Upper East</td>
<td>13,986.07</td>
<td>7,606.13</td>
<td>10</td>
<td>0.3425</td>
<td>0.122</td>
</tr>
<tr>
<td>Upper West</td>
<td>19,951.54</td>
<td>16,044.95</td>
<td>13</td>
<td>0.3425</td>
<td>0.122</td>
</tr>
<tr>
<td>Total</td>
<td>19,802.23</td>
<td>15,814.30</td>
<td>50</td>
<td>0.3425</td>
<td>0.122</td>
</tr>
<tr>
<td>3. District</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asante Akim South</td>
<td>9,653.37</td>
<td>3,283.68</td>
<td>7</td>
<td>0.0188*</td>
<td>0.002**</td>
</tr>
<tr>
<td>Atwima Mponua</td>
<td>34,623.71</td>
<td>17,578.65</td>
<td>6</td>
<td>3.05</td>
<td>0.0188*</td>
</tr>
<tr>
<td>Bunkpurugu Yunyoo</td>
<td>30,554.87</td>
<td>14,141.94</td>
<td>6</td>
<td>0.0188*</td>
<td>0.002**</td>
</tr>
<tr>
<td>Ga West</td>
<td>16,529.47</td>
<td>20,276.02</td>
<td>8</td>
<td>0.0188*</td>
<td>0.002**</td>
</tr>
<tr>
<td>Kassena Nankana</td>
<td>13986.07</td>
<td>7,606.13</td>
<td>10</td>
<td>3.05</td>
<td>0.0188*</td>
</tr>
<tr>
<td>Wa Municipal</td>
<td>19951.54</td>
<td>16,044.95</td>
<td>13</td>
<td>0.0188*</td>
<td>0.002**</td>
</tr>
<tr>
<td>Total</td>
<td>19802.23</td>
<td>15,814.30</td>
<td>50</td>
<td>0.0188*</td>
<td>0.002**</td>
</tr>
</tbody>
</table>
### Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Freq.</th>
<th>ANOVA</th>
<th>Bartlett Test for equal variances</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Type of area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>17,587.98</td>
<td>12,423.47</td>
<td>39</td>
<td>3.66</td>
<td>0.061</td>
</tr>
<tr>
<td>Urban</td>
<td>27,652.78</td>
<td>23,495.42</td>
<td>11</td>
<td>**</td>
<td>7.6139</td>
</tr>
<tr>
<td>Total</td>
<td>19,802.23</td>
<td>15,814.30</td>
<td>50</td>
<td></td>
<td>0.006**</td>
</tr>
<tr>
<td>4. Ownership</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>18,517.50</td>
<td>15,064.07</td>
<td>47</td>
<td>5.66</td>
<td>0.0214*</td>
</tr>
<tr>
<td>CHAG</td>
<td>39,929.66</td>
<td>16,170.84</td>
<td>3</td>
<td></td>
<td>0.0172</td>
</tr>
<tr>
<td>Total</td>
<td>19,802.23</td>
<td>15,814.30</td>
<td>50</td>
<td></td>
<td>0.896</td>
</tr>
</tbody>
</table>

Due to the fact that the total economic cost distribution curve is not normally distributed, the Log transformation function of this variable is performed.

**Graph 19: Box and Whiskers plot of Log of Total Economic cost, outliers removed, Ghana**

![Box and Whiskers plot of Log of Total Economic cost, outliers removed, Ghana](image-url)
7.4.2. Regression models of the total costs of routine immunization

Table 39 displays the final regression models performed upon health facilities. The theoretical model is (M0) while the subsequent ones are those with controlling covariates.

Table 39: Final linear regression model evaluating the association of different variables with total immunization costs in Ghana

<table>
<thead>
<tr>
<th>Variables (M0)</th>
<th>(M1)</th>
<th>(M2)</th>
<th>(M3)</th>
<th>(M4)</th>
<th>(M5)</th>
<th>(M6)</th>
<th>(M7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. log of Full Immunized Children</td>
<td>0.395***</td>
<td>0.420***</td>
<td>0.360***</td>
<td>0.356***</td>
<td>0.381***</td>
<td>0.391***</td>
<td>0.383***</td>
</tr>
<tr>
<td></td>
<td>(4.47)</td>
<td>(5.18)</td>
<td>(3.72)</td>
<td>(4.41)</td>
<td>(4.55)</td>
<td>(4.85)</td>
<td>(5.87)</td>
</tr>
<tr>
<td>B. log of Average dedication proportion time</td>
<td>0.432**</td>
<td>0.433**</td>
<td>0.458†</td>
<td>0.422*</td>
<td>0.445*</td>
<td>0.474**</td>
<td>0.429**</td>
</tr>
<tr>
<td></td>
<td>(3.37)</td>
<td>(2.94)</td>
<td>(2.63)</td>
<td>(2.25)</td>
<td>(2.41)</td>
<td>(2.79)</td>
<td>(3.14)</td>
</tr>
<tr>
<td>C. log of Average monthly wage of staff</td>
<td>0.608</td>
<td>0.609†</td>
<td>0.587</td>
<td>0.633</td>
<td>0.677†</td>
<td>0.505</td>
<td>0.442</td>
</tr>
<tr>
<td></td>
<td>(1.51)</td>
<td>(1.98)</td>
<td>(1.53)</td>
<td>(1.68)</td>
<td>(1.75)</td>
<td>(1.28)</td>
<td>(1.21)</td>
</tr>
<tr>
<td>D. Enough staff to perform RI well (Yes =1/No =0)</td>
<td>0.511**</td>
<td>0.443*</td>
<td>0.448*</td>
<td>0.501**</td>
<td>0.488*</td>
<td>0.530**</td>
<td>0.443**</td>
</tr>
<tr>
<td></td>
<td>(3.05)</td>
<td>(2.67)</td>
<td>(2.57)</td>
<td>(2.79)</td>
<td>(2.51)</td>
<td>(3.11)</td>
<td>(3.03)</td>
</tr>
<tr>
<td>E. Region (Greater Accra =1/ Others= 0)</td>
<td>-0.438*</td>
<td>-0.438*</td>
<td>-0.438*</td>
<td>-0.438*</td>
<td>-0.438*</td>
<td>-0.438*</td>
<td>-0.438*</td>
</tr>
<tr>
<td></td>
<td>(-2.03)</td>
<td>(-2.93)</td>
<td>(-2.93)</td>
<td>(-2.93)</td>
<td>(-2.93)</td>
<td>(-2.93)</td>
<td>(-2.93)</td>
</tr>
<tr>
<td>F. Type of facility (Health center used as reference)</td>
<td>RCH</td>
<td>-0.120</td>
<td>-0.120</td>
<td>-0.120</td>
<td>-0.120</td>
<td>-0.120</td>
<td>-0.120</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.56)</td>
<td>(-0.56)</td>
<td>(-0.56)</td>
<td>(-0.56)</td>
<td>(-0.56)</td>
<td>(-0.56)</td>
</tr>
<tr>
<td></td>
<td>CHPS</td>
<td>-0.144</td>
<td>-0.144</td>
<td>-0.144</td>
<td>-0.144</td>
<td>-0.144</td>
<td>-0.144</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.57)</td>
<td>(-0.57)</td>
<td>(-0.57)</td>
<td>(-0.57)</td>
<td>(-0.57)</td>
<td>(-0.57)</td>
</tr>
<tr>
<td></td>
<td>Mission hospital</td>
<td>-0.382†</td>
<td>-0.382†</td>
<td>-0.382†</td>
<td>-0.382†</td>
<td>-0.382†</td>
<td>-0.382†</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-1.74)</td>
<td>(-1.74)</td>
<td>(-1.74)</td>
<td>(-1.74)</td>
<td>(-1.74)</td>
<td>(-1.74)</td>
</tr>
<tr>
<td>G. Ownership (Government =1/ Others=0)</td>
<td>-0.293</td>
<td>-0.293</td>
<td>-0.293</td>
<td>-0.293</td>
<td>-0.293</td>
<td>-0.293</td>
<td>-0.293</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-1.16)</td>
<td>(-1.16)</td>
<td>(-1.16)</td>
<td>(-1.16)</td>
<td>(-1.16)</td>
<td>(-1.16)</td>
</tr>
<tr>
<td>H. Location (Urban=1/Rural=0)</td>
<td>-0.141</td>
<td>-0.141</td>
<td>-0.141</td>
<td>-0.141</td>
<td>-0.141</td>
<td>-0.141</td>
<td>-0.141</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.66)</td>
<td>(-0.66)</td>
<td>(-0.66)</td>
<td>(-0.66)</td>
<td>(-0.66)</td>
<td>(-0.66)</td>
</tr>
<tr>
<td>I. User fees (Yes =1/No=0)</td>
<td>-0.188</td>
<td>-0.188</td>
<td>-0.188</td>
<td>-0.188</td>
<td>-0.188</td>
<td>-0.188</td>
<td>-0.188</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-1.13)</td>
<td>(-1.13)</td>
<td>(-1.13)</td>
<td>(-1.13)</td>
<td>(-1.13)</td>
<td>(-1.13)</td>
</tr>
<tr>
<td>J. Cold chain equipment in facility (Yes =1/No=0)</td>
<td>0.312*</td>
<td>0.312*</td>
<td>0.312*</td>
<td>0.312*</td>
<td>0.312*</td>
<td>0.312*</td>
<td>0.312*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.20)</td>
<td>(2.20)</td>
<td>(2.20)</td>
<td>(2.20)</td>
<td>(2.20)</td>
<td>(2.20)</td>
</tr>
<tr>
<td>K. Existence of Volunteers supporting immunization (Yes =1/No=0)</td>
<td>0.260†</td>
<td>0.260†</td>
<td>0.260†</td>
<td>0.260†</td>
<td>0.260†</td>
<td>0.260†</td>
<td>0.260†</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.70)</td>
<td>(1.70)</td>
<td>(1.70)</td>
<td>(1.70)</td>
<td>(1.70)</td>
<td>(1.70)</td>
</tr>
</tbody>
</table>

| Constant | 3.930† | 3.817† | 4.418† | 4.225† | 3.586 | 4.677† | 5.719† |
| | (1.83) | (1.90) | (1.90) | (1.93) | (1.60) | (2.05) | (2.36) |
| r2 | 0.549 | 0.567 | 0.524 | 0.499 | 0.497 | 0.510 | 0.568 |
| | 0.502 | 0.543 | 0.440 | 0.439 | 0.437 | 0.451 | 0.529 |
| N | 48 | 48 | 48 | 48 | 48 | 48 | 48 |
| df_r | 43 | 42 | 40 | 42 | 42 | 42 | 42 |

t statistics in parentheses
† p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

In the final regression model including all 50 facilities in Ghana, the variables associated with total immunization costs per facility were the number of fully immunized children, the dedication proportion of vaccinating personnel time, availability of enough staff to perform immunization activities, region, and the availability of cold chain equipment. Urban/rural status, facility ownership, user fees, and facility type did not contribute to the regression model.

Holding constant all the remain covariates, an equal 1% increase in FIC or in the proportion of time dedicated to immunization were associated with, respectively, a 0.37% and 0.44% increase in total facility immunization cost. The existence of cold chain equipment also increased total immunization cost by an average of 44%. Overall, the existence of enough staff to perform routine immunization properly (as reported by the facility manager) increased facility cost by 51%. Also, immunization...
cost is 39% less in Greater Accra than in the remaining regions. There was no statistically significant relationship between the total economic cost and the controlling variables like urban/rural status, government facility ownership, user fees, and type of facility.

Finally, the means of the total economic costs differed from one region to another, from urban area to rural facilities and from one type of health facility to another. These figures reveal an uneven distribution of the total economic costs by region, type of area and type of facility. The EPI Coordination as well as staff at decentralized levels should closely look at these figures and dig around so as to better assess the factors associated.

7.4.3. Productivity Analysis for Ghana facilities

Productivity is thought of as the relationship between units of output per unit of input. In that vein, the following productivity indicators are explored and evaluated and summarized for each county in the table 40. There are:

- Doses administered per Full Time Equivalent for routine immunization
- Doses administered per total facility staff (includes all staff including the ones not working on immunization) per working day
- Doses per FIC, (FIC here measured as children receiving third dose of DTP)

One can perceive from these figures that the total doses administered per FTE was 1,943 in Ghana. Whereas the doses per the total number of fully Immunized children was 10.24 (table 40).

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Ghana</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total doses administered in 2011 / FTE</td>
<td>1,943.51</td>
</tr>
<tr>
<td>2. Total doses/Total facility staff/working day</td>
<td>1.04</td>
</tr>
<tr>
<td>3. Doses per FIC</td>
<td>10.24</td>
</tr>
</tbody>
</table>

The productivity analysis of the total of cost of immunization and doses administered are run through quadrant analysis: 9 out of the 50 facilities (18%) have performed well, since they fell in the southern-east region of the quadrant. Conversely, 6 (12%) fell in the northern-west counter-performance area. An overwhelming majority of facilities fell in the northern-east area (36%) and 17 (34%) fell in the southern-west area.
Graph 20: Quadrant analysis of Total Economic Cost (y axis) vs Total doses administered in 2011 (x axis), Ghana
8. Analysis of Financial and commodity flows for routine immunization

8.1. Background on health care financing and funding flows for immunization

8.1.1. Overview of health sector financing in Ghana
The health sector in Ghana receives funds from the following revenues: general taxes, earmarked taxes (tax on added value), out-of-pocket payments and donors (11). Three type of funding sources for the health sector can be identified (1): Government of Ghana, Internally Generated Funds, development partners (multilateral or bilateral donors) (Graph 21).

Graph 21: Source of MOH revenues in Ghana

Graph extracted from “health financing in Ghana” (2), Source MOH

Funding from the Government of Ghana is provided in annual budget allocations to the sector through the Ministry of Health as part of the routine budget. Internally generated funds consist of out-of-pocket payments and direct National Health Insurance Scheme (NHIS) payments (2). This prepayment system has been implemented in 2005. Internally Generated Funds contribute to the sector budget at facility level. Since NHIS implementation, the share of NHIS payments in the MOH revenues is increasing whereas the proportion of government subsidy, donor support and out of pocket payments is declining (Graph 22). Consequently, health ministry facilities themselves are becoming increasingly dependent on Internally Generated Funds (2). In that sense, health sector financing is gradually moving from supply-side MOH subsidies towards a demand-side
financing. However, the current health system is still fragmented between these two types of funding schemes as providers still receive MOH subsidies.

Graph 22: Internally Generated Funds by MOH facilities

![Graph 22: Internally Generated Funds by MOH facilities](image)

Development Partners (DPs) funds are provided through Sector Budget Support (SBS) channeled through the Ministry of Finance and Economic Planning (MOFEP) and is part of the annual budget process. Donors also provide earmarked funds for specific projects or programs (including GAVI Alliance funding).

The Government Of Ghana is the main funding source for the public health sector in Ghana (3). There are four areas of public expenditure (personnel salaries, administrative, service and investment expenses).

8.1.2. Background on funding flows for immunization

In low-income settings, immunization financing (besides limited budgets) in many countries faces the issue of inefficient national disbursement procedures (4). According to MOH Ghana, a considerable amount of Districts’ service budgets (GOG3) is allocated to delivering routine immunization (12). However, no data is currently available to confirm this assertion. What is known is that since 2008, the Government of Ghana (GOG) purchases all traditional vaccines and devices and fulfills its co-financing amount (1). Funding for operational costs for campaigns is also partly covered by the Government. Immunization is considered as heavily subsidized with tax or donor financing (11) compared to curative care.

Salaries and benefits of all EPI staff are paid by the Government. Government budget for administration (GOG2) and service (GOG3) is allocated to districts based on the final activity plan (district are also called “cost centers”). District plans include provision for outreach, supervision, training and monitoring.

The planning process in Ghana is a “bottom-up” process. The process of annual planning is carried out in collaboration with the regions based on immunization performance and key issues highlighted during the course of the year and during the annual review meeting. Micro planning for immunization service delivery is widely used by peripheral health facilities using the Reaching Every District (RED) strategy.
8.2. Methods for the quantitative analysis of financial and commodity flows

8.2.1. Scope
For this exercise, the focus was on financial and commodity flows for the routine immunization program from external, government, and other domestic sources. The purpose of this analysis was to better describe these flows, to quantify funding available from various sources for routine immunization, and to document how funds and commodities flow to end users.

8.2.2. Data collection
The sampled unit were similar than the ones chosen for the costing study. Specific financing questionnaires were developed to capture funding flows for routine immunization. These questionnaires were administered to the following institutions and departments:
- MOH/GHS including: Central EPI (included EPI manager), Disease Control Department (included DCD accountant), GHS Finance Unit, MOH Supply Division.
- Development Partners12 (included WHO and UNICEF)
- 5 Regional Health Administrations (respondents included accountants and regional director of public health, EPI coordinators)
- 6 District Health Administrations (respondents included accountants, district director of public health and EPI coordinators)
- Data was collected from budget and expenses records from the different levels. Health facilities did not have any or insufficient financial information to be included in the analysis. Data was entered in Excel template for data entry.

8.2.3. Coding
A methodology derived from the System Health Accounts methodology for coding financial flows was adopted. Each financial flow was allocated to one type and was further sub categorized (table 41).

<table>
<thead>
<tr>
<th>Table 41: Financial flow type and categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial flow type</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Funding Source (FS)</td>
</tr>
<tr>
<td>Financing Agent (FA)</td>
</tr>
<tr>
<td>Health Financing Mechanism (HF)</td>
</tr>
<tr>
<td>Health Provider (HP)</td>
</tr>
</tbody>
</table>

12 Although the Rotary was mapped as a partner for immunization, they did not provide any funding for routine immunization in 2010 and 2011. Therefore, no questionnaire was administered.
<table>
<thead>
<tr>
<th>Financial flow type</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>ancillary services, Providers of preventive care, Providers of health care system administration and financing, Rest of the economy, Rest of the world</td>
<td></td>
</tr>
<tr>
<td>Health Care Function (HC)</td>
<td>Curative care, Preventive care, (IEC / Social mobilization), facility-based delivery, training, vaccine collection, distribution and storage, cold chain maintenance, supervision, program management, other routine activity, EPI surveillance, record-keeping and HMIS, not disaggregated.</td>
</tr>
<tr>
<td>Health Care Provision (FP)</td>
<td>Compensation of employees, Self-employed professional remuneration, materials and services used, consumption of fixed capital, other items of spending on inputs</td>
</tr>
</tbody>
</table>

The codes used for the categorization of funding flows are provided in appendix 5.

### 8.2.4. Aggregation

For district a weighted average of funding flow was generated based on district sampling weight and region population. This was then aggregated based on the number of districts for the full country in order to provide estimate of funding flows at sub national levels. In addition, regional amounts could not be disaggregated for immunization and therefore their expenses are not included as part of the quantitative analysis results. The costing study showed that their cost represented only 2% of total aggregated cost for routine immunization. The transfers received by districts from regions are however included.
8.3. Results of the quantitative analysis

8.3.1. Specification of Ghana funding flow framework

Table 42: Identification of financial flow types for Ghana (2010-2011)

<table>
<thead>
<tr>
<th>Financial flow type</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding Source (FS)</td>
<td><strong>Government domestic resources</strong> (internal transfers, internal transfers within central government, internal transfer within region/local government) Direct financial support from donors (USAID, UNICEF, WHO, GAVI Alliance) <strong>Social Insurance Contributions</strong> (National Health Insurance Scheme) Compulsory prepayments from households (user-fees) <strong>In-kind support from donors</strong> (UNICEF, WHO, GAVI Alliance, World Vision)</td>
</tr>
<tr>
<td>Financing Agent (FA)</td>
<td>MOH Central, EPI program, District level Ministry of Health, Ghana Health Service, Central Cold Store, National Surveillance Agency, UNICEF, WHO</td>
</tr>
<tr>
<td>Health Financing Mechanism (HF)</td>
<td>Central government scheme, Community level financing, Compulsory contributory health insurance schemes, rest of the world, state/regional/local government schemes</td>
</tr>
<tr>
<td>Health Provider (HP)</td>
<td>Ambulatory health care facilities, Central MOH, Regional MOH, District MOH, Rest of the World</td>
</tr>
</tbody>
</table>

8.3.2. Funding sources to Financing Agents in 2011

The funding received for routine immunization represents 49.9 million USD in 2011 (table 43). The funding is mostly provided through domestic sources that accounts for 78.17% of the support (Graph 23). Transfers from domestic revenues are mostly channeled through central MOH with 61.85% of funds received. Regional transfers to District Health Administrations represent 8.84% of total support. Internally Generated Funds (IGF) transferred to District Health Administrations account for 2.08% of total funds received. Within IGF, the national social insurance scheme represents 1.85% of total funding and out-of-pocket payments are marginal with 0.23% of total support. External funding sources represent 21.83% of the funding received. Most of the external financing is provided by GAVI Alliance New Vaccine Support (17.50%) through vaccines and supplies distributed by UNICEF supply division. External financial support distributed by Government are provided by GAVI Alliance (1.41 million USD), WHO (0.24 million USD), UNICEF (0.17 million USD) and USAID (0.15 million USD). GAVI support is channeled through the Ghana Health Service and part of GAVI support is directly disbursed to District Health Administration. Minor in-kind support is provided by UNICEF (0.10%), WHO (0.13%) and World Vision (0.16%).
Graph 23: Distribution of funding sources for routine immunization (USD, 2011)

- FS.1 (Transfers from domestic sources)
- FS.2 (Transfers distributed by government from foreign origin)
- FS.3 (Social Insurance Contribution)
- FS.4 (Prepayments)
- FS.7 (Direct foreign transfers)

76% 18% 0% 2% 4%
Table 43: Funding sources (FS) to financing agents (FA), 2011

<table>
<thead>
<tr>
<th>Transfers from government domestic revenue</th>
<th>EPI program</th>
<th>Central MOH</th>
<th>District HA</th>
<th>GHS</th>
<th>Cold Stores</th>
<th>National Surveillance Agency</th>
<th>UNICEF</th>
<th>WHO</th>
<th>Total</th>
<th>Dist</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS.1.1 Internal transfers</td>
<td>30 881 135</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 881 135</td>
<td></td>
<td></td>
<td>61.85%</td>
<td></td>
</tr>
<tr>
<td>FS.1.1.1 Central transfers</td>
<td>14 686</td>
<td>112 214</td>
<td></td>
<td></td>
<td></td>
<td>14 686</td>
<td>2 669 372</td>
<td>5.35%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.1.1.2 within local</td>
<td></td>
<td></td>
<td>24 799</td>
<td></td>
<td></td>
<td>24 799</td>
<td></td>
<td></td>
<td>0.05%</td>
<td></td>
</tr>
<tr>
<td>FS.1.1.4 Regional transfer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 416 113</td>
<td>4 416 113</td>
<td></td>
<td></td>
<td>8.84%</td>
<td></td>
</tr>
<tr>
<td>Transfers distributed by Government from foreign origin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.2.1.1.1 USAID</td>
<td>147 220</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>147 220</td>
<td>4 473 167</td>
<td>0.29%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.2.1.2.1 UNICEF</td>
<td>4 473</td>
<td>167 811</td>
<td></td>
<td></td>
<td></td>
<td>4 473</td>
<td>2 647 063</td>
<td>0.35%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.2.1.2.2 WHO</td>
<td>131 769</td>
<td></td>
<td>665 784</td>
<td></td>
<td></td>
<td>131 769</td>
<td>236 063</td>
<td>0.47%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.2.1.3 GAVI</td>
<td>351 847</td>
<td>1 057 303</td>
<td></td>
<td></td>
<td></td>
<td>351 847</td>
<td>1 409 150</td>
<td>2.82%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Insurance contribution and compulsory prepayment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.3 Social Insurance</td>
<td>925 335</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>925 335</td>
<td></td>
<td></td>
<td>1.85%</td>
<td></td>
</tr>
<tr>
<td>FS.4.1 User Fees</td>
<td>114 869</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>114 869</td>
<td></td>
<td></td>
<td>0.23%</td>
<td></td>
</tr>
<tr>
<td>Direct foreign aid in-kind</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.7.2.2.2.1 UNICEF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>51 426</td>
<td>51 426</td>
<td>0.10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.7.2.2.2.2 WHO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64 617</td>
<td>64 617</td>
<td>0.13%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS.7.2.2.2.4 GAVI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8 740 169</td>
<td>8 740 169</td>
<td></td>
<td></td>
<td>17.50%</td>
<td></td>
</tr>
<tr>
<td>FS.7.2.2.3.3 World Vision</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80 300</td>
<td>80 300</td>
<td></td>
<td></td>
<td>0.16%</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>298 147</td>
<td>30 993 349</td>
<td>6 081 075</td>
<td>1 123 087</td>
<td>11 282 640</td>
<td>38 510</td>
<td>51 426</td>
<td>64 617</td>
<td>49 932 852</td>
<td>100%</td>
</tr>
</tbody>
</table>

87
8.3.3. Financing Agents to Health-Care Providers in 2011

Most of funds spent for routine immunization are executed by central level and paid to staff directly. The total amount spent is higher than total of funds received the same year indicating that some activities have been performed either with balance from previous year or financed on other budgets. Central MOH executes 65.25% of expenditures (mostly driven by salaries). The funds executed at district level account for 10.84% of total spending. However, when excluding the salaries and vaccines, expenditures executed at district level represent 61% of total funds, outlining the level of decentralization for the execution of funds. Expenses by ambulatory health care centers are limited to salaries for routine immunization and are executed by central MOH. Funds spent for other flows than salaries have been disaggregated up to the district level but not up-to facility level.

Table 44: Financing agents (FA) to health care providers (HP) (2011)

<table>
<thead>
<tr>
<th>FA (HP)</th>
<th>EPI program</th>
<th>Central MOH</th>
<th>DHA</th>
<th>National Health Service Agency (GHS)</th>
<th>National Medical Stores / Central Cold Stores</th>
<th>National Surveillance Agency</th>
<th>UNICEF</th>
<th>WHO</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulatory health care centers</td>
<td>30 231 147,02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 231 147,02</td>
</tr>
<tr>
<td>District MOH</td>
<td>2 082 758,67</td>
<td>5 478 069,04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7 560 827,72</td>
</tr>
<tr>
<td>National MOH</td>
<td>242 587,29</td>
<td>238 829,24</td>
<td>387 527,26</td>
<td>11 282 639,87</td>
<td>38 523,87</td>
<td>29 028,85</td>
<td>12 219 136,39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provincial MOH</td>
<td>396 758,40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>396 758,40</td>
</tr>
<tr>
<td>Rest of the world</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22 396,71</td>
<td>64 616,77</td>
<td>87 013,48</td>
</tr>
<tr>
<td>Total</td>
<td>242 587,29</td>
<td>32 949 493,33</td>
<td>5 478 069,04</td>
<td>387 527,26</td>
<td>11 282 639,87</td>
<td>38 523,87</td>
<td>51 425,56</td>
<td>64 616,77</td>
<td>50 494 883,01</td>
</tr>
</tbody>
</table>
8.3.4. Financing Agents to Health Care Financing Mechanisms in 2011

Health care financing mechanisms focus on the financing modality. Central government schemes represent 92% of total funds spent, executed mainly by central MOH (65%) and Central Cold Stores (22%). Service delivery and financing being decentralized at district level; this level captures the five different financing schemes. 45.13% of district administration spending is provided through sub national (regions) government schemes, 31% of through central government schemes, 17% through the health insurance fund. External financing schemes and out of pocket payments are minor schemes at district level with respectively 4.85% and 2.1% of total spending.

<table>
<thead>
<tr>
<th>FA HF</th>
<th>EPI program</th>
<th>Central MOH</th>
<th>DHA</th>
<th>GHS</th>
<th>Central Stores</th>
<th>Cold Stores</th>
<th>National Surveillance Agency</th>
<th>UNICEF</th>
<th>WHO</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central government schemes</td>
<td>242 587</td>
<td>32 949 493</td>
<td>1 700 257</td>
<td>387 527</td>
<td>11 282 640</td>
<td>38 524</td>
<td>46 601 028</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community level financing</td>
<td></td>
<td>114 869</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>114 869</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compulsory contributory health insurance schemes</td>
<td></td>
<td>925 335</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>925 335</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest of the world</td>
<td>265 548</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>51 426 64 617</td>
<td>38 1 590</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State/regional/local government schemes</td>
<td>2 472 060</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 472 060</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>242 587</td>
<td>32 949 493</td>
<td>5 478 069</td>
<td>387 527</td>
<td>11 282 640</td>
<td>38 524</td>
<td>51 426 64 617</td>
<td>2 472 060</td>
<td></td>
<td>50 494 883</td>
</tr>
</tbody>
</table>
8.4. Schematic illustration of funds flow for routine immunization services in Ghana (2011)
The graph below provides the flow of funds and their distribution from funding sources to financing agents to health care provider to activities (Graph 24).
Graph 24: Mapping of funding flows for routine immunization in Ghana (2011)
8.5. Methodology for the qualitative assessment

In order to complement and further interpret the quantitative analysis, a qualitative survey was conducted focusing on the process and perception of the different actors relating to the funding for routine immunization. In particular, the results reported here reflect the viewpoint of the interviewed officials (government and development partners) on their engagement in the process, complementing the quantitative analysis on actual financing data.

Semi-structured interviews were conducted at the central, regional and district levels on the following topics:
- Access to funding
- Reporting requirements
- Key difficulties faced relating to financial management
- Bottlenecks for planning, budgeting, disbursement, expenditure and reporting

8.6. Results on qualitative assessment of funding flows for routine immunization

8.6.1. Access to funds for EPI and funding flow mechanisms

8.6.1.1. Central level perspective

The EPI Ghana prepares a budget. It is then submitted to the Director of Public Health and collated as one budget with other department and programs. EPI Ghana receives earmarked funds from donors and partners (WHO, UNICEF, USAID, GAVI). Government of Ghana is the domestic funding source.

8.6.1.2. Regional perspective

Through the Ghana Health Service, the funds are directly transferred on the regional department of health (RDH) accounts (Graph 24).

Graph 25: Funding flow from GOG to Regions

Funds are usually transferred to regions with a memo attached that provides them guidance on how the funds should be spent or to which institution they should be transferred. The RDH then disburses the funds to one of the four Budget and Management Centers (Office of the Regional Director, Public Health Unit, Support services unit and the Finance Unit). Funds allocated to EPI activities (campaigns or routine) flow through the Public Health Unit. In general, specific funding is provided for campaigns / NIDs but not for routine immunization.
8.6.1.3. District perspective

The Government and Ministry of Health provide quarterly budget to all districts via the regional administrative level to support service delivery including immunization (non earmarked transfer). Districts access funds through the Ghana Health Service at regional level by submitting their plan of activities and budget. The funding flow for routine immunization goes from GOG to MOH to GHS to RDH to DHMT account (Graph 25). Districts then transfer funds to sub districts or directly pay for expenses (no data was available to inform distribution between the two).

Graph 26: Funding flow to district level

Funding sources at district level are either Internally Generated Funds, GOG (2 & 3), donor pooled funding, and support from other vertical programs (National Malaria Control Program and HIV/AIDS). Significant funds are also received through the support of NGOs.

8.6.2. Reporting requirements

8.6.2.1. Central level

For domestic funding, the DCD accountant submits monthly reports to the Ghana Health Service Headquarters (Finance Unit at GHS). For UNICEF, the reporting mechanism is the Funding Authorization and Certificate of Expenditures (FACE) form. For WHO, the reporting mechanism is the Direct Financial Cooperation (DFC) form. The financial reporting is compulsory on any expenditure from these funding sources (WHO or UNICEF). Reporting on GAVI Alliance use of funds are provided through financial statements attached to the country Annual Progress Report (APR) submitted to GAVI.

8.6.2.2. Regional level

Sub-districts report to District Health Management Teams, which report to the Regional Health Department, to Ghana Health Service to MoH (Graph 26). Regions have a standard MOH/GHS reporting format which has to be followed strictly. Regions mentioned the lack of quality in the financial reports received from the districts.

Graph 27: Reporting flows for regional level

8.6.2.3. District level

MOH and GHS have a reporting format that districts must follow strictly. It includes validation reports, financial reports and completion of receipt books. The reporting of expenditures involves financial monitoring to validate the financial statements which can burden the services.

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13 GOG 2 = Administration GOG 3 = Services
8.6.3. Key difficulties faced by EPI

8.6.3.1. Central level
The funding is considered as insufficient and in particular for routine immunization (as opposed to campaigns) by EPI manager. There is a late release of funds from GHS, DCD and development partners to EPI. The positive balance of funds from other activities is used to support routine immunization activities. The financial support for the cold chain is considered by respondent as too low. Another difficulty is the lack of flexibility on how the funds can be spent. For EPI, one of the challenges is to spend the funds within the same budgeted line items despite that issues from the field may arise and require immediate action from EPI.

8.6.3.2. Regional level
At regional level, there are no funds dedicated to routine immunization. Regional cold stores are funded and maintained by the central level. As mentioned at central level, the key difficulty at regional level is the late release of funds. In general government funds only start to flow around the months of April/May. The funds received (shared funding) are insufficient as they are often inferior to the approved budgets. Consequently, EPI programs ride on other program budgets to conduct routine immunization activities.

8.6.3.3. District level
For disbursement, districts use the GOG funding transferred by regions but they do not receive it in a timely manner (4 districts). The funding is insufficient to carry out all the routine immunization activities in the sub districts and inferior than the approved budget (3 districts). Districts have no alternative funds to close the gap between the amount of approved funds and funds received.

8.6.4. Bottlenecks for planning, budgeting, disbursement, expenditure and reporting

8.6.4.1. Central level
From EPI perspective, the delays in receiving the funds impact the spending.

8.6.4.2. Regional level
Pre-financing EPI activities sometimes result in overspending. Funding is sometimes provided to regions without a memo guide on the spending. In that case, the disbursement of funds by the region can be difficult which results in uneven allocation of funds. Also, the inflation in prices or pricing differentials can result in shortfalls in budget proposals.

8.6.4.3. District level
One issue mentioned is the fact that budget ceilings limit the availability of funds (1 district). The procurement laws sometime burden the spending of funds. Reporting activities face inadequate human resource skills and late reporting. One issue mentioned by one district is the need to pay for volunteers for the campaigns which burdens the budget due to the high number of volunteers in this district. Another bottleneck mentioned was the inadequate logistic equipment in the district.
8.6.5. Other challenges related to funding for routine immunization

8.6.5.1. Regional level
Among other challenges mentioned, one region mentioned that the vehicle fleet of motorbikes was insufficient.

8.6.6. Results at the facility level
Most facilities do not have any financial data available. In the facilities where data was available financing amounts were not disaggregated for routine immunization. The funding sources identified in the surveys are mostly Internally Generated Funds (IGF) through out-of-pocket-payments. IGF are generated from user fees or sale of drugs and is retained at the point of collection or transfer to the district level. For urgent needs, health facilities may use IGF to pay for their expenses. MoH facilities are becoming increasingly dependent on IGF. The survey conducted in the 50 facilities found that 86% of facilities had collected user fees in 2011. The amount collected through user fees was available in 64% of the facilities collecting user. The average sum collected (not weighted) through user fees was 1,156 USD. The portion going to immunization services was not known.

8.6.7. Results from development partners

8.6.7.1. Routine immunization activities supported
The table below provides the routine immunization activities supported by WHO and UNICEF (table 46).

<table>
<thead>
<tr>
<th>WHO</th>
<th>UNICEF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red approach implementation</td>
<td>Provision of cold chain equipment, Technical support</td>
</tr>
<tr>
<td>Cold chain management and logistics</td>
<td>Monitoring and evaluation</td>
</tr>
<tr>
<td>Data management</td>
<td>Provision of vehicles to support service delivery</td>
</tr>
<tr>
<td>Vaccine Preventable Disease</td>
<td>Direct financial support for service delivery</td>
</tr>
<tr>
<td>Surveillance</td>
<td></td>
</tr>
<tr>
<td>Operation research (assessment.</td>
<td></td>
</tr>
<tr>
<td>Review, surveys etc)</td>
<td></td>
</tr>
<tr>
<td>Waste management</td>
<td></td>
</tr>
<tr>
<td>Laboratory services</td>
<td></td>
</tr>
</tbody>
</table>

8.6.7.2. Access to donor funds
WHO funds are accessed through submission of a proposal, budget and an official request letter from Heads of Units. Funding flows depend on the administrative level requesting the funds and the type of activity. Most of the time, funds are channeled through the national head office for transmission to various level. This is to ensure coordination, monitoring and accountability. For some programs implemented by civil society organizations, funds flow directly to these organizations with the same submission process.

For UNICEF, at the planning stage, the implementing partner institution and UNICEF discuss areas where support is needed. These areas are incorporated into UNICEFs annual work plan. The institution sends a proposal and budget to access funds to implement activities which is then approved by the chief of section. Finance section processes and transfers the funds to the requesting institution. Finally, the chief of Section notifies requesting institution about the transfer (date and amount).
8.6.7.3. Conditions for funding and reporting requirements

For UNICEF, funds to be used for activities must be agreed upon. UNICEF must be informed and approve of any variation in expenditure before it is carried out. The reporting requirements are the following:
A report must be submitted no later than six months from the date of transfer of the funds.
The report should include a narrative report showing how the activity was implemented, any specific outputs indicating any variation from what was planned and reasons for this; challenges, constraints and any further action.
The financial report should indicate whether funds were used as planned. Any unutilized funds are to be refunded unless permission has been sought from and granted by UNICEF for these to be reprogrammed.

For WHO, all relevant documents must be submitted. All outstanding finances must be accounted for with technical report. The request must satisfy the priority needs (enhancing disease prevention or contributing to MDG) and a credible mechanism or sources for financial transactions must be in place (accredited bank).
For WHO, two reports are required after utilization of funds:
- Comprehensive activity technical report giving full detail about output.
- Financial report accounting for funds received and utilization of funds.

8.6.7.4. Difficulties faced by recipient of donor funds

According to donors, the issues faced by recipient in efficiently spending the funds transferred to them by the donor institution are the following ones:
- Delay in utilizing and accounting for funds
- UN rates for some expenditure are too low
- Meeting requirements for release of funds (GSM process for WHO)
- Organization specific reporting format (DFC)
- Delayed Bank transactions
- Change of value in terms of exchange rates

8.6.7.5. Causes of bottlenecks in the funding mechanisms

Donor identified the key causes of bottlenecks in the funding mechanisms, in terms of planning, budgeting, disbursements, expenditure, and reporting. The donors mentioned the inability to determine in advance amount of funds that will be available for the year. Recipients are not able to develop long term strategic plans for resource mobilization. In terms of budgeting, some requests for funds for activities are not covered by the work plan. For disbursement, delays in disbursement for current request are due to failure of requesting institution to account for previous use of funds. For expenses, there is a delay in utilizing and accounting for funds. For reporting, donor requirements for funds are not standardized. Reports are of poor quality and there are delays in the reporting.

8.6.7.6. Other issues and challenges related to funding for routine immunization services

The following challenges were mentioned by development partners regarding routine immunization financing: late submission of request, lack of skills to mobilize resources locally and high dependency on donor support.
8.7. Discussion and comparison of funding flow analysis

Regarding the funding flow quantitative analysis of 2011 and 2010, the 2011 amount of financing is higher than the 2010 amount (increase of US$ million 8.12). There are several factors that explain this increase. The main factor is the value of vaccines which increased significantly between 2010 and 2011 (from 4.4 million USD in 2010 to 11.3 million USD in 2011). In particular, the cost of the pentavalent vaccine increased from 2.72 million USD (1.2 USD per dose) in 2010 to 7.40 million USD (2.9 USD per dose) in 2011(23). This increase is due to a switch in pentavalent vaccine presentation (from one dose per vial to ten doses per vial). Secondly, health insurance funds have been reported in the 2011 funding flow analysis but not in 2010. The volume of activities seems to be impacted by the insufficient financing for routine immunization. For example, monthly EPI reviews have been scaled to quarterly due to lack of funds in one region (20). Furthermore, the difficulties in delays of funds can be explained by the fact that financing for immunization used to be pooled under MOH. Since 2007, multi-budget financial support is under the MOFEP, and delays in the release of funds for the purchase of vaccines have been identified since then (1). Cold chain equipment has been identified as lacking funds. However, there is no dedicated budget line in the national budget for cold chain equipment.

Donor dependency has decreased significantly compared to the costing and financing study conducted in 2000 (5). In 2000, routine immunization was much more donor dependant as 51% of its costs were supported by development partners (mostly from the DFID with 41% of total support). Government of Ghana represented 49% of the funding. In the funding flow analysis, donor support accounts for less than 20% of total support and is mostly captured by GAVI support for vaccines.
9. Policy implications & recommendations

Policy implications and recommendations were discussed during a dissemination workshop dedicated to this study with Ghana Health Service and EPI in Accra. A summary of these is provided below.

9.1. Policy implications

The policy implications are the following:
- The study results provide solid evidence on the actual cost and financing of routine immunization; it should serve as reference points for planning, budgeting and advocacy.
- Study findings confirm the current high wage bill in service delivery (this is confirmed by the regression analysis where the Full Time Equivalent and the average wage of staff involved in immunization per facility are statistically and strongly related to the total economic routine immunization costs).
- Study highlights the substantial contribution of volunteer labor and whether it should be taken into account.
- Additional resources are required to reach additional children and strengthening CHPS.
- Findings reaffirm government strategies of CHPS, National Health Insurance Scheme and decentralization to attain Universal Health Coverage.
- Key challenges ahead for EPI Ghana is to maintain the current level of performance but also reaching additional children, most of whom will require outreach strategies.
- Adequate financing of outreach is critical to sustain and improve immunization program performance.
- Vaccines remain mostly supported by donors and immunization service delivery remains supported mostly through supply-side subsidies through MoH transfers to district level.
- Routine immunization are hampered by limited and delayed financing (non earmarked).
- Study results show that immunization is labor intensive.
- The high unit cost of CHPS, highlights the importance of proper micro planning from CHPS to ensure service delivery.

9.2. Recommendations

9.2.1. To MOH, EPI, NHIS and donors
- The evidence and findings from this costing study should be used as an advocacy tool to call for funding for routine immunization from all stakeholders including Ministry of health, National Health Insurance and Health partners.

9.2.2. To District Health Administration planning departments
- There is the need to get the managers at the lower levels to do proper micro planning for CHPS implementation (including the construction of the compounds).

9.2.3. To Ghana Health Service, Policy Planning, Monitoring & Evaluation (PPME) Department
- For the future, there is the need to look at public health financing in terms of purely government commitment since this is key for national development.
- There is the need to look at other vaccinations outside the traditional routine vaccinations such as costing of HPV vaccines.
- When integrating these new cost estimates, there is the need to assess impact of potential graduation (within four to five years) on financial sustainability of the immunization program.
- Budget requirements should be based on actual cost rather than projections.
- The number of staff involved in routine immunization (and their associated FTE) in the cMYP tool should be reconsidered for personnel cost calculations
- There is the need to secure funding (to be provided in the adequate amount and in a timely manner) for outreach to be conducted regularly
- The vaccine introduction plans only covers part of the introduction cost and also there is the need to plan well in advance for cold chain expansion.

9.2.4. To donors
- Donors need to improve predictability and visibility of funding (1 to 2 years) to immunization program
10. Conclusions

Our study found a high cost of routine immunization compared to previous estimates in Ghana (6,7) and other costing studies (5). Key findings show that the non-vaccine routine immunization costs at facility level are substantial. The unit cost of immunization is even higher in CHPS facilities, both for outreach delivery costs and associated support activities.

We found that current cMYP assumptions on human resources involvement at facility levels seem to underestimate the real implication of staff for routine immunization. Consequently, the number of staff involved in routine immunization (and their associated FTE) should be reconsidered for personnel cost calculations in the cMYP. The distribution of costs varied importantly when compared to cMYP costs structure. However, this may be linked to methodological assumptions from cMYP which provide a mix of line items and activities whereas the costing study provided a clear cut separation between line items and activities.

The unit cost of immunization was higher in hard to reach areas and small rural facilities, both for outreach delivery costs and associated support activities. Similarly, the unit cost per dose decreases with the facility type implying that delivery in larger facilities requires less resources for a given activity volume. The percentage of total costs due to volunteer labor was substantially higher in rural than urban settings as this labor source was mobilized more often in remote facilities or to target hard-to-reach populations. Similarly, the percentage of transportation and fuel in total costs was higher in rural settings. The cost per FIC (DTP3-HepB-Hib) was lower in Reproductive and Child Health units of district hospitals (38.5 USD) compared to Community-based Health and Planning Services facilities (87.8 USD). The higher cost of CHPS can be ascribed to a smaller catchment population that requires more effort to vaccinate (as outreach requires more manpower and fuel costs per vaccinated child). District hospitals were located in district capitals and had a significantly higher catchment population and more health workers entirely dedicated to immunization.

Budget estimate only show a small portion of routine immunization costs for the health system. For planning of expenses, a financial costing should be favored whereas for broader health system analysis, an economic costing should be preferred. However, financial costs may be less accurate due to the absence of financial reporting at facility level and lack of financial reporting at district levels.

Vaccine introduction grant was found to be lower than the incremental fiscal costs related to introduction. Part of it was covered with remaining with domestic funding and additional external funds.

Routine immunization program received 50 million USD in 2011. This funding was provided mostly through domestic resources accounting for 78% of total support; external sources accounted for 22% of total funding. The financing analysis also outlined the substantial increase in 2011 versus 2010 and the lack of timely financing.

Considering these main findings, one of the key challenges ahead for EPI Ghana is to maintain the current level of performance but also reaching additional children, most of whom will require outreach strategies. However, one of the main difficulty to improve outreach is the insufficient financing to implement micro plans for immunization (1). At the same time, routine immunization programs are hampered by limited and delayed financing. Without changes, this situation may get worse as Ghana implements new vaccines such as rotavirus, pneumococcal conjugate vaccine and potentially others in the future.

One path taken by the Ghanaian health system is the expansion of community-based service delivery under the ‘CHPS initiative,’ which will address the lack of access in some areas. This full costing study shows that this strategy being implemented relies heavily on staff in the first line of service delivery (for its immunization component at least). Similarly, volunteers are paid for campaigns but not for activities relating to routine immunization. It also appears that community
health nurse are paid much less than in the private sector (1). Therefore, the contribution of volunteers and community health nurses needs to be fully assessed, recognized and potentially incentivized when needed to make sure that CHPS strategy is successful.

The challenge of this initiative will be to ensure financial sustainability by mobilizing more resources through MOH subsidies (supply-side), National Health Insurance Scheme and user fees (demand-side). At a time when the Ghanaian health sector moves towards more demand-side financing, funding profile for immunization is particular, as vaccines remain mostly supported by donors and immunization service delivery remains supported mostly through supply-side subsidies through MOH transfers to district level. These larger issues relate to the larger eventual goal of national immunization program self-sufficiency.
## 11. Main Findings

<table>
<thead>
<tr>
<th>Main findings by topic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nationwide routine immunization costs:</strong></td>
</tr>
<tr>
<td>✓ The total aggregated costs for the routine immunization program amounted to 53.49 million USD in 2011</td>
</tr>
<tr>
<td>✓ The cost per dose administered was 5.7 USD</td>
</tr>
<tr>
<td>✓ The cost per FIC (DTP3-HepB-Hib) by administrative level was 60.30 USD</td>
</tr>
<tr>
<td>✓ The cost per infant in the country was 52.9 USD</td>
</tr>
<tr>
<td>✓ The cost per capita was 2.1 USD.</td>
</tr>
<tr>
<td>✓ The share of total national costs varies by administrative level was the following: 69% at facility level, 9% at district level, 2% at regional level and 20% at central level (with vaccines counted at central level).</td>
</tr>
<tr>
<td>✓ The unit cost per FIC (DTP3-HepB-Hib) aggregated is consistent with the unit cost per FIC of the sample</td>
</tr>
<tr>
<td>✓ Vaccine and injection supplies costs were captured at the central level and accounted for 19% of total costs.</td>
</tr>
<tr>
<td>✓ Recurrent line items accounted for 91% of the aggregated costs.</td>
</tr>
<tr>
<td>✓ Within recurrent costs, salaried labor was the main cost driver, accounting for 61% of total routine EPI costs</td>
</tr>
<tr>
<td>✓ The remaining substantial recurrent cost items, as a percentage of total EPI costs, were: volunteer labor (4.2%), transport (3.4%) and overhead utilities and communication (2.0%).</td>
</tr>
<tr>
<td>✓ Outreach and Fixed delivery costs accounted for 21% of total cost (excluding vaccines)</td>
</tr>
<tr>
<td><strong>Administrative offices costs for routine immunization:</strong></td>
</tr>
<tr>
<td>✓ The average EPI routine costs of administrative offices was 28 285 USD per District Health Administration (DHA) office, and 92 858 USD per Regional Health Administration (RHA) level and the total EPI routine cost at central level was 702 727 USD</td>
</tr>
<tr>
<td>✓ Salaried labor represented a significant share of total cost in DHA (38.49%) and RHA (38.59%) but is lower at central level (18.02%)</td>
</tr>
<tr>
<td>✓ The share transport and fuel cost in DHA (13.76%) was much higher than in RHA (4.65%) and at central EPI (2.99%) as most of the supervisory, surveillance and operational activities for routine immunization take place at DHA level</td>
</tr>
<tr>
<td>✓ Program management, Surveillance, Supervision and Vaccine collection/distribution were the most important activities in terms of costs at the district health administration level.</td>
</tr>
<tr>
<td>✓ At regional level, the highest share in total cost is for vaccine/collection/distribution/storage</td>
</tr>
<tr>
<td><strong>Routine Immunization facility-level costs:</strong></td>
</tr>
<tr>
<td>✓ The unit cost per routine dose administered was 5.1 USD</td>
</tr>
<tr>
<td>✓ The cost per FIC (DTP3-HepB-Hib) was 51.3 USD</td>
</tr>
<tr>
<td>✓ The cost per infant population in the catchment area was 36.1 USD</td>
</tr>
<tr>
<td>✓ The main cost driver was salaried labor with 61%</td>
</tr>
<tr>
<td>✓ Vaccines and injection supplies were the second highest cost driver with 26% of the total facility cost</td>
</tr>
<tr>
<td>✓ Vaccines and supplies are mostly delivered through outreach as (58% of the vaccines &amp; supplies cost)</td>
</tr>
<tr>
<td>✓ Almost half of the facility costs (47%) could be attributed to service delivery</td>
</tr>
<tr>
<td>✓ Outreach service delivery represented 25% of total facility costs and facility-based delivery 22% (including the value of vaccines)</td>
</tr>
<tr>
<td>✓ Cost of support activities (53%) is mostly driven by record-keeping, social mobilization and surveillance</td>
</tr>
<tr>
<td>✓ The cost per dose was lower in urban settings (3.2 USD in urban areas; 5.8 USD in rural areas)</td>
</tr>
<tr>
<td>✓ Outreach services are more mobilized by remote facilities and to target hard-to-reach population</td>
</tr>
<tr>
<td>✓ The share of volunteer labor is significantly higher in rural settings (4.9% vs. 2.6%)</td>
</tr>
<tr>
<td>✓ Similarly, the share of transportation and fuel is higher in rural settings</td>
</tr>
</tbody>
</table>
Main findings by topic

- The cost per FIC (DTP3-HepB-Hib) was lower in Reproductive and Child Health units of district hospitals (38.5 USD).
- Cost per FIC (DTP3-HepB-Hib) was higher in Community-based Health and Planning Services facilities (87.8 USD).
- The unit cost per routine dose administered decreases with the facility type implying efficiency differences according to facility type.
- Distribution within capital costs varies between urban and rural settings with capital costs being mostly driven by vehicle costs in rural areas and by the costs of buildings in urban areas.

**Costs for New Vaccine Introduction (NUVI):**

- Total economic cost of new vaccine introduction in Ghana was 26.7 million USD (including vaccines and supplies).
- Programmatic incremental costs amounted to 3.9 million USD (representing 9% of routine immunization costs).
- Fiscal costs amounted to 33 million USD.
- Cost of new vaccine purchases represented a three-fold increase in total vaccine costs of routine 2011.
- The personnel cost for vaccine administration outreach was higher (1.2 million USD) than for fixed-based (0.9 million USD).

**Determinants analysis of routine immunization:**

- The number of fully immunized children, the dedication proportion time of vaccinating personnel, the availability of sufficient human resource capacity to perform immunization activities correctly, and the availability of cold chain equipment were all associated with total costs at facility level.

**Quantitative funding flow analysis of routine immunization:**

- Routine immunization program received 50 million USD in 2011 (including salaries).
- This funding was provided mostly through domestic sources, which accounted for 78% of the support.
- The main funding source was the central MOH.
- Donor support accounts for less than 20% of total support and is mostly captured by GAVI support for vaccines.
- Funding for immunization is mostly based on supply-side subsidies from MOH and demand-side financing remains marginal (2%) in 2011.
- External funding plays a critical role in funding the vaccines and supplies that have become a major cost driver of routine immunization costs and new vaccine introduction costs.
- Central government scheme is the main funding mechanism.
- Excluding salaries and vaccines, district receive and execute most of the spending for routine immunization delivery.
- 86% of facilities had collected user fees in 2011.
- The amount collected through user fees was available in 64% of the facilities collecting user fees.
- The average sum collected (not weighted) through user fees was 1,156 USD and the portion going to immunization services was not known (if any).

**Qualitative assessment of funding flows for routine immunization:**

- According to qualitative assessment, funding for routine immunization is considered at all levels (central, regional and district) as insufficient (sometimes inexistenst) and is not provided in a timely manner.
- Consequently, regions and district need to ride on other program budgets to fund and implement routine immunization activities in their area.
- No funds are specifically earmarked for routine immunization and are shared with overall
<table>
<thead>
<tr>
<th>Main findings by topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>service delivery</td>
</tr>
<tr>
<td>✓ The view from donors is different as the main issue concerns the efficient spending of funds received by the recipients</td>
</tr>
<tr>
<td>✓ According to donors, the late disbursement is due to the failure from recipients in accounting for the funds and delays in reporting on their use</td>
</tr>
<tr>
<td>✓ According to regions, there is a lack of quality in financial reporting from districts</td>
</tr>
</tbody>
</table>
12. References (Vancouver)
15. UNICEF Supply Division. UNICEF supply catalogue for cold chain equipment [Internet]. 2011. Disponible sur: https://supply.unicef.org/unicef_b2c/app/displayApp/%28cpgsize=5&layout=7.0-12_1_66_68_115_2&uiarea=2&carea=4F0BAEC7A0B90688E10000009E711453&cpgnum=1%29/do?rf=y
Appendix

A1 - Project Team

The project team role and responsibilities were as follow:

- The health economist adapted the methodology and tools, performed central level data collection, cost calculation, cost and funding analysis, report and manuscript writing (Jean-Bernard Le Gargasson, AMP).
- The project leader recruited the core team, oversaw the project development and implementation, guided the methodology and the data analysis, reviewed project documents including protocol, reports and articles (Anaïs Colombini, AMP).
- Two technical advisors assisted with design, analysis, and interpretation (Alfred Da Silva and Brad Gessner, AMP).
- The MOH focal point was in charge of interface between the health authorities of the country and AMP, represent the project towards national authorities, including the Ethics Committee, facilitate administrative implementation, and participate in meetings and conference calls about the project (Dr Frank Nyonator, MOH Ghana).
- The national technical advisor provided advice on costing and financing issues of immunization program (Dr Dan Osei, MOH Ghana).
- A statistician health economist performed the statistical analysis on determinants of facility-level costs and determinants of productivity at facility level (Césaire Ahanhanzo, AMP).
- A statistician health economist developed the data entry template and cost calculation program (Darwin Young, Consultant).
- The national team leader was in charge of survey implementation and data entry oversaw data collection, and data entry phase by supervising the interviewers and oversaw data entry (Dr Moses Adibo).
- The project operations manager (Audrey Gavard Lonche AMP).
- Five interviewers performed the data collection at the immunization service delivery and administrative units as well as data entry (Bernard Achampong, Seth Adjei, Vida Gyasi, Irene Hamba, Gustav Togobo).
A2 – Definition of activity types

The definition of the different activities included in the study is listed below:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine facility-based service delivery:</td>
<td>Administering the vaccine to children within the facility/compound.</td>
</tr>
<tr>
<td>Outreach service delivery:</td>
<td>Administering the vaccine to children outside of the facility, travelling to and from a place for this purpose.</td>
</tr>
<tr>
<td>Record-keeping, Health Management Information System (HMIS), monitoring and evaluation:</td>
<td>Entering and analyzing data, including maintaining stock registers, maintaining records of children vaccinated, completing reports and analyzing, monitoring, and evaluating immunization program data.</td>
</tr>
<tr>
<td>Supervision:</td>
<td>Supervising subordinate or peer health or community workers.</td>
</tr>
<tr>
<td>Training:</td>
<td>Attending and/or providing immunization-related training.</td>
</tr>
<tr>
<td>Social mobilization and advocacy:</td>
<td>Mobilizing the community and households, and advocating for vaccination. This could include the cost of television and radio time, as well as the cost of hiring actors, etc. Also includes the activities related to information and education.</td>
</tr>
<tr>
<td>Surveillance:</td>
<td>Following-up post-vaccination events and active cases of diseases that are prevented by vaccination.</td>
</tr>
<tr>
<td>Vaccine collection, distribution and storage:</td>
<td>Collecting vaccines at the airport or other distribution points, storing vaccines in national and/or sub national cold stores, maintaining stock records of vaccines, and distributing vaccines down to the facility.</td>
</tr>
<tr>
<td>Program management:</td>
<td>Planning, budgeting, and managing the immunization program at various levels. This would include the cost of time and resources spent on forecasting vaccine needs and procuring vaccines.</td>
</tr>
<tr>
<td>Cold chain maintenance:</td>
<td>Maintaining the cold chain at the respective level of analysis.</td>
</tr>
<tr>
<td>Vehicle maintenance:</td>
<td>Maintaining vehicles (of all types) used for immunization-related activities.</td>
</tr>
<tr>
<td>Other:</td>
<td>Other immunization-related activity not covered in the above categories.</td>
</tr>
</tbody>
</table>
A3 - Definition of line items (input)

The following line items capture the types of inputs included in the scope for routine immunization activities (when existing):

<table>
<thead>
<tr>
<th>Line item</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paid labor:</td>
<td>salaried labor to immunization-related activities.</td>
</tr>
<tr>
<td>Volunteer labor:</td>
<td>Value of volunteer labor used for immunization-related activities.</td>
</tr>
<tr>
<td>Per Diem and travel allowances:</td>
<td>Any allowances paid or volunteer workers for immunization-related activities.</td>
</tr>
<tr>
<td>Vaccines:</td>
<td>Traditional and new vaccines.</td>
</tr>
<tr>
<td>Vaccine injection and safety supplies:</td>
<td>Auto-disabled syringes, diluents, reconstituting syringes, safety boxes and other supplies used for administration of vaccines</td>
</tr>
<tr>
<td>Transport and fuel:</td>
<td>Bus/taxi fare and the cost of fuel for immunization-related transport.</td>
</tr>
<tr>
<td>Cold chain energy costs:</td>
<td>Butane, gas, electricity for the running the cold chain.</td>
</tr>
<tr>
<td>Printing costs:</td>
<td>Printing of immunization cards, training and IEC materials, and other materials that are immunization-related.</td>
</tr>
<tr>
<td>Overheads, utilities and communication:</td>
<td>Building overheads, including maintenance, utilities, telephone, and internet connections.</td>
</tr>
<tr>
<td>Other supplies:</td>
<td>Stationery and other supplies for the immunization program that needs to be renewed every year.</td>
</tr>
<tr>
<td>Other recurrent:</td>
<td>Other recurrent costs for immunization-related activities those are not included in the above line items.</td>
</tr>
<tr>
<td>Cold chain equipment:</td>
<td>Cold chain equipment used to store and transport vaccines.</td>
</tr>
<tr>
<td>Vehicles:</td>
<td>Vehicles and modes of transport (pick up, saloon cars, motorbikes, bicycles)</td>
</tr>
<tr>
<td>Other equipment:</td>
<td>Computers, printers, peripherals, furniture, other medical equipment used for immunization-related activities (lifespan &gt; one year).</td>
</tr>
<tr>
<td>Buildings:</td>
<td>Building space used for the delivery (or program management at district and regional levels) and storage of vaccines.</td>
</tr>
<tr>
<td>Other capital</td>
<td>Other capital investments (this category should be very small) not included in the above line items.</td>
</tr>
</tbody>
</table>
## A4 - Vaccine prices of Ghana routine immunization schedule in 2011

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Presentation</th>
<th>Vial Size (doses)</th>
<th>price per dose (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCG</td>
<td>Lyophilized</td>
<td>20</td>
<td>0.069</td>
</tr>
<tr>
<td>Polio</td>
<td>Liquid</td>
<td>20</td>
<td>0.13</td>
</tr>
<tr>
<td>Measles 1</td>
<td>Lyophilized</td>
<td>10</td>
<td>0.193</td>
</tr>
<tr>
<td>Yellow Fever</td>
<td>Lyophilized</td>
<td>5</td>
<td>0.66</td>
</tr>
<tr>
<td>Tetanus Toxoid</td>
<td>Liquid</td>
<td>10</td>
<td>0.085</td>
</tr>
<tr>
<td>Pentavalent DTP-HepB-Hib</td>
<td>Liquid</td>
<td>1</td>
<td>2.96</td>
</tr>
</tbody>
</table>

## A5 - Sampling frame

Note that in each district, there are never more than 5 of the above strata. In the selected districts, the **total number** of facilities was distributed as follows:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Asante Akim South</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>Atwima Mponua</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Ga West</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Bunkpurugu Yunyoo</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Kassena Nankana</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>19</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23</td>
<td>10</td>
</tr>
<tr>
<td>Wa Municipal</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>52</td>
<td>3</td>
<td>12</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>107</td>
<td>50</td>
</tr>
</tbody>
</table>

Miss= Mission; HC= Health Center; CHP=CHPS; Cli=Clinic; MH= Municipal Hospital

By applying this rule we obtain the following number of facility to select in each strata and for each district:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Asante Akim South</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Atwima Mponua</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ga West</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Bunkpurugu Yunyoo</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Kassena Nankana</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wa Municipal</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>19</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
The following facilities were selected as replacement facilities: Nachanta, Doba, Gia, Adomfe, Nnadieiso, Bimbagu, Nasua, and Boli.

<table>
<thead>
<tr>
<th>District</th>
<th>Facility Name</th>
<th>Strata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asante Akim South</td>
<td>Banso CHPS (linked with Ofosae HC*)</td>
<td>Rural Government CHPS</td>
</tr>
<tr>
<td></td>
<td>Juaso RCH/FP</td>
<td>Urban Government Clinic</td>
</tr>
<tr>
<td></td>
<td>Kyempo Epi Centre</td>
<td>Rural Government Clinic</td>
</tr>
<tr>
<td></td>
<td>Juaso District Hospital</td>
<td>Urban Government District</td>
</tr>
<tr>
<td></td>
<td>Banka Health Centre</td>
<td>Rural Government Health Centre</td>
</tr>
<tr>
<td></td>
<td>Dwendwenase Health Centre</td>
<td>Rural Government Health Centre</td>
</tr>
<tr>
<td></td>
<td>Ofosae Health Centre *</td>
<td>Rural Government Health Centre</td>
</tr>
<tr>
<td></td>
<td>Banso CHPS (linked with Ofosae HC*)</td>
<td>Rural Government CHPS</td>
</tr>
<tr>
<td></td>
<td>Juaso RCH/FP</td>
<td>Urban Government Clinic</td>
</tr>
<tr>
<td></td>
<td>Kyempo Epi Centre</td>
<td>Rural Government Clinic</td>
</tr>
<tr>
<td></td>
<td>Juaso District Hospital</td>
<td>Urban Government District</td>
</tr>
<tr>
<td></td>
<td>Banka Health Centre</td>
<td>Rural Government Health Centre</td>
</tr>
<tr>
<td></td>
<td>Dwendwenase Health Centre</td>
<td>Rural Government Health Centre</td>
</tr>
<tr>
<td></td>
<td>Ofosae Health Centre *</td>
<td>Rural Government Health Centre</td>
</tr>
<tr>
<td>Atwima Mponua</td>
<td>Ahyiresu CHPS Compound (linked with Gyereso HC*)</td>
<td>Rural Government CHPS</td>
</tr>
<tr>
<td></td>
<td>St Peters (atwima Mponua) Clinic</td>
<td>Rural CHAG Clinic</td>
</tr>
<tr>
<td></td>
<td>Nyinahin Hospital</td>
<td>Urban Government District</td>
</tr>
<tr>
<td></td>
<td>Anglican Health Centre</td>
<td>Rural CHAG Health Centre</td>
</tr>
<tr>
<td></td>
<td>Gyereso Health Center*</td>
<td>Rural Government Health Centre</td>
</tr>
<tr>
<td></td>
<td>Bayerebon Health Centre</td>
<td>Rural Government Health Centre</td>
</tr>
<tr>
<td>Ga West</td>
<td>Akramaman CHPS</td>
<td>Rural Government CHPS</td>
</tr>
<tr>
<td></td>
<td>Nsakina CHPS</td>
<td>Rural Government CHPS</td>
</tr>
<tr>
<td></td>
<td>Pokuase CHPS</td>
<td>Urban Government CHPS</td>
</tr>
<tr>
<td></td>
<td>Oduman Community Clinic</td>
<td>Rural Government Clinic</td>
</tr>
<tr>
<td></td>
<td>Afiaman Outreach Clinic</td>
<td>Rural Government Clinic</td>
</tr>
<tr>
<td></td>
<td>Kojo Ashong Community Clinic</td>
<td>Urban Government Clinic</td>
</tr>
<tr>
<td></td>
<td>Mayera Faase Community Clinic</td>
<td>Urban Government Clinic</td>
</tr>
<tr>
<td></td>
<td>Ga West Municipal Hospital</td>
<td>Urban Government Municipal Hospital</td>
</tr>
<tr>
<td>Bunkpurugu Yunyoo</td>
<td>Kambaghu CHPS (linked with Bunkpurugu HC*)</td>
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### A7 - Sample weights by district and facility or other area used in the analysis

Sampling weights = inversed probability of being selected

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A8 - Coding for financial flow analysis: Funding sources

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**A10 - Health financing mechanism codes**

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**A11 - Health Providers codes**

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### A12 - Health Care Functions codes

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### Comparison of Economic and Financial Costs by Activity by Facility Type (USD, 2011)

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<td>4 119 USD</td>
</tr>
<tr>
<td>Routine Facility-based Service Delivery</td>
<td>12 341 USD</td>
<td>5 346 USD</td>
</tr>
<tr>
<td>Social Mobilization &amp; Advocacy</td>
<td>905 USD</td>
<td>680 USD</td>
</tr>
<tr>
<td>Supervision</td>
<td>754 USD</td>
<td>754 USD</td>
</tr>
<tr>
<td>Surveillance</td>
<td>1 369 USD</td>
<td>1 160 USD</td>
</tr>
<tr>
<td>Training</td>
<td>344 USD</td>
<td>344 USD</td>
</tr>
<tr>
<td>Vaccine Collection, Distribution, &amp; Storage</td>
<td>471 USD</td>
<td>445 USD</td>
</tr>
</tbody>
</table>
A 15 – Nationwide economic total and unit costs by activity (US$, 2011)

**Total costs by activity (Economic Costs USD, 2011)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Facilities</th>
<th>District Health Administration</th>
<th>Regional Health Administration</th>
<th>Central EPI</th>
<th>Total routine immunization costs</th>
<th>Percent Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold chain maintenance</td>
<td>1 030 467</td>
<td>111 145</td>
<td>18 095</td>
<td>46 500</td>
<td>1 206 207</td>
<td>2.23%</td>
</tr>
<tr>
<td>Other</td>
<td>1 745 983</td>
<td>409 273</td>
<td>61 020</td>
<td>15 971</td>
<td>2 232 246</td>
<td>4.18%</td>
</tr>
<tr>
<td>Outreach service delivery</td>
<td>5 488 246</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5 488 246</td>
<td>10.16%</td>
</tr>
<tr>
<td>Program management</td>
<td>809 867</td>
<td>880 277</td>
<td>158 973</td>
<td>102 229</td>
<td>1 951 346</td>
<td>3.80%</td>
</tr>
<tr>
<td>Record-keeping &amp; HMIS</td>
<td>6 107 476</td>
<td>453 237</td>
<td>39 322</td>
<td>13 545</td>
<td>6 613 579</td>
<td>12.25%</td>
</tr>
<tr>
<td>Routine facility-based service delivery</td>
<td>5 570 428</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5 570 428</td>
<td>10.32%</td>
</tr>
<tr>
<td>Social mobilization &amp; advocacy</td>
<td>5 012 898</td>
<td>559 570</td>
<td>45 543</td>
<td>156 756</td>
<td>5 774 767</td>
<td>11.04%</td>
</tr>
<tr>
<td>Supervision</td>
<td>1 887 611</td>
<td>678 372</td>
<td>101 658</td>
<td>72 534</td>
<td>2 740 174</td>
<td>5.10%</td>
</tr>
<tr>
<td>Surveillance</td>
<td>4 844 307</td>
<td>807 339</td>
<td>78 979</td>
<td>8 905</td>
<td>5 739 530</td>
<td>10.70%</td>
</tr>
<tr>
<td>Training</td>
<td>1 161 962</td>
<td>255 951</td>
<td>76 375</td>
<td>19 790</td>
<td>1 514 078</td>
<td>3.03%</td>
</tr>
<tr>
<td>Vaccine collection, distribution, &amp; storage</td>
<td>3 335 341</td>
<td>653 302</td>
<td>348 618</td>
<td>10 324 422</td>
<td>14 661 684&lt;sup&gt;14&lt;/sup&gt;</td>
<td>27.19%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36 994 586</strong></td>
<td><strong>4 808 465.51</strong></td>
<td><strong>928 582</strong></td>
<td><strong>10 760 651</strong></td>
<td><strong>53 492 285</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

<sup>14</sup> Includes vaccines and Injection supplies
## Cost per routine dose administered by activity (USD, 2011)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Facilities</th>
<th>District Health Administration</th>
<th>Regional Health Administration</th>
<th>Central EPI</th>
<th>Total routine immunization costs</th>
</tr>
</thead>
<tbody>
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<td>Cold Chain Maintenance</td>
<td>0.11</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.13</td>
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<tr>
<td>Other</td>
<td>0.18</td>
<td>0.04</td>
<td>0.01</td>
<td>0.00</td>
<td>0.24</td>
</tr>
<tr>
<td>Outreach Service Delivery</td>
<td>0.58</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.58</td>
</tr>
<tr>
<td>Program Management</td>
<td>0.09</td>
<td>0.09</td>
<td>0.02</td>
<td>0.01</td>
<td>0.21</td>
</tr>
<tr>
<td>Record-Keeping &amp; HMIS</td>
<td>0.65</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>0.70</td>
</tr>
<tr>
<td>Routine Facility-based Service Delivery</td>
<td>0.59</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.59</td>
</tr>
<tr>
<td>Social Mobilization &amp; Advocacy</td>
<td>0.53</td>
<td>0.06</td>
<td>0.00</td>
<td>0.02</td>
<td>0.61</td>
</tr>
<tr>
<td>Supervision</td>
<td>0.20</td>
<td>0.07</td>
<td>0.01</td>
<td>0.01</td>
<td>0.29</td>
</tr>
<tr>
<td>Surveillance</td>
<td>0.51</td>
<td>0.09</td>
<td>0.01</td>
<td>0.00</td>
<td>0.61</td>
</tr>
<tr>
<td>Training</td>
<td>0.12</td>
<td>0.03</td>
<td>0.01</td>
<td>0.00</td>
<td>0.16</td>
</tr>
<tr>
<td>Vaccine Collection, Distribution, &amp; Storage</td>
<td>0.35</td>
<td>0.07</td>
<td>0.04</td>
<td>1.09</td>
<td>1.55</td>
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<tr>
<td><strong>Total per routine dose administered</strong></td>
<td>3.91</td>
<td>0.51</td>
<td>0.10</td>
<td>1.14</td>
<td>5.65</td>
</tr>
</tbody>
</table>
## Cost per fully immunized child (DTP-HepB-Hib) by activity (USD, 2011)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Facilities</th>
<th>District Health Administration</th>
<th>Regional Health Administration</th>
<th>Central EPI</th>
<th>Total routine immunization costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Chain Maintenance</td>
<td>1,16</td>
<td>0,13</td>
<td>0,02</td>
<td>0,05</td>
<td>1,36</td>
</tr>
<tr>
<td>Other</td>
<td>1,97</td>
<td>0,46</td>
<td>0,07</td>
<td>0,02</td>
<td>2,52</td>
</tr>
<tr>
<td>Outreach Service Delivery</td>
<td>6,19</td>
<td>0,00</td>
<td>0,00</td>
<td>0,00</td>
<td>6,19</td>
</tr>
<tr>
<td>Program Management</td>
<td>0,91</td>
<td>0,99</td>
<td>0,18</td>
<td>0,12</td>
<td>2,20</td>
</tr>
<tr>
<td>Record-Keeping &amp; HMIS</td>
<td>6,88</td>
<td>0,51</td>
<td>0,04</td>
<td>0,02</td>
<td>7,46</td>
</tr>
<tr>
<td>Routine Facility-based Service Delivery</td>
<td>6,28</td>
<td>0,00</td>
<td>0,00</td>
<td>0,00</td>
<td>6,28</td>
</tr>
<tr>
<td>Social Mobilization &amp; Advocacy</td>
<td>5,65</td>
<td>0,63</td>
<td>0,05</td>
<td>0,18</td>
<td>6,51</td>
</tr>
<tr>
<td>Supervision</td>
<td>2,13</td>
<td>0,76</td>
<td>0,11</td>
<td>0,08</td>
<td>3,09</td>
</tr>
<tr>
<td>Surveillance</td>
<td>5,46</td>
<td>0,91</td>
<td>0,09</td>
<td>0,01</td>
<td>6,47</td>
</tr>
<tr>
<td>Training</td>
<td>1,31</td>
<td>0,29</td>
<td>0,09</td>
<td>0,02</td>
<td>1,71</td>
</tr>
<tr>
<td>Vaccine Collection, Distribution, &amp; Storage</td>
<td>3,76</td>
<td>0,74</td>
<td>0,39</td>
<td>11,64</td>
<td>16,53</td>
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<tr>
<td>Total per FIC</td>
<td>41,70</td>
<td>5,42</td>
<td>1,05</td>
<td>12,13</td>
<td>60,30</td>
</tr>
</tbody>
</table>
A16 - Funding Sources to Health-Care Functions in 2011
25.82% of the funds are spent for vaccine collection, distribution and storage. This activity is supported by GAVI at 67.03% (through in-kind). 31.98% of this activity is supported by domestic funding. External financial support is also provided by USAID for this activity to a minor extent (0.77%). 10.49% of the funds spent for routine immunization could not be disaggregated by health care function. WHO mostly supports surveillance (39% of WHO support), program management (20%) and training (18.56%).
## Financing sources (FS) to health care functions (HC) (USD, 2011)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HC.6.1.1</td>
<td>HC.6.2</td>
<td>HC.6.2.1</td>
<td>HC.6.2.2</td>
<td>HC.6.2.3</td>
<td>HC.6.2.4</td>
<td>HC.6.2.5</td>
<td>HC.6.2.6</td>
<td>HC.6.2.7</td>
<td>HC.6.2.8</td>
<td>HC.6.5.1</td>
<td>HC.6.6</td>
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</tr>
</tbody>
</table>

**Transfers from government domestic revenue**

<table>
<thead>
<tr>
<th>Internal transfers</th>
<th>4 469 607</th>
<th>4 857 790</th>
<th>4 773 351</th>
<th>1 403 900</th>
<th>1 627 661</th>
<th>1 163 061</th>
<th>1 932 962</th>
<th>1 213 370</th>
<th>1 407 028</th>
<th>3 951 292</th>
<th>6 037 258</th>
<th>32 837 279</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central transfers</td>
<td>112 214</td>
<td>2 542 471</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14 686</td>
</tr>
<tr>
<td>Within local</td>
<td>24 799</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 799</td>
</tr>
<tr>
<td>Regional transfer</td>
<td>3 153 588</td>
<td>627 052</td>
<td>46 445</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 827 085</td>
</tr>
</tbody>
</table>

**Transfers distributed by Government from foreign origin**

| USAID              |          | 100 315  |          |          |          |          |          |          |          |          |          | 100 315  |
| UNICEF             | 167 811  |          |          |          |          |          |          |          |          |          |          | 168 711  |
| WHO                | 7 609    | 0        |          | 42 870   | 16 318   | 20 236   | 46 193   | 90157    | 7 609    |          |          | 230 990  |
| GAVI               | 709 284  |          |          |          |          |          |          |          |          |          |          | 709 284  |

**Social Insurance contribution and compulsory prepayment**

| Insurance  | 925 335 |          |          |          |          |          |          |          |          |          |          | 925 335  |
| User fees  | 114 869 |          |          |          |          |          |          |          |          |          |          | 114 869  |

**Direct foreign transfers**

| WHO       | 22 397  | 29 029   |          |          |          |          |          |          |          |          |          | 51 426   |
| UNICEF    | 64 617  |          |          |          |          |          |          |          |          |          |          | 64 617   |
| GAVI      | 8 740 169|          |          |          |          |          |          |          |          |          |          | 8 740 169|
| World Vision | 30 632 |          |          |          |          |          |          |          |          |          |          | 30 632   |
| Total     | 4 477 216| 5 294 914| 5 484 841| 4 773 351| 1 523 846| 13 039 645| 1 180 279| 1 953 198| 1 259 563| 1 407 028| 4 041 449| 6 037 258| 22 295  | 494 3    |
A 17 - Funding Sources to Health-Care Provisions in 2011

Wages and salaries represent 65.03% of total funds spent for routine immunization and are entirely paid for by central government. Vaccines and supplies capture 22.34% of the expenses, and are supported by GAVI and Central MOH. 11.17% of the funds spent could not be disaggregated by health care provision (line item) due to the absence of systematic disaggregated financial data at sub national levels. Cold chain equipment is supported by UNICEF and USAID and represents 0.26% of total spending. Taxes and custom duties account for 0.22% of total funds spent and are exclusively paid by central government. Per diems represent 0.20% and are supported by local government (district, province) and WHO. 0.19% of funds spent can be allocated to transport/fuel expenses, mostly supported by district administration and WHO, to a minor extent. Vehicles purchase accounts for 0.17% and was supported by GAVI. 0.06% of funds spent is attributable to utilities & communication and are supported evenly by central MOH and WHO.
## Financing sources (FS) to health care provision (FP) in 2011

<table>
<thead>
<tr>
<th>Category</th>
<th>FS.1.1</th>
<th>FS.1.1.1</th>
<th>FS.1.1.2</th>
<th>FS.1.1.4</th>
<th>FS.2.1.1.1</th>
<th>FS.2.1.1.2</th>
<th>FS.2.1.2.2</th>
<th>FS.2.1.3</th>
<th>FS.3</th>
<th>FS.4.1</th>
<th>FS.7.2.2.2.1</th>
<th>FS.7.2.2.2.2</th>
<th>FS.7.2.2.2.4</th>
<th>FS.7.2.2.3.3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold chain equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100 315</td>
<td>900</td>
<td>29 029</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>130 244</td>
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<tr>
<td>Not disaggregated /n.e.c</td>
<td>24 799</td>
<td></td>
<td></td>
<td></td>
<td>3 678 636</td>
<td>167 811</td>
<td>143 958</td>
<td>552 535</td>
<td>925 335</td>
<td>114 869</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 632</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>19 183</td>
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<tr>
<td>Other equipment</td>
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<td></td>
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<td></td>
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<td></td>
<td>70 290</td>
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<td>Per diem</td>
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<td>46 445</td>
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<td>Transport</td>
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<td>31 005</td>
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<tr>
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<td></td>
<td></td>
<td>32 924 293</td>
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<td>Total</td>
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<td>3 827 085</td>
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<td>709 284</td>
<td>925 335</td>
<td>114 869</td>
<td>51 426</td>
<td>64 617</td>
<td>8 740 169</td>
<td>30 632</td>
<td>50 494 883</td>
</tr>
</tbody>
</table>
A18 - Funding sources to Financing Agents in 2010

The funding received for routine immunization represents 41.81 million USD in 2010. It is mostly provided through domestic sources that accounts for 91.87% of the support. Transfers from domestic revenues are mostly channeled through central MOH. Regional transfers to District Health Administrations represent 6.28% of total support. Out of pocket payments are marginal with 0.30% of total support. External funding sources represent 8.13% of the funding received. Most of the external financing is provided by GAVI Alliance New Vaccine Support (5.51%) through vaccines and supplies distributed by UNICEF supply division. External financial support distributed by Government are provided by GAVI Alliance (0.45 million USD), WHO (0.45 million USD), UNICEF (0.06 million USD). GAVI support is channeled through the Ghana Health Service and part of GAVI support is directly disbursed to District Health Administration. Minor in-kind support is provided by UNICEF (0.06%), WHO (0.17%) and World vision (0.09%).
### Funding sources (FS) to financing agents (FA) (USD, 2010)

<table>
<thead>
<tr>
<th>EPI program</th>
<th>Central Ministry of Health (other program)</th>
<th>Central Ministry of Health: Community organizations</th>
<th>District Level Ministry of Health (GHS)</th>
<th>National Laboratories</th>
<th>Central Cold Stores</th>
<th>Local Govt Agents</th>
<th>UNICEF</th>
<th>WHO</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfers from government domestic revenue</td>
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<td>24 144</td>
<td>49 328</td>
<td>69 657</td>
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<td>2 303 993</td>
<td>36 984</td>
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<td>A19 - Financing Agents to Health-Care Providers in 2010</td>
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<td></td>
</tr>
<tr>
<td>Most of funds spent for routine immunization are executed by central level. Central MOH executes 81.31% of expenditures (mostly driven by salaries). The funds executed at district level account for 6.22% of total spending.</td>
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</table>

<table>
<thead>
<tr>
<th>Financing agents to health-care provider (USD, 2010)</th>
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<tbody>
<tr>
<td><strong>Central Ministry of Health / DCD / EPI program</strong></td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Total 187 405</td>
</tr>
<tr>
<td>Ambulatory health care centers 32 621</td>
</tr>
<tr>
<td>District MOH 428 133</td>
</tr>
<tr>
<td>Hospitals 0</td>
</tr>
<tr>
<td>National MOH 187 405</td>
</tr>
<tr>
<td>Providers of health care system administration and financing 0</td>
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<tr>
<td>Provincial MOH 136 627</td>
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<tr>
<td>Public research institutions 0</td>
</tr>
<tr>
<td>Rest of the world 24 144</td>
</tr>
<tr>
<td>Total 187 405</td>
</tr>
</tbody>
</table>
A20 - Financing Agents to Health Care Financing Mechanisms in 2010

Central government schemes represent 93.29% of total funds spent, executed mainly by central MOH and Central Cold Stores. Service delivery and financing being decentralized at district level; this level captures the four different financing schemes. 93.44% of district administration spending is provided through sub national (regions) government schemes in 2010.

<table>
<thead>
<tr>
<th>Financing Agents to health care financing mechanism (USD, 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EPI program</strong></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Central government schemes</td>
</tr>
<tr>
<td>Community level financing</td>
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<tr>
<td>Rest of the world</td>
</tr>
<tr>
<td>State/regional/local government schemes</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
A 21 - Funding Sources to Health-Care Functions in 2010

14.90% of the funds are spent for vaccine collection, distribution and storage. This activity is supported by GAVI and by domestic funding. 5.38% of the funds spent for routine immunization could not be disaggregated by health care function.

**Funding sources to health care function (USD, 2010)**

<table>
<thead>
<tr>
<th>Int. Transf.</th>
<th>Domestic revenue</th>
<th>Financial donors</th>
<th>In-kind from donors</th>
<th>Total</th>
</tr>
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<td>GAVI</td>
<td>User fees</td>
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<td>FS.1.2.2.2.2</td>
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<td>WHO</td>
<td>GAVI</td>
<td>FS.7.2.2.2.2.4</td>
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<td>FS.1.2.3</td>
<td>FS.4.1</td>
<td>FS.7.2.2.2.2.2.4</td>
<td>FS.7.2.2.3.3</td>
<td>World Vision</td>
</tr>
</tbody>
</table>

| HC.6.1.1      | 4 953            | 4 886            | 4 602               |
| HC.6.2        | 94 970           | 84 013           | 2 233               |
| HC.6.2.1      | 5 241 933        | 470 965          | 5 712 898           |
| HC.6.2.2      | 5 150 817        | 5 150 817        | 5 150 817           |
| HC.6.2.3      | 1 184 903        | 308 766          | 1 568 038           |
| HC.6.2.4      | 1 383 672        | 2 145 658        | 2 303 993           |
| HC.6.2.5      | 1 145 661        | 1 300            | 1 146 861           |
| HC.6.2.6      | 1 885 666        | 3 474            | 1 936 831           |
| HC.6.2.7      | 992 169          | 26 177           | 1 018 346           |
| HC.6.2.8      | 1 679            | 0                | 1 375 679           |
| HC.6. 5.1 | 4 014 644 |   |   |   |   |   |   |   |   | 4 045 596 |
| HC.6. 6 | 6 061 302 |   |   |   | 105 904 |   |   |   |   | 6 167 206 |
| Total | 33 010 | 323 629 | 2 240 | 84 013 | 2 415 | 246 329 | 12 57 | 7 227 | 223 761 | 334 934 | 123 830 | 24 144 | 69 657 | 2 303 993 | 123 830 | 24 144 | 993 36 984 | 41 080 925 |
A 22 - Funding Sources to Health-Care Provisions in 2010

Wages and salaries represent 81.34% of total funds spent for routine immunization in 2010 and are entirely paid for by central government. Vaccines and supplies capture 10.83% of the expenses, and are supported by GAVI and Central MOH. 6.59% of the funds spent could not be disaggregated by health care provision (line item) due to the absence of systematic disaggregated financial data at sub national levels. Cold chain equipment is supported by GAVI and represents 0.34% of total spending. Taxes and custom duties account for 0.21% of total funds spent and are exclusively paid by central government. Per diems represent 0.40% and are supported by local government (district, province), UNICEF, WHO and GAVI. 0.17% of funds spent can be allocated to transport/fuel expenses, mostly supported by district administration and WHO, to a minor extent. 0.03% of funds spent are attributable to utilities and communication supported evenly by central MOH and WHO.
<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Area</th>
<th>Type</th>
<th>Total cost (USD)</th>
</tr>
</thead>
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<td>admofe</td>
<td>CHPS</td>
<td>rural</td>
<td>6 463.42 USD</td>
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<tr>
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<td>Clinic</td>
<td>rural</td>
<td>8 560.88 USD</td>
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<tr>
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<td>CHPS</td>
<td>rural</td>
<td>6 755.76 USD</td>
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<td>anglican</td>
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<td>rural</td>
<td>24 286.60 USD</td>
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<tr>
<td>ashiresu</td>
<td>CHPS</td>
<td>rural</td>
<td>19 167.05 USD</td>
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<tr>
<td>bamahu</td>
<td>Health Centre</td>
<td>rural</td>
<td>39 683.04 USD</td>
</tr>
<tr>
<td>banka</td>
<td>Health Centre</td>
<td>rural</td>
<td>11 163.67 USD</td>
</tr>
<tr>
<td>bayerebon</td>
<td>Health Centre</td>
<td>rural</td>
<td>27 926.71 USD</td>
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<td>CHPS</td>
<td>rural</td>
<td>29 660.44 USD</td>
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<tr>
<td>biu</td>
<td>Clinic</td>
<td>rural</td>
<td>11 725.68 USD</td>
</tr>
<tr>
<td>boli</td>
<td>CHPS</td>
<td>rural</td>
<td>10 135.88 USD</td>
</tr>
<tr>
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<td>Health Centre</td>
<td>rural</td>
<td>29 059.83 USD</td>
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<tr>
<td>charingu</td>
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<td>rural</td>
<td>17 076.66 USD</td>
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<tr>
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<td>rural</td>
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<td>Urban</td>
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<td>Type</td>
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<td>36 506.41 USD</td>
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### Distribution of total cost by activity for each facility

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<th>Facility Name</th>
<th>Total Cost (USD)</th>
<th>Cold Chain Maintenance</th>
<th>Outreach Service Delivery</th>
<th>Program Management</th>
<th>Record-Keeper</th>
<th>HMIS</th>
<th>Facilities-based Service Delivery</th>
<th>Social Mobilization &amp; Advocacy</th>
<th>Surveillance</th>
<th>Training</th>
<th>Vaccine Collection</th>
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<td>adomfe</td>
<td>9991</td>
<td>1.89%</td>
<td>0.42%</td>
<td>40.05%</td>
<td>0.73%</td>
<td>8.87%</td>
<td>27.32%</td>
<td>1.95%</td>
<td>5.20%</td>
<td>8.82%</td>
<td>1.20%</td>
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<td>0.00%</td>
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<td>0.00%</td>
<td>3.93%</td>
<td>2.61%</td>
<td>45.11%</td>
<td>0.00%</td>
<td>0.19%</td>
<td>0.06%</td>
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<td>1.13%</td>
<td>21.79%</td>
<td>0.28%</td>
<td>16.92%</td>
<td>7.93%</td>
<td>10.50%</td>
<td>6.20%</td>
<td>14.88%</td>
<td>2.77%</td>
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<td>26.34%</td>
<td>0.00%</td>
<td>12.77%</td>
<td>12.12%</td>
<td>27.25%</td>
<td>2.26%</td>
<td>5.25%</td>
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<td>1.55%</td>
<td>17.49%</td>
<td>1.75%</td>
<td>18.44%</td>
<td>4.76%</td>
<td>36.46%</td>
<td>0.00%</td>
<td>9.40%</td>
<td>1.02%</td>
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<td>61343</td>
<td>0.26%</td>
<td>0.69%</td>
<td>19.05%</td>
<td>1.21%</td>
<td>16.94%</td>
<td>15.63%</td>
<td>30.69%</td>
<td>4.87%</td>
<td>8.08%</td>
<td>0.51%</td>
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<td>19.03%</td>
<td>1.98%</td>
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<td>7.13%</td>
<td>1.86%</td>
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<td>5.69%</td>
<td>0.90%</td>
<td>18.60%</td>
<td>5.69%</td>
<td>2.30%</td>
<td>24.31%</td>
<td>3.56%</td>
<td>5.69%</td>
<td>4.45%</td>
<td>14.66%</td>
</tr>
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<td>bimbagu</td>
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<td>34.35%</td>
<td>20.05%</td>
<td>0.53%</td>
<td>1.24%</td>
<td>8.36%</td>
<td>0.63%</td>
<td>1.02%</td>
<td>26.22%</td>
<td>2.62%</td>
</tr>
<tr>
<td>biu</td>
<td>18126</td>
<td>3.36%</td>
<td>1.46%</td>
<td>12.79%</td>
<td>1.20%</td>
<td>12.71%</td>
<td>17.20%</td>
<td>13.89%</td>
<td>3.72%</td>
<td>22.31%</td>
<td>2.16%</td>
</tr>
<tr>
<td>boli</td>
<td>15668</td>
<td>0.00%</td>
<td>0.01%</td>
<td>8.17%</td>
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<td>0,00%</td>
<td>0,00%</td>
<td>0,01%</td>
<td>84,54%</td>
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<td>8,88%</td>
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<tr>
<td>ofose</td>
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<td>0,71%</td>
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<td>0,50%</td>
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<td>piisi</td>
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<td>0,00%</td>
<td>0,00%</td>
<td>0,02%</td>
<td>77,67%</td>
<td>11,32%</td>
<td>0,00%</td>
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<td>4,72%</td>
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<td>57,69%</td>
<td>0,00%</td>
<td>41,65%</td>
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<tr>
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<td>0,26%</td>
<td>0,00%</td>
<td>2,11%</td>
<td>0,03%</td>
<td>94,79%</td>
<td>0,16%</td>
<td>0,00%</td>
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<td>vunania</td>
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<td>0,00%</td>
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<td>0,01%</td>
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<td>2,76%</td>
<td>46,55%</td>
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<td>1,81%</td>
<td>0,00%</td>
<td>26,58%</td>
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<td>67,33%</td>
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<td>1,02%</td>
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</tr>
</tbody>
</table>

15 High share of vehicles is explained by 2 pick up to collect vaccines and distribute to other facilities + one motrocylce for other routine activities. Most facilities rely on one motorcycle only or sometimes do not have any vehicles and use taxi/public transportation.
## A26 – District costs and distribution by activity

<table>
<thead>
<tr>
<th>District</th>
<th>Total Cost (USD)</th>
<th>Cold Chain</th>
<th>Maintenance</th>
<th>Other</th>
<th>Outreach Delivery</th>
<th>Service Delivery</th>
<th>Program Management</th>
<th>Record-Keeping &amp; HMIS</th>
<th>Routine Service Delivery</th>
<th>Facility-based Service Delivery</th>
<th>Social Mobilization &amp; Advocacy</th>
<th>Supervision</th>
<th>Surveillance</th>
<th>Training</th>
<th>Vaccine Collection, Distribution, &amp; Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>asante_akim_south_dha</td>
<td>16 554</td>
<td>1,11%</td>
<td>8,06%</td>
<td>0,00%</td>
<td>7,40%</td>
<td>5,99%</td>
<td>0,00%</td>
<td>2,02%</td>
<td>10,24%</td>
<td>41,41%</td>
<td>12,44%</td>
<td>11,32%</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>atwima_mponua_dha</td>
<td>44 663</td>
<td>2,93%</td>
<td>18,25%</td>
<td>0,00%</td>
<td>32,86%</td>
<td>4,90%</td>
<td>0,00%</td>
<td>4,34%</td>
<td>2,34%</td>
<td>16,41%</td>
<td>8,95%</td>
<td>9,02%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bunkpurugu_yunyoo_dha</td>
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<td>4,96%</td>
<td>0,00%</td>
<td>25,01%</td>
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<td>0,00%</td>
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<td>5,45%</td>
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<td>35,17%</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ga_west_dha</td>
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<td>12,29%</td>
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<td>9,71%</td>
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<td>1,91%</td>
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</tr>
<tr>
<td>kassena_nankana_dha</td>
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<td>2,33%</td>
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<td>2,73%</td>
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<td>4,67%</td>
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<td>1,64%</td>
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<tr>
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<td>0,00%</td>
<td>7,26%</td>
<td>17,77%</td>
<td>0,00%</td>
<td>39,31%</td>
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<td>6,50%</td>
<td>4,40%</td>
<td>7,63%</td>
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### A27- Region costs distribution by activity

<table>
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<tr>
<th>Region</th>
<th>Total Cost</th>
<th>Cold Chain</th>
<th>Maintenance</th>
<th>Other</th>
<th>Program Management</th>
<th>Record-Keeping</th>
<th>HMIS</th>
<th>Social Mobilization &amp; Advocacy</th>
<th>Supervision</th>
<th>Surveillance</th>
<th>Training</th>
<th>Vaccine Collection, Distribution, &amp; Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>atwima_mponua_rha</td>
<td>135 289</td>
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<td>0.67%</td>
<td>1.11%</td>
<td>0.36%</td>
<td>0.54%</td>
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<td>0.42%</td>
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<td>94.99%</td>
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<td></td>
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<tr>
<td>bunkpurugu_yunyoo_rha</td>
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<td>0.17%</td>
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<tr>
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<td>89.95%</td>
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<td>1.75%</td>
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A28- Funding sources to health care provisions

### Funding sources to health care provisions (USD, 2010)

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<th>FS.1.1.1</th>
<th>FS.1.1.3</th>
<th>FS.1.4</th>
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<th>FS.2.1.2.2</th>
<th>FS.2.1.3</th>
<th>FS.4.1</th>
<th>FS.7.2.2.2.1</th>
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<td>14 073</td>
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<tr>
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<td>223 761</td>
<td>334 934</td>
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<td>24 144</td>
<td>69 657</td>
<td>2 303 993</td>
<td>36 984</td>
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</table>

|                  | 41 080 925 |
## DO NOT CIRCULATE OR QUOTE WITHOUT PERMISSION

### A29 – Vaccine Volume Calculator for new vaccines introduction in Ghana

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Presentation (dose/vial)</th>
<th>Packed volume national data</th>
<th>Maxi packed volume from data base</th>
<th>Price of vaccine (#/dose)</th>
<th>Vaccine wastage %</th>
<th>WHO/GAVI indicative wastage rates</th>
<th>Wastage factor</th>
<th>Enter as % of total population</th>
<th>Target Group</th>
<th>National immunization schedule Routine vaccinations</th>
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<td>current + Polio</td>
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<td>currentVault/OPV</td>
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<td>currentRota</td>
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<td>10</td>
<td>1,33</td>
<td>1.0</td>
<td>current</td>
<td>current/Measles</td>
</tr>
<tr>
<td>TT</td>
<td>29</td>
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<td></td>
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<td>current</td>
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</tr>
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</table>

Net volume of OPV at -20°C in higher level stores, per FIC 11.4
Net volume of all vaccines except OPV stored at +5°C in higher level stores, per FIC 19.3
Net volume of all vaccines, including OPV, stored at +5°C in lower level stores, per FIC 30.7
Net volume of vaccines and diluents, stored at +5°C at service points, per FIC 40.6

Percent increase of the net vaccine volume compared to Schedule A in store for 20°C

- OPV: 54%, 137%, 334%, 358%
- PCV: 34%, 85%, 210%, 225%
- DTP: 22%, 58%, 138%, 153%