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

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Final Report

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Abbreviations

AD	Auto-destruct (syringe)
BCG	Bacillus Calmette-Guerin
BMC	Budget Management Centers
CC	Cold Chain
CHAG	Christian Health Association of Ghana
CHN	Community Health Nurse
CHPS	Community-based Health Planning and Services
CSO	Civil Society Organization
CWC	Child Welfare Clinics
DDHS	District Director of Health Services
DDPH	Deputy Director Public Health
DHMT	District Health Management Team
DHIMS	District Health Information Management System
DP	Development Partners
DTP	Diphtheria, Tetanus, Pertussis (vaccine)
DVDMT	District Vaccine Distribution Management Tool
EPI	Expanded programme on Immunization
GAVI	Global Alliance for Vaccines and Immunization
GDP	Gross Domestic Product
GDHS	Ghana Demographic and Health Survey
GHS	Ghana Health Service
GIVS	Global Immunization Vision and Strategy
GOG	Government of Ghana
GPRS	Ghana Poverty Reduction Strategy
GSS	Ghana Statistical Service
HC	Health Centre
HCW	Health Care Worker
HSMTDP	Health Sector Medium Term Development Plan
HepB	Hepatitis B vaccine
HF	Health Facility
Hib	Haemophilus Influenzae type b vaccine
HMIS	Health Management Information System
HSMTDP	Health Sector Medium Term Development Plan
ICC	Inter Agency Coordinating Committee
IDSR	Integrated Disease Surveillance and Response
IEC	Information, Education and Communication
ISS	Immunization Services Support
MCH	Maternal and Child Health
MCV-2	Measles Containing Vaccine 2nd dose
MDG	Millennium Development Goal
M&E	Monitoring and Evaluation
MNT	Maternal and Neonatal Tetanus
MoFEP	Ministry of Finance and Economic Planning
MoH	Ministry of Health
NID	National immunization Day
NIP	National Immunization Programme
NT	Neonatal Tetanus
OPV	Oral Polio Vaccine

PCV	Pneumococcal Vaccine
Penta	Pentavalent vaccine
REC/RED	Reaching Every Child/Reaching Every District
PPME	Policy, Planning, Monitoring and Evaluation
RCH	Reproductive and Child Health
RHMT	Regional Health Management Team
RI	Rotary International
SIAs	Supplemental Immunization Activities
SWAp	Sector-Wide Approach
TT	Tetanus Toxoid
UNICEF	United Nations Children's Fund
USAID	United State Agency for International Development
VPD	Vaccine preventable Disease
WHO	World Health Organization
WICR	Walk In Cold Room

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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

[1] World Bank national accounts data, and OECD National Accounts data files: http://data.worldbank.org/indicator/NY.GDP.MKTP.CD

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 under-estimated: 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 NUVI)

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

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

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

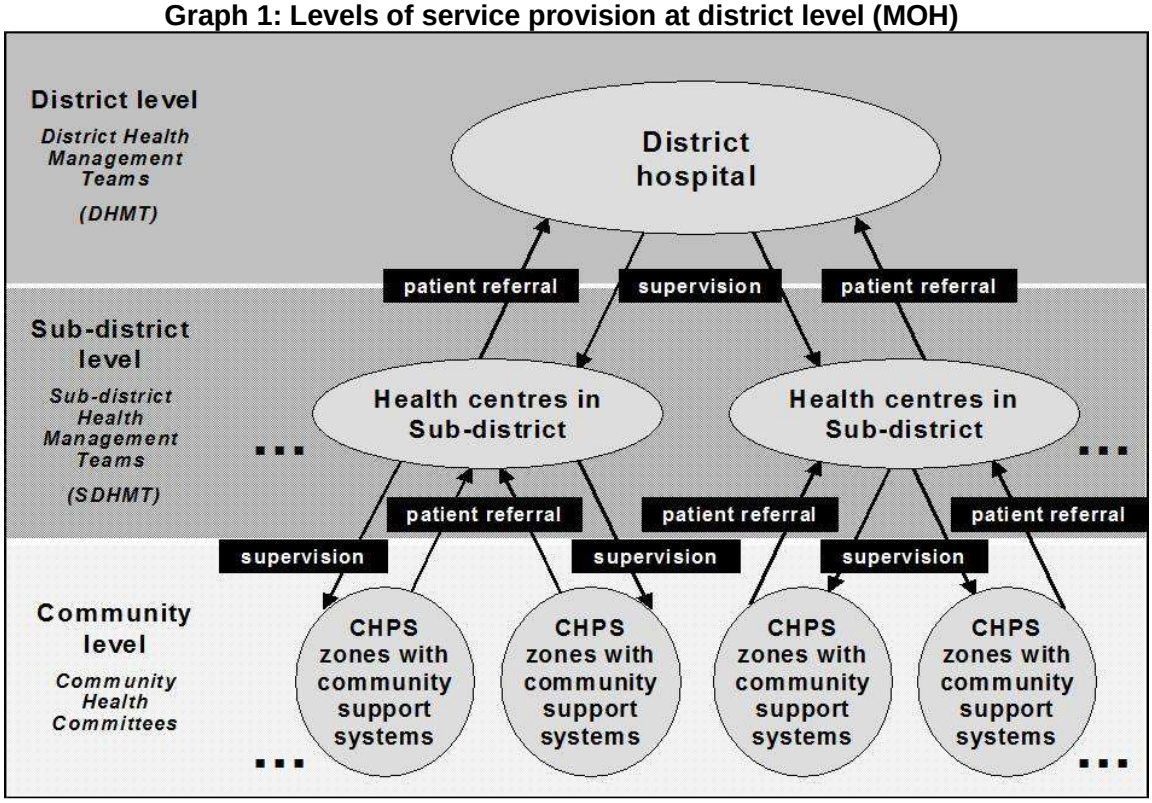
3.2. Health System and routine immunization program in Ghana

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-districts[3]. 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

Graph 1: Levels of service provision at district level (MOH)



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.

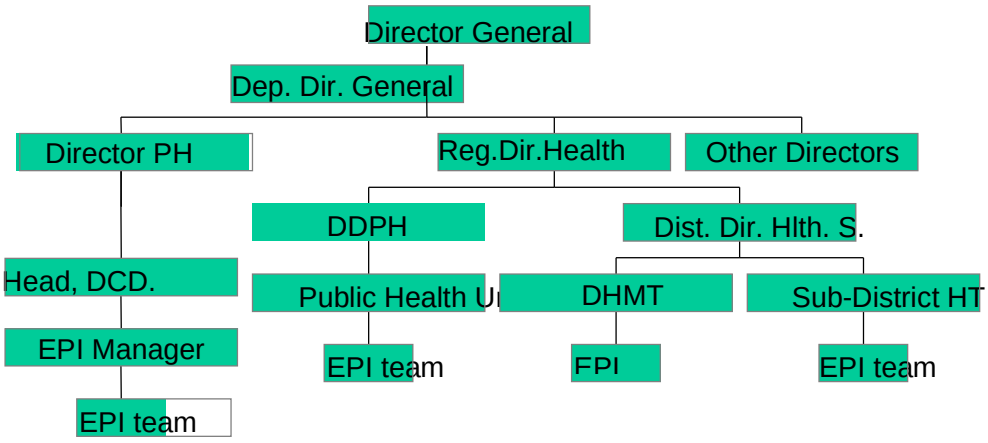
All these facilities conduct outreach services in addition to facility-based delivery.

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



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

Vaccine/ antigen	Dosage	Doses required	Minimum interval between doses	Minimum age to start	Mode of administration	Site of administration	Doses per vial	Presentation	Price per dose USD 2011 (source EPI Ghana)
BCG	0.05ml up to11 months, 0.10ml after11 months	1 dose	None	None At birth (or first contact)	Intra-dermal	Right Upper Arm	20	Lyophilized	0.07
Pentavalent	0.5 ml	3 doses 6, 10 and 14 weeks	4 weeks	At 6 weeks (or first contact after that age)	Intra-muscular	Outer Upper Aspect of Left Thigh	1	Liquid	2.96
Pneumo	0.5 ml	3doses 6, 10 and 14 weeks	4 weeks	At 6 weeks (or first contact after that age)	Intra-muscular	Outer upper Aspect of Right Thigh	1	Liquid	7*
Polio	2 drops	4 doses At birth, 6, 10 and 14 weeks	4 weeks	At birth or within the first2 weeks	Oral	Mouth	20	Liquid	0.13
Rotarix	1.2 ml	2 doses, 6 and 10 weeks	4 weeks	At 6 weeks (or first contact after that age)	Oral	Mouth	1	Liquid	2.42*
Measles first dose	0.5 ml	1 doses at 9 months	9 months	At 9 months	Sub-cutaneous	Left Upper Arm	10	Lyophilized	0.19
Measles second dose		1 doses 18 months		At 18 months		Right Upper Arm	10	Lyophilized	0.19
Yellow Fever	0.5 ml	1 dose	None	At 9 months	Sub-cutaneous	Right Upper Arm	5	Lyophilized	0.66
Tetanus Toxoid	0.5 ml	2 doses	1 month	Pregnant Women	Inta-musculary	Upper Arm	10	Liquid	0.085

**2012 price = NUVI*

Table 3: Doses administered by routine EPI and coverage rate in Ghana from 2006 to 2011

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

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 4: comprehensive Multi-Year Plan (cMYP) estimates for 2011

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

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 capita[4].

[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, whiles 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)[5] 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.

- Low Population density and high doses administered: Atwima Mponua (Ashanti region)
- Low Population density and low doses administered Kassena Nankana (Upper East region)

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 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 5: Final sample selected by district and location

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

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

- District level: EPI administrative unit within the district health services and district hospitals (District Health Administration), and reproductive and child health units of district hospitals for service delivery.
- At sub-district level: primary health care facilities that provide immunization services (owned by government or NGOs): including health centers, community based health planning and services (CHPS), and clinics.

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 overnigh (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 respondents[7]. 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 DTP[8]. 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 6: Useful Life Years by type of cold chain equipment

Cold Chain equipment type	Useful life years
Walk In Cold Room (WICR)	15
Refrigerator / freezer	8
Cold Box	5
Vaccine Carrier	3

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 7: Useful life years by type of vehicles

Vehicle type	Useful life years
Pick up	8
Saloon car	8
Motorbike	5

[7] 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.

[8] The following formula for the tracing factor was applied: factor = FIC / (outpatient vists + r * inpatient admissions);

4.1.5.12. Other capital items

The estimated useful life year of incinerator was five years (16).

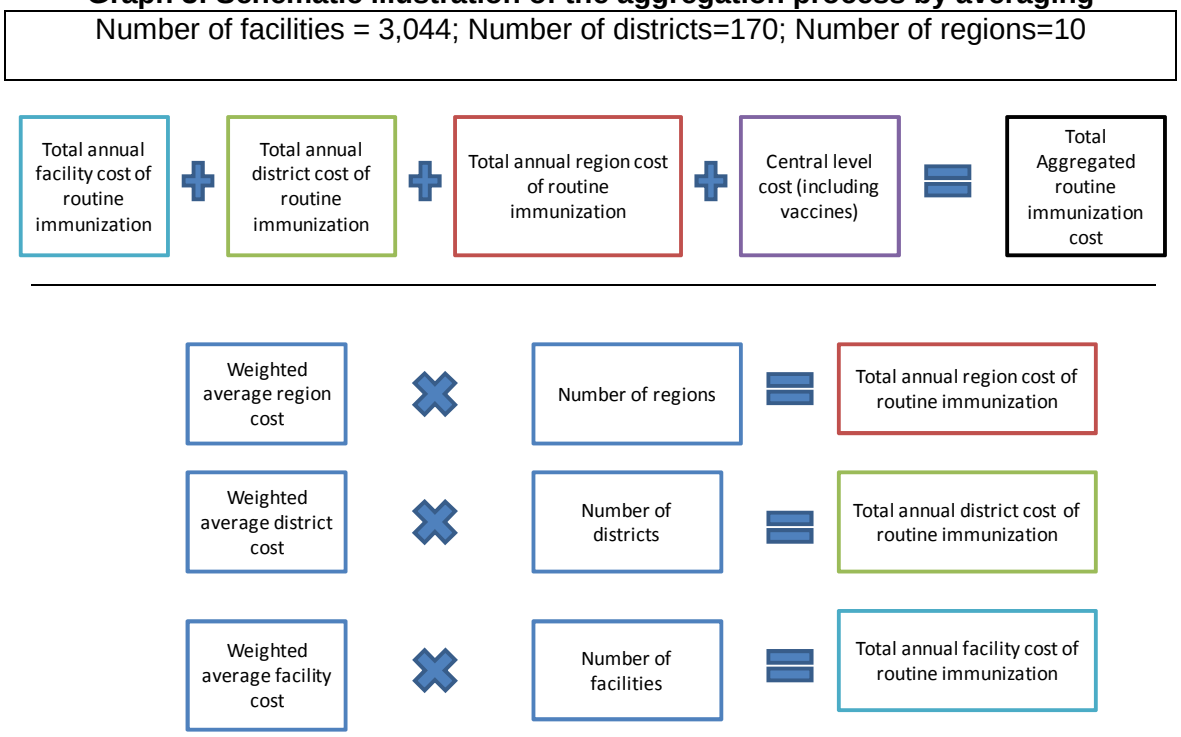
4.1.5.13. Other

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.

Graph 3: Schematic illustration of the aggregation process by averaging



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

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

	Economic	Financial
Salaried labor	Included	Included
Volunteer labor	Included	Excluded
Per diems	Included	Included
Transport and fuel	Included	Included
Vaccines	Included	Included (central level)
Building overheads	Included	Included
Cold Chain equipment	Included (discounting)	Included (straight line depreciation)
Vehicles	Included (discounting)	Included (straight line depreciation)
Buildings	Included	Excluded

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.

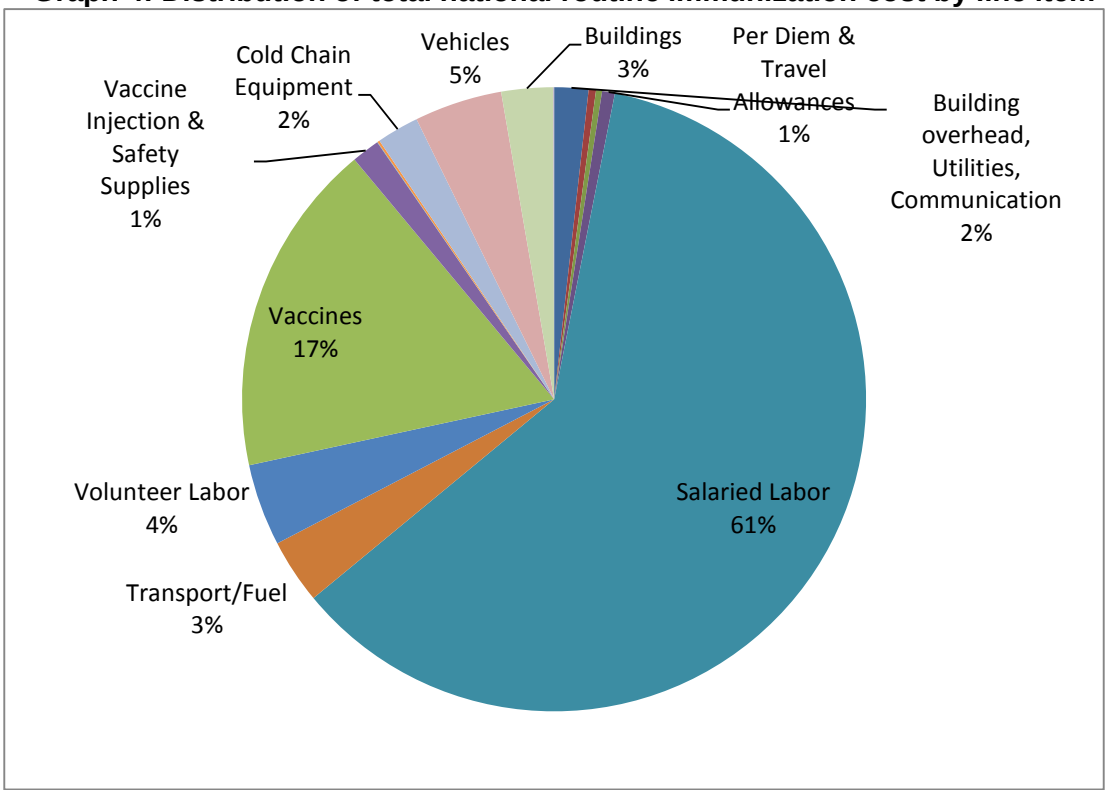
4.2. Nationwide Routine immunization costs

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.

[9] General Government Health Expenditure and gross domestic product data are extracted from 'Health Expenditure Series', WHO (http://apps.who.int/nha/database/StandardReport.aspx?ID=REP_WEB_MINI_TEMPLATE_WEB_VERSION&COUNTRYKEY=84639)

[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

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

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)

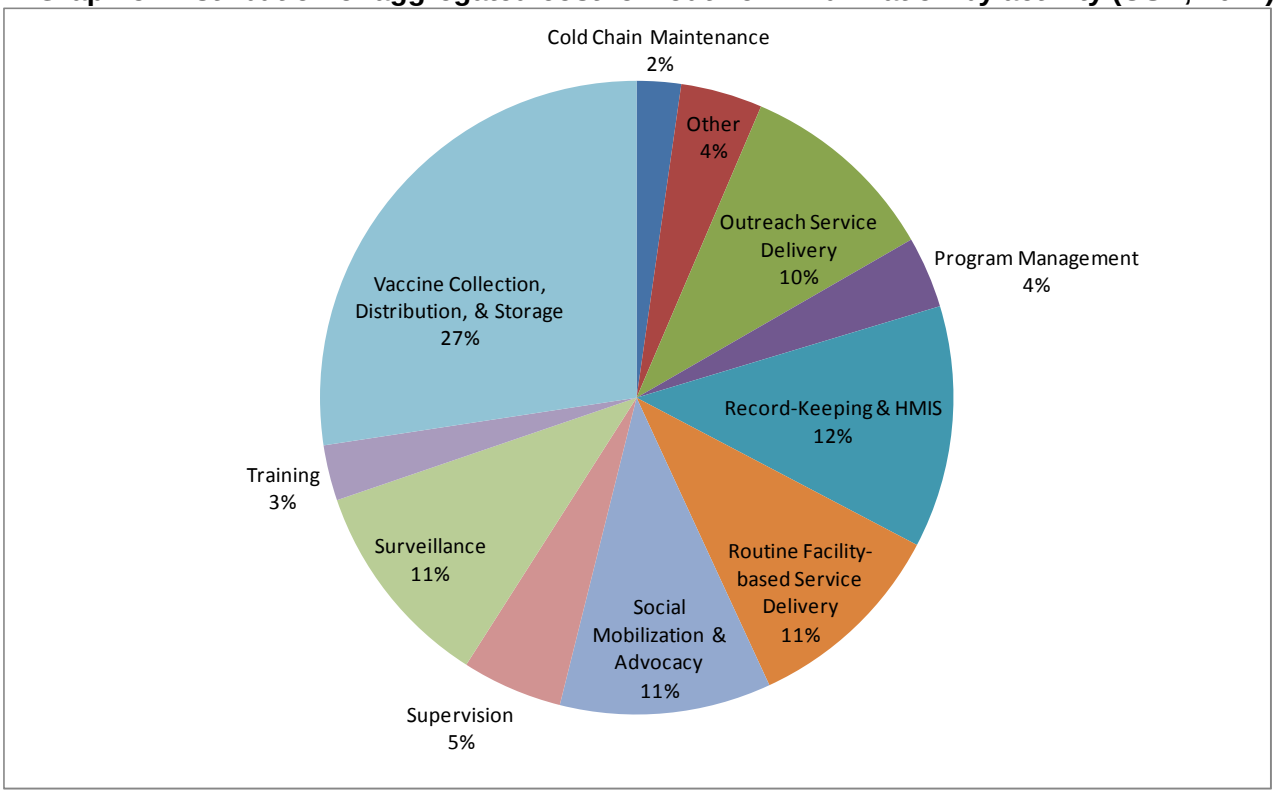
Line item	Total Cost	Share	Facilities	District Health Administration	Regional Health Administration	Central EPI
Recurrent costs						
Building overhead, utilities & communication	**953,099**	*2.02%*	83,470	723,089	52,326	94,215
Cold chain energy costs	**196,677**	*0.36%*	0	0	169,510	27,167
Other recurrent	**169,377**	*0.31%*	0	75,899	8,028	85,450
Per diems & travel allowances	**355,483**	*0.75%*	125,788	167,067	55,790	6 838
Salaried labor	**32,566,697**	*60.81%*	30,231,147	1,850,881	358,054	126,615
Transport/fuel	**1,795,528**	*3.37%*	1,069,759	661,529	43,225	21,016
Volunteer labor	**2,267,997**	*4.20%*	2,267,997	0	0	0
Vaccines	**9,278,187**	*17.18%*	0	0	0	9,278,187
Vaccine injection & safety supplies	**779,738**	*1.44%*	0	0	0	779,738
Vehicle maintenance	**13,516**	*0.03%*	0	0	0	13,516
Printing	**58,279**	*0.11%*	0	0	0	58,279
subtotal recurrent	***48,434,577***	*91%*	*33,778,159*	*3,478,465*	*686,932*	*10,491,020*
Capital costs						
Cold chain equipment	**1,174,019**	*2.21%*	726,026	203,467	71,106	173,417
Vehicles	**2,432,026**	*4.52%*	1,742,250	497,118	124,373	68,285
Buildings	**1,431,615**	*2.65%*	748,149	613,628	41,908	27,930
other capital	**20,048**	*0.05%*	0	15,785	4,263	0
subtotal capital	***5,057,708***	*9%*	*3,216,426*	*1,330,001*	*241,651*	*269,631*
TOTAL	**53,492,285**	***100%***	**36,994,586**	**4,808,466**	**928,582**	**10,760,651**
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 superficy 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)

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

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)

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

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)[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)

Outputs and Unit Costs	RCH N=4	Clinic N=9	Health Center N=17	CHPS N=20	All N=50
Total routine doses administered	11,119	3,628	4,432	1,647	3,245
Standard deviation	*1,241*	*409*	*157*	*75*	*53*
Total DTP3 Vaccinated Children (FIC)	695	330	545	146	321
Standard deviation	*84*	*33*	*21*	*5*	*5*
Infant population (catchment area)	1,402	552	573	261	513
Standard deviation	*192*	*66*	*22*	*12*	*8*
Total population (catchment area)	56,547	8,875	13,809	5,831	12,398
Standard deviation	*11,537*	*646*	*573*	*221*	*222*
Routine immunization costs (vaccines & delivery cost)					
Weighted average facility total cost	26,743	12,885	22,989	12,778	16,460
Standard deviation	*3,692*	*712*	*612*	*564*	*217*
Cost per routine dose administered	*2.41*	*3.55*	*5.19*	*7.76*	*5.07*
Cost per FIC	*38.49*	*39.07*	*42.17*	*87.78*	*51.26*
Cost per infant population	*19.08*	*23.33*	*40.11*	*48.89*	*36.11*
Cost per capita	*0.47*	*1.45*	*1.66*	*2.19*	*1.50*
Delivery cost (excluding vaccines and supplies)					
Weighted average delivery cost	16,425	10,526	14,515	10,891	12,154
Standard deviation	*2,330*	*461*	*440*	*381*	*146*
Cost per routine dose administered	*1.48*	*2.90*	*3.27*	*6.61*	*3.75*
Cost per FIC	*23.64*	*31.91*	*26.62*	*74.82*	*37.85*
Cost per infant population	*11.72*	*19.06*	*25.32*	*41.67*	*26.66*
Cost per capita	*0.29*	*1.19*	*1.05*	*1.87*	*1.10*

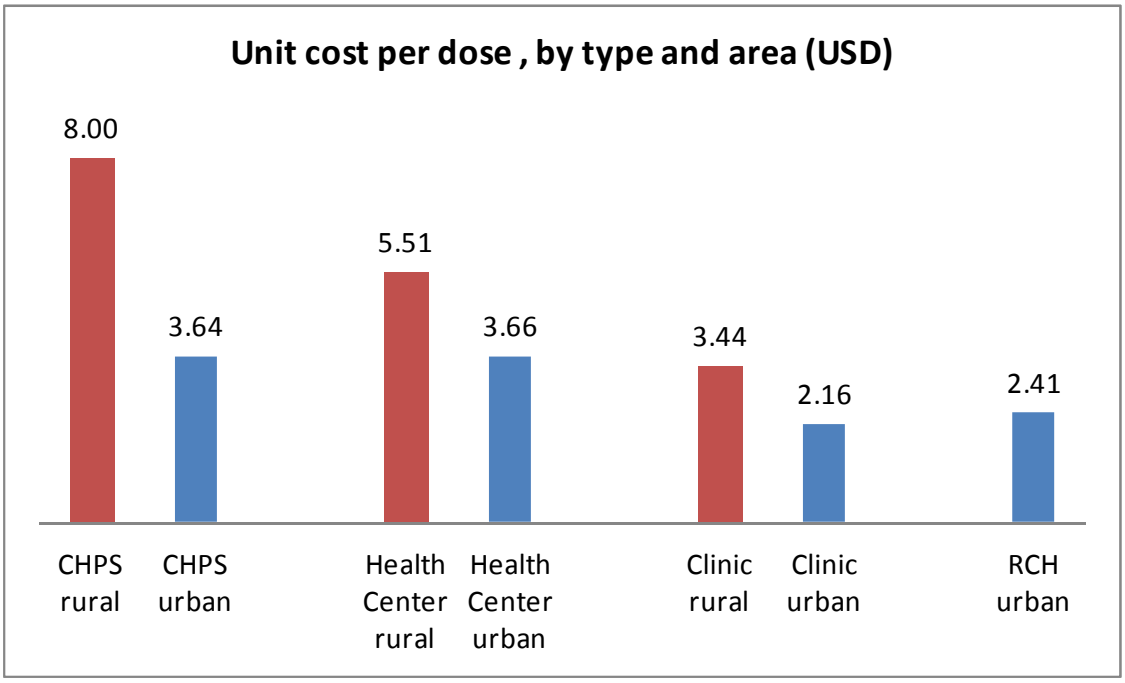
Larger catchment facilities have both higher total costs and relatively higher numbers of children they are immunizing.

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

[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)



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

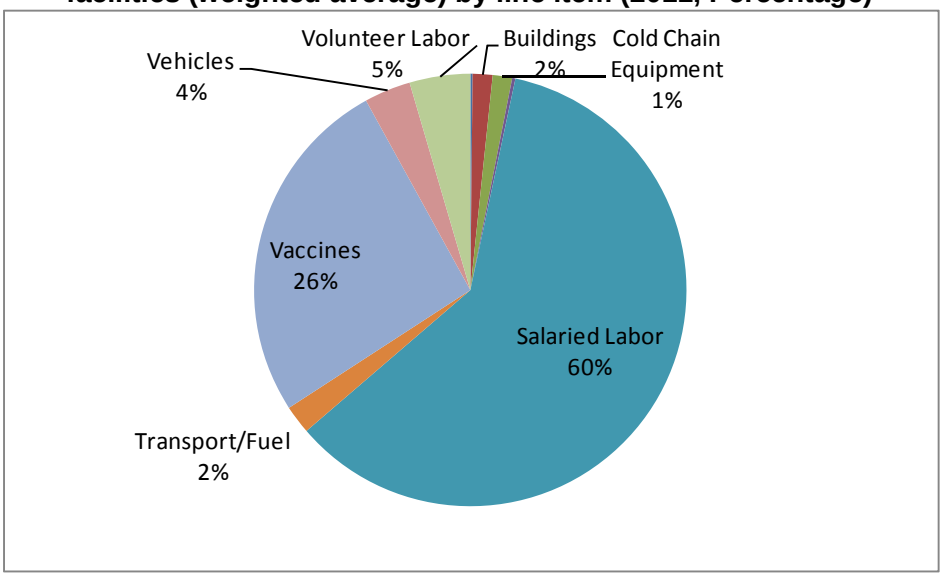
	CHPS rural N=19	CHPS urban N=1	Health center rural N=14	Health center urban N=3	Clinic rural N=6	Clinic urban N=3	RCH urban N=4
Average cost	12,833	11,017	23,098	22,238	13,501	11,413	26,743
Standard deviation	*593*	-	*679*	*4953*	*1023*	*2418*	*3692*
Average delivery cost	11,030	6,429	14,537	14,364	11,000	9,393	16,425
Standard deviation	*394*	-	*510*	*2,973*	*579*	*1,841*	*2,330*
Outputs							
Routine dose	1,604	3,024	4,195	6,078	3,925	5,276	11,119
Standard deviation	*79*	-	*196*	*581*	*720*	*1452*	*1241*
FIC	136	443	545	549	365	245	695
Standard deviation	*5*	-	*26*	*62*	*55*	*52*	*84*
Infant	263	-	562	650	607	422	1,402
Standard deviation	*12*	-	*27*	*25*	*109*	*147*	*192*
Total population	5,842	5,468	13,457	16,246	8,009	10,949	56,547
Standard deviation	*232*	-	*722*	*632*	*679*	*3,526*	*11,537*
Unit costs							
per dose	*8.00*	*3.64*	*5.51*	*3.66*	*3.44*	*2.16*	*2.41*
per FIC	*94.16*	*24.87*	*42.41*	*40.50*	*36.94*	*46.66*	*38.49*
per infant	*48.85*	-	*41.09*	*34.24*	*22.25*	*27.06*	*19.08*
per total population	*2.20*	*2.01*	*1.72*	*1.37*	*1.69*	*1.04*	*0.47*
Unit delivery costs							
per dose	*6.88*	*2.13*	*3.47*	*2.36*	*2.80*	*1.78*	*1.48*
per FIC	*80.94*	*14.51*	*26.69*	*26.16*	*30.10*	*38.41*	*23.64*
per infant	*41.99*	*29.36*	*25.86*	*22.11*	*18.13*	*22.27*	*11.72*
per total population	*1.89*	*1.18*	*1.08*	*0.88*	*1.37*	*0.86*	*0.29*

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.

Graph 7: Distribution of total routine immunization economic costs of sampled facilities (weighted average) by line item (2011, Percentage)



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)

Facility Type / Line Items	RCH Unit n=4		Clinic n=9		Health Center n=17		CHPS n=20		All n=50	
	Cost (USD)	%	Cost (USD)	%	Cost (USD)	%	Cost (USD)	%	Cost (USD)	%
Salaried Labor	15,331	57.33%	9,545	74.08%	10,752	46.77%	9,066	70. 95%	9,931	60.34%
Volunteer Labor	553	2.07%	321	2.49%	908	3.95%	816	6.34%	745	4.53%
Per Diems	22	0.08%	22	0.17%	99	0.43%	15	0.12%	41	0.25%
Vaccines	10,318	38.58%	2,359	18.31%	8,474	36.86%	1,887	14.77%	4,306	26.16%
Transport & fuel	183	0.68%	267	2.07%	467	2.03%	326	2.55%	351	2.14%
Building overheads	0	-	6	0.05%	81	0.35%	5	0.04%	27	0.17%
Subtotal recurrent	26,407	98.74%	12,127	97.16%	20,474	90.40%	12,114	94.81%	15,066	93.58%
Cold chain equipment	157	0.59%	117	0.91%	477	2.07%	143	1.12%	239	1.45%
Vehicles	155	0.58%	209	1.62%	1,322	5.75%	280	2.19%	572	3.48%
Buildings	24	0.09%	41	0.31%	409	1.78%	240	1.88%	246	1.49%
Subtotal capital	336	1.26%	366	2.84%	2,208	9.60%	664	5.19%	1,057	6.42%
Total Facility Immunization Cost	26,743	100%	12,885	100%	22,989	100%	12,778	100%	16,460	100%

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)

Input	Rural	Urban
Building overheads, utilities & communication	0.20%	0.00%
Buildings	1.06%	3.61%
Cold chain equipment	1.56%	0.90%
Per diems & travel allowances	0.28%	0.12%
Salaried labor	60.95%	57.31%
Transport / fuel	2.46%	0.55%
Vaccines	24.69%	33.41%
Vehicles	3.88%	1.48%
Volunteer labor	4.91%	2.63%
Total général	**100.00%**	**100.00%**

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.

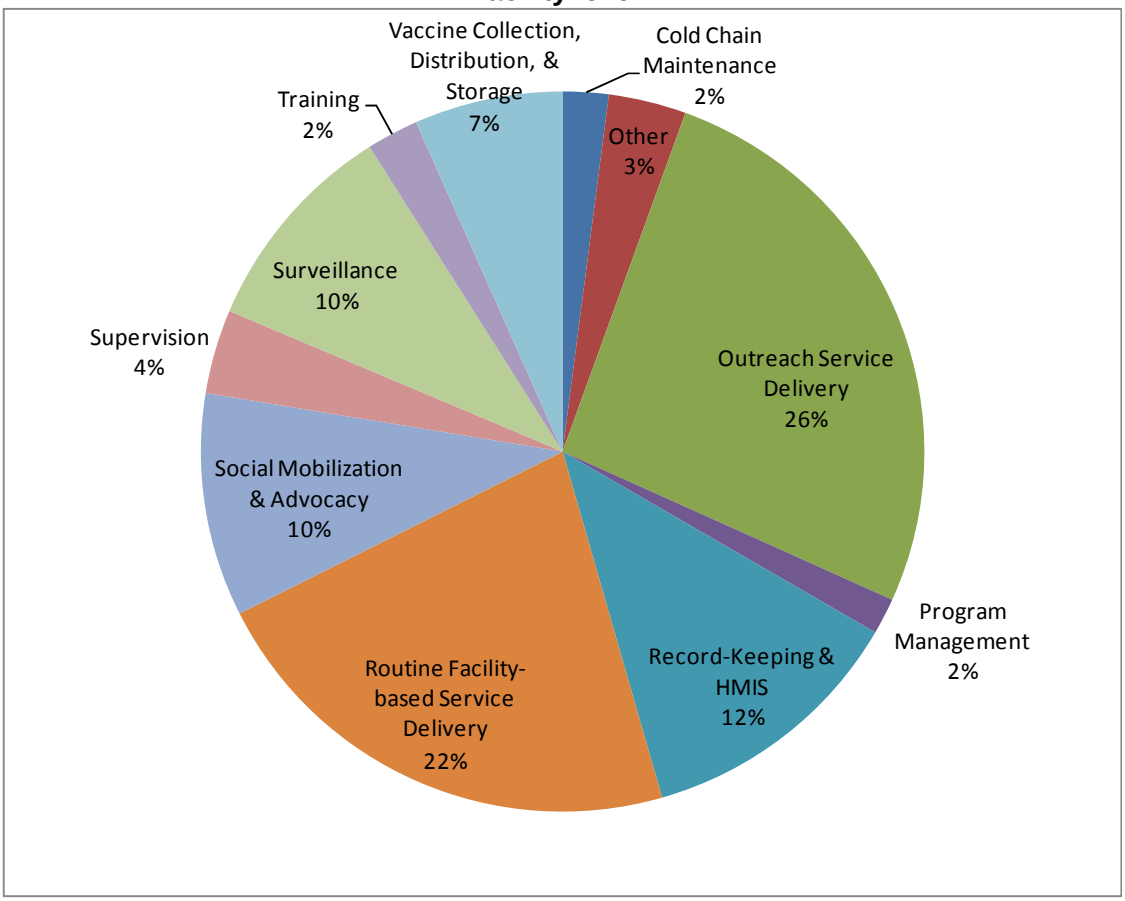
When excluding salaried labor costs, CHPS had the highest unit cost per dose, per child and per FIC. On the opposite, RCH units had the lowest cost per dose, per child and per FIC. These findings are consistent with the total and delivery costs per unit of output (table 17).

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

Facility Type	Unit cost	Non-HR unit cost	Delivery unit cost	Non-HR Delivery unit cost
Per dose administered				
CHPS	7.76 USD	2.25 USD	6.61 USD	1.11 USD
Clinic	3.55 USD	0.92 USD	2.90 USD	0.27 USD
Health Center	5.19 USD	2.76 USD	3.27 USD	0.85 USD
RCH	2.41 USD	1.03 USD	1.48 USD	0.10 USD
All facilities	5.07 USD	2.01 USD	3.75 USD	0.68 USD
Per infant population				
CHPS	48.96 USD	14.22 USD	41.73 USD	6.99 USD
Clinic	23.34 USD	6.05 USD	19.07 USD	1.78 USD
Health Center	40.12 USD	21.36 USD	25.33 USD	6.57 USD
RCH	19.07 USD	8.14 USD	11.72 USD	0.78 USD
All facilities	32.09 USD	12.73 USD	23.69 USD	4.33 USD
Per Fully Immunized Child (FIC)				
CHPS	87.52 USD	25.43 USD	74.59 USD	12.50 USD
Clinic	39.05 USD	10.12 USD	31.90 USD	2.97 USD
Health Center	42.18 USD	22.45 USD	26.63 USD	6.90 USD
RCH	38.48 USD	16.42 USD	23.63 USD	1.57 USD
All facilities	51.28 USD	20.34 USD	37.86 USD	6.92 USD

4.4.3. Economic costs at facility level, by activity

Graph 8: Distribution of total routine immunization economic costs by activity at facility level



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)

Facility type / Activity	RCH n=4		Clinic n=9		HC n=17		CHPS n=20		All	Percent
Facility-based delivery	12,341	46.15%	2,862	22.21%	5,248	22.83%	2,098	16.42%	3,627	22.04%
Record-keeping/HMIS	4,271	15.97%	1,399	10.86%	2,160	9.40%	1,920	15.03%	2,006	12.19%
Supervision	754	2.82%	889	6.90%	701	3.05%	461	3.61%	620	3.77%
Outreach services	5,428	20.30%	3,434	26.65%	7,485	32.56%	2,574	20.15%	4,312	26.20%
Social mobilization	905	3.38%	1,867	14.49%	1,729	7.52%	1,586	12.41%	1,647	10.01%
Cold chain maintenance	246	0.92%	157	1.22%	536	2.33%	291	2.28%	339	2.06%
Vaccine coll. & dist.	471	1.76%	785	6.10%	1,823	7.93%	818	6.40%	1,096	6.66%
Program management	597	2.23%	159	1.24%	515	2.24%	121	0.95%	266	1.62%
Training	344	1.29%	233	1.80%	689	3.00%	250	1.96%	382	2.32%
Surveillance	1,369	5.12%	1,069	8.29%	1,280	5.57%	1,991	15.58%	1,591	9.67%
Other	16	0.06%	31	0.24%	823	3.58%	667	5.22%	574	3.48%
Total Cost	**26,743**	**100%**	**12,885**	**100%**	**22,989**	**100%**	**12,778**	**100%**	**16,460**	**100%**

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

Facility type	Three main cost drivers
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)

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

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

Facility type	RCH	Health Center	Clinic	CHPS
FTE for routine immunization *Range (Min-Max)*	3.00 *(1.19-8.38)*	1.57 *(0.44-5.60)*	1.99 *(0.56-4.90)*	1.69 *(0.53-3.85)*
Distribution of salaried labor costs by activity				
Cold chain maintenance	1.60%	4.99%	1.65%	3.21%
Other	0%	3.73%	0.09%	6.75%
Outreach delivery	12.47%	12.66%	25.10%	15.07%
Program management	3.90%	4.76%	1.66%	1.18%

Facility type	RCH	Health Center	Clinic	CHPS
Record-keeping & HMIS	26.87%	19.70%	14.59%	17.54%
Routine Facility-based Service Delivery	34.87%	20.67%	14.13%	10.50%
Social Mobilization & Advocacy	4.44%	12.94%	18.07%	14.43%
Supervision	4.92%	5.73%	8.39%	4.02%
Surveillance	6.68%	5.70%	8.55%	19.03%
Training	2.20%	5.55%	2.36%	1.95%
Vaccine Collection, Distribution, & Storage	2.05%	3.58%	5.41%	6.32%
Total facility immunization cost	**26,743**	**22,989**	**12,885**	**12,778**

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)

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

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

	Rural		**Urban**	
% FTE for routine immunization (weighted average)	1.71		2.08	
Salaried labor cost by activity	Cost (USD) *(standard deviation)*	%	Cost (USD) *(standard deviation)*	%
Cold Chain Maintenance	324 *(11)*	3,31%	425 *(49)*	3,95%
Other	352	3,59%	791	7,36%

	Rural		Urban	
	(53)		*(239)*	
Outreach Service Delivery	1,590 *(39)*	16,24%	1,442 *(128)*	13,42%
Program Management	257 *(11)*	2,63%	266 (35)	2,47%
Record-Keeping & HMIS	1,701 *(43)*	17,37%	2,546 *(248)*	23,69%
Routine Facility-based Service Delivery	1,456 *(47)*	14,87%	2,402 *(248)*	22,35%
Social Mobilization & Advocacy	1,531 *(48)*	15,64%	496 *(55)*	4,62%
Supervision	500 *(17)*	5,11%	718 *(86)*	6,68%
Surveillance	1,241 *(42)*	12,67%	998 *(86)*	9,29%
Training	332 *(21)*	3,39%	234 *(17)*	2,17%
Vaccine Collection, Distribution, & Storage	507 *(16)*	5,18%	428 *(50)*	3,99%
Total	**9,790**		**10,746**	

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)

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

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)

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

4.5.5. Comparison of aggregated results

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

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

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

Scenarios	Weighted Average (USD)	Change from Baseline (USD)	% Change from Baseline
Baseline estimate	16,460	-	-
Scenario 1: Provision of allowance to volunteers by Government of Ghana based on the daily minimum wage (3.39 USD per day)	16,460	16,124	-2% *-45% for volunteer labor costs*
Scenario 2: Increase of 10% in wastage rate for all vaccines	16,460	16,890	+2.6%
Scenario 3: Decrease of 5% in wastage rate for all vaccines	16,460	16,029	-1.3%
Scenario 4: Assumption of occupancy rate = 50% of cold chain equipment costs in 2011	16,460	16,340	-0.7%
Scenario 5: labor time allocation higher by 10%	16,460	17,453	+6.03%
Scenario 6: labor time allocation lower by 5%	16,460	15,963	-3.02%

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 varations 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 28: Doses administered the year of introduction

Vaccine	Doses administered	Denominator	Coverage
PCV first dose	667,237	821,185	81%
PCV second dose	524,458	739,067	71%
PCV third dose	419,715	656,948	64%

Vaccine	Doses administered	Denominator	Coverage
rotavirus vaccine first dose	613,983	821,185	75%
rotavirus vaccine second dose	483,105	739,067	65%
measles vaccine second dose	523,891	903,304	58%

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.

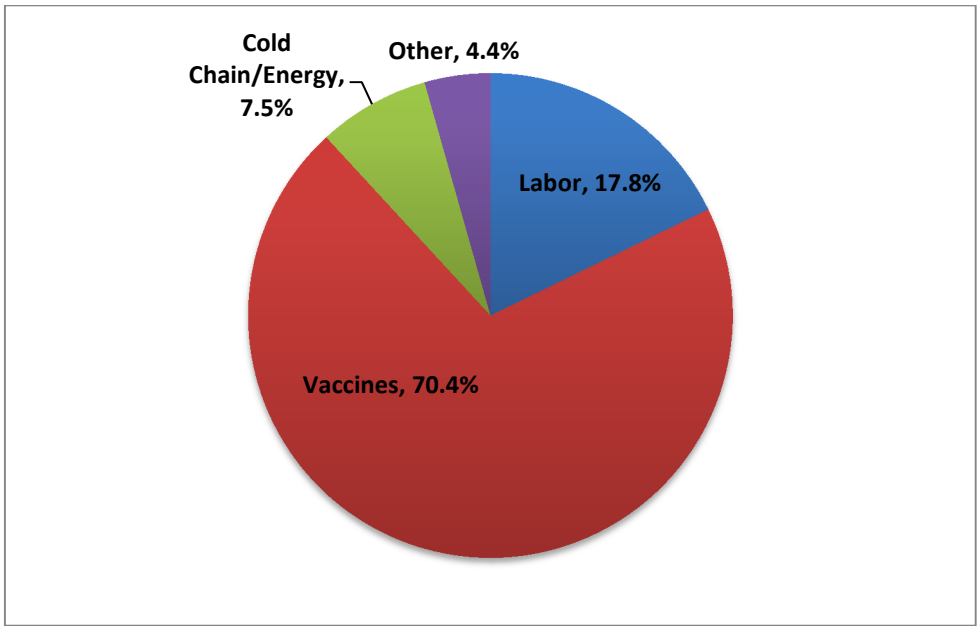
5.4. New vaccines introduction costs results (economic and fiscal)

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.

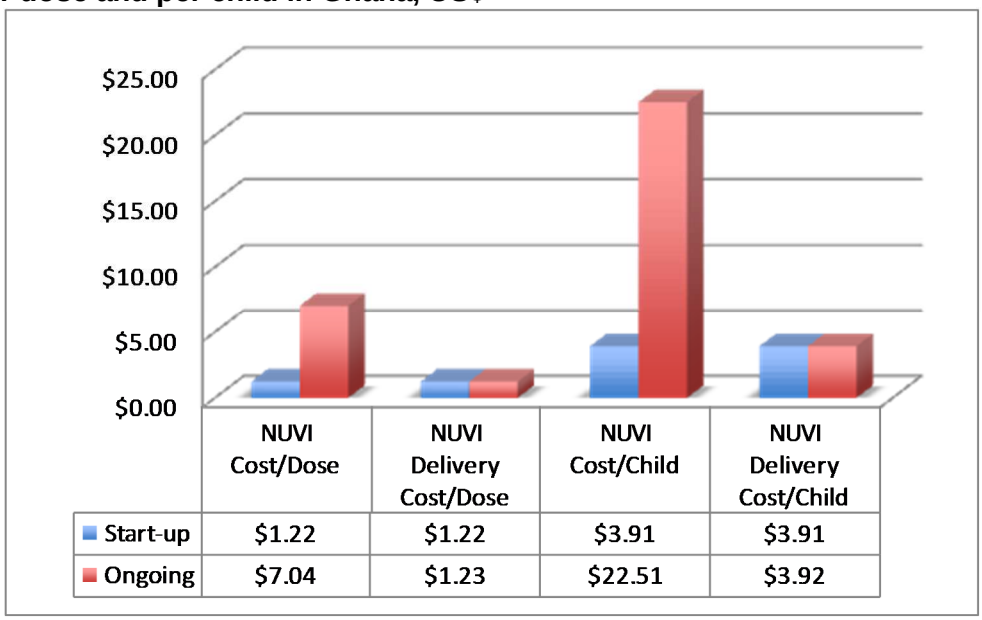
The total economic cost (start-up and ongoing) per NUVI dose administered represented 6.9 USD with programmatic representing 1.7 USD per dose. The cost per infant amounted to 26.9 USD with 4.0 for start-up programmatic costs (graph 9).

Graph 9: Distribution of new and underutilized vaccines introduction total costs in Ghana



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$

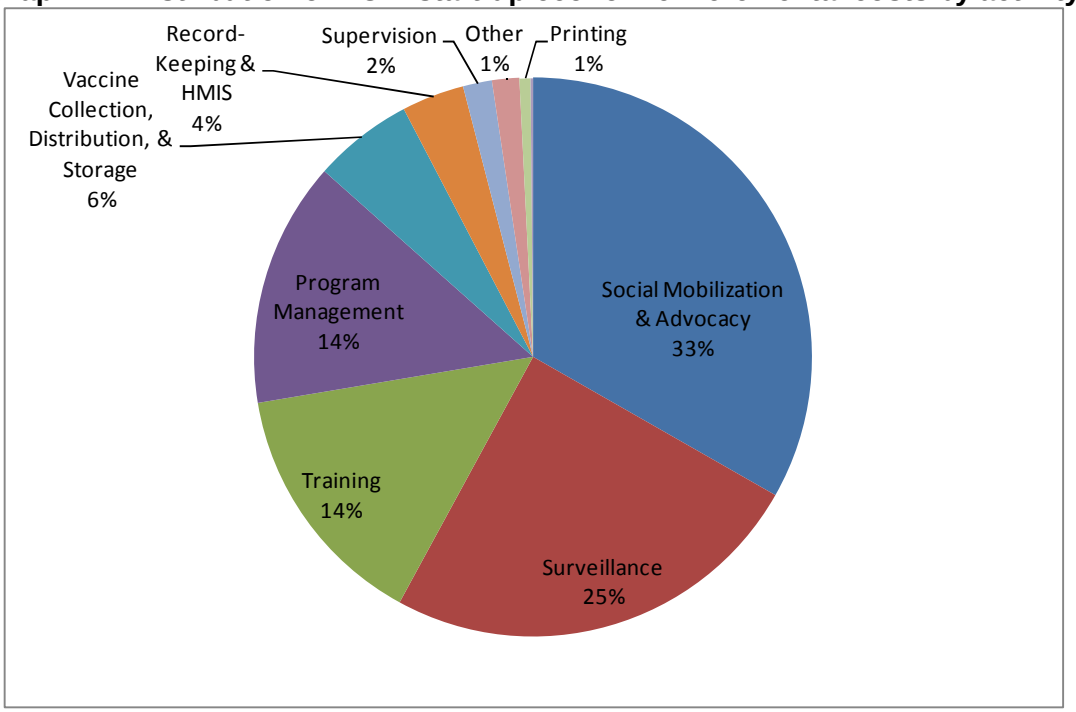


	NUVI Cost/Dose	NUVI Delivery Cost/Dose	NUVI Cost/Child	NUVI Delivery Cost/Child
Start-up	$1.22	$1.22	$3.91	$3.91
Ongoing	$7.04	$1.23	$22.51	$3.92

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%)

Graph 11: Distribution of NUVI start-up economic incremental costs by activity



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)

Type of cost \ Input	Cost (USD)	Distribution
On-going	**22,762,790**	**85.19%**
Fixed based delivery	914,416	3.42%
Outreach delivery	1,202,935	4.50%
Vaccine collection distribution and storage	20,645,440	77.27%
Start up	**3,956,321**	**14.81%**
Cold chain maintenance	5,806	0.02%
Other	61,891	0.23%
Outreach service delivery	0	0.00%
Program management	581,871	2.18%
Record-keeping & HMIS	143,026	0.54%
Facility-based delivery	0	0.00%
Social mobilization & advocacy	1,321,657	4.95%
Supervision	66,301	0.25%
Surveillance	975,036	3.65%
Training	571,888	2.14%
Vaccine collection, distribution, & storage	228,845	0.86%
Total	**26,719,111**	**100.00%**

Table 30: New vaccine introduction economic costs by Line Item (USD, 2011)

	Total Cost (2011$)	Percent of Cost
On-going	**22,762,790**	**85.19%**
cold chain energy cost	296,204	1.11%
cold chain equiment	1,549,177	5.80%
Salaried Labor	2,117,351	7.92%
vaccines	18,800,058	70.36%
Start up	**3,956,321**	**14.81%**
Building overhead, utilities, communication	164,461	0.62%
Cold Chain equipment	149,853	0.56%
Other	52,723	0.20%
other capital	27,021	0.10%
Other recurent	552,413	2.07%
Per diem & travel allowances	101,403	0.38%
Salaried Labor	2,634,785	9.86%
Transport & fuel	69,130	0.26%
Vehicles	90,073	0.34%
Volunteer labor	89,231	0.33%
Printing	25,229	0.09%
Total	**26,719,111**	**100.00%**

Table 31: New vaccine introduction fiscal costs by line item (USD, 2011)

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

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

Line item	Economic costs US$		Fiscal costs US$	
Start-up costs				
Salaried labor for introduction-related activities	2,634,785	7.92%	28 389*	0.09%
Other recurrent expenses**	552,413	2.07%	552,413	1.67%
Building overheads, utilities, communication	164,461	0.62%	157,007	0.48%
Per diem & travel allowances	101,403	0.38%	101,356	0.31%
Volunteer labor	89,231	0.33%		
Transport/fuel	69,130	0.26%	92,191	0.28%
Printing	25,229	0.09%	25,229	0.08%
New cold chain equipment	149,853	0.56%	1,531,426	4.64%
Vehicles	90,073	0.34%	584,000	1.77%
other capital	27,021	0.10%	100,000	0.30%
Other	52,723	0.20%	52,723	0.16%
On-going costs				
Salaried labor for new vaccines delivery	2,117,351	7.92%	-	-
Vaccines and supplies	18,800,058	70.36%	29,813,420	90.24%
Cold chain energy cost	296,204	1.11%	-	-
Cold chain equipment utilization	1,549,177	5.80%	-	-
Total start-up economic costs ***per doses administered***	3,956,321 *1.22*	14.81%	-	-
Total on-going economic costs (delivery) ***Per doses administered***	3,962,732 *1.23*	85.19%	-	-
Total economic delivery cost ***Per doses administered***	7,919,053 *2.45*			
Total fiscal costs	-	-	33,038,153	100%

**Hiring of coordinator for new vaccine introduction*
***Studies, new vaccines pilot, launch, AEFI surveillance*

Table 33: Cold chain equipment purchased specific to NUVI in Ghana

Number	Type of equipment (specify)	Brand name	Make year	Vaccine storage Capacity (m^3)	Funding sources
91	Refrigerator	TCW2000	2009	99 Liters	USAID, UNICEF, GAVI
98	Refrigerator	TCW3000	2009	126,5 Liters	USAID, UNICEF, GAVI
21	Freezers	TFW800	2009	247 Liters	USAID, UNICEF, GAVI
8	WICR	Dayard Europer	2006	30 m3	JICA
1	WICR	Dayard Europer	2006	40 m3	UNICEF
1	WICR	Dayard Europer	2006	40 m3	JICA

Table 34: Comparison of full needs and expenses for the new vaccine introduction (USD)

Line item / activity	NUVI Plan (2011 USD)	Study Fiscal Cost Estimate (2011 USD)	Variance
Training	40,000	79,668	-39,668
Social mobilization, IEC and advocacy	60,000	472,478	-412,478
Cold chain equipment & maintenance	300,000	1,531,426	-1,231,426
Vehicles and transportation	500,000	584,000	-84,000
Program management	50,000	62,495	-12,495
Surveillance	150,000	164,560	-14,560
Technical assistance	45,000	0	45,000
Injection safety and waste management	100,000	100,000	0
Total NUVI plan	1,245,000	2,994,627	-1,749,627
Additional staff hired (NUVI coordinator)		28,389	
Record-keeping and HMIS		134,880	-134,880
Supervision		24,957	-24,95
Vaccine collection		13,047	-13,047
Other		28,533	-3,244
	1,245,000	**3,224,733**	**-1,989,558**

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.

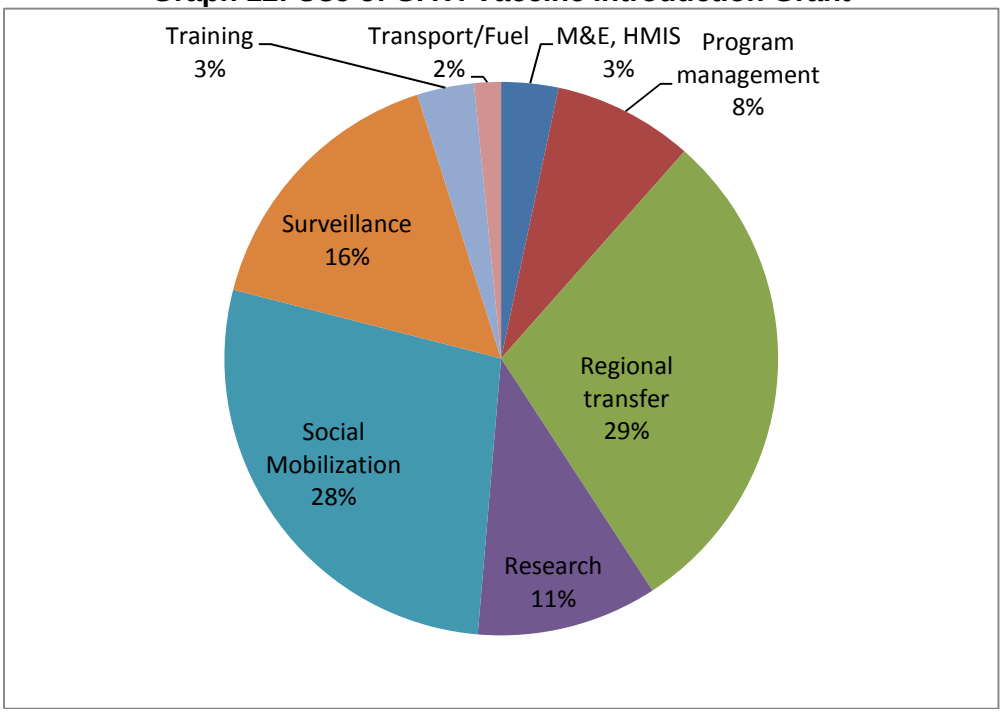
Table 35: External financing for NUVI in Ghana

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

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).

Graph 12: Use of GAVI Vaccine Introduction Grant



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”.

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 heath 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:
$$n_0 = \frac{Z^2 * p * q}{e^2}$$

Where a normal distribution is assumed, and:
n0 = 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
n0 = 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 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, CQi is the total facility immunization cost (including vaccine cost); FICi the Fully Immunized Child number expressed as a measure of production outcome; FTEi 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; Pi the average wage of staff as a price measure; and Zi 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 ovtest 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

Characteristics	Percentage
District (n = 50)	
Asante Akim South	14.0%
Atwima Mponua	12.0%
Bunkpurugu Yunyoo	12.0%
Ga West	16.0%
Kassena Nankana	20.0%
Wa Municipal	26.0%
Region (n = 50)	
Ashanti	26.0%
Greater	16.0%
Northern	12.0%
Upper East	20.0%
Upper West	26.0%
Type of facility (n = 50)	
CHPS	40.0%
Health Center	34.0%
Clinic	18.0%
RCH	8.0%
Ownership (n = 50)	
Government	94.0%
Christian Health Association Of Ghana (CHAG)	6.0%
Type of area (n = 50)	
Rural	78.0%
Urban	22.0%
State of roads from this facility to the outreach sites (n = 50)	
Tarred	10.0%
Graveled	26.0%
Not tarred	64.0%
Existence of Volunteers supporting immunization (n = 50)	
Yes	84.0%
No	16.0%
Cold chain equipment in facility (n = 50)	
Yes	68.0%
No	32.0%

Characteristics	Percentage
Way of disposing (n = 50)	
burning in a pit	58.0%
Transferred to / collected by DHMT	22.0%
sent to /collected by hospital or other health center	6.0%
Other	2.0%
Incinerator	8.0%
Not Applicable	4.0%
Users' fees (n = 50)	
Yes	54.0%
No	46.0%
Flood in the year (n = 50)	
Yes	34.0%
No	66.0%
Availability of public transportation (n = 50)	
Low	48.0%
Medium	34.0%
High	18.0%
Energy supply for cold chain (n = 50)	
Grid electricity	48.0%
Bottled gas	4.0%
Solar energy	8.0%
Not applicable	40.0%
Enough staff to perform RI well? (50)	
Strongly agree & Agree	64.0%
Others responses	32.0%
Missing	4.0%

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.

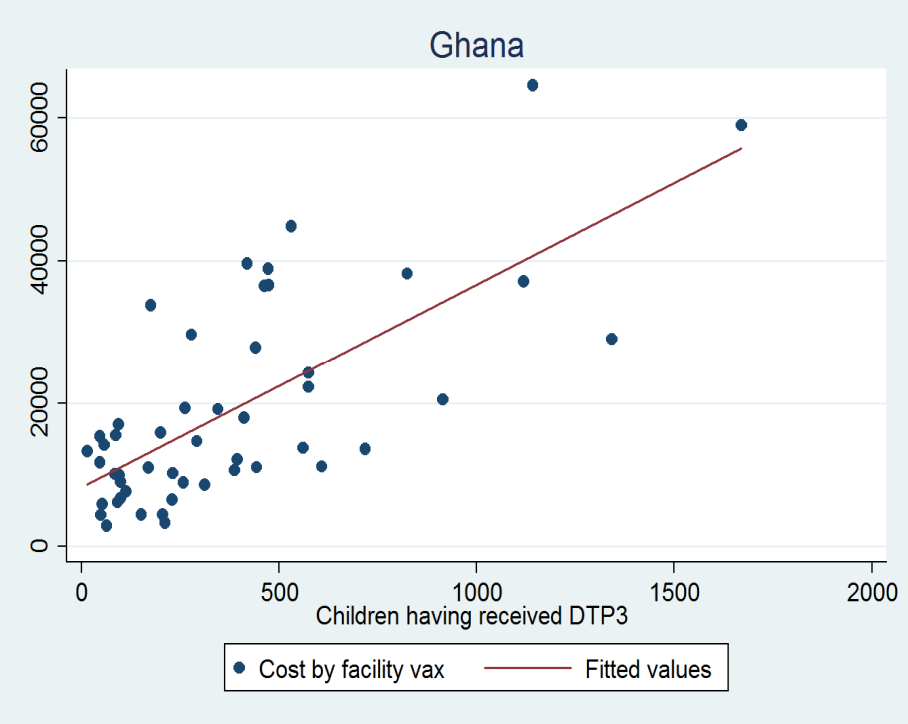
Table 37: Distribution of facilities as per some core continuous variables surveyed in Ghana

Characteristics	Weighted Mean	Std. Dev.
Total routine immunization costs (USD)	16,459.38	1,624.02
Total routine immunization cost, excluding vaccine costs (USD)	12,153.01	1,041.89
Children having received DTP-HepB-Hib dose 3 (defined as a fully immunized child)	321.09	40.76

Characteristics	Weighted Mean	Std. Dev.
Number of days of interruption due to flood	6.86	3.2
Total full-time equivalents working on routine immunization	1.76	0.16
Proportion of time on RI for personnel involved in immunization	34.67%	2.73%
Routine doses administered in 2011	3,244.52	411.47
Total number of facility staff	12.2	1.97
Number of campaigns in 2011	2.21	0.31
Average wage of staff per facility	432.55	10.94

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.

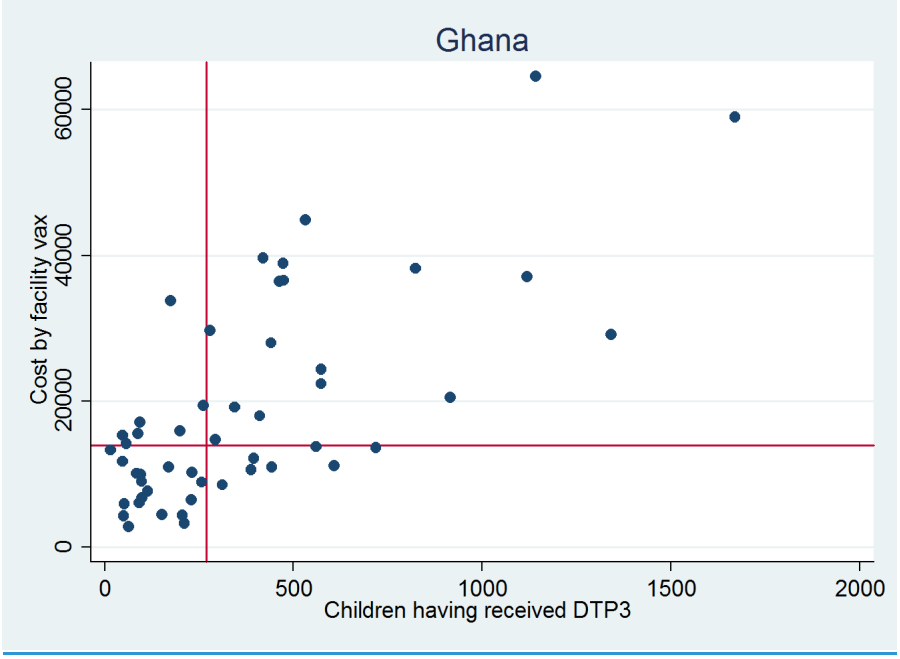
Graph 13: Total economic routine immunization Costs in USD (x axis) vs DTP3 vaccinated children (x axis), Ghana



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

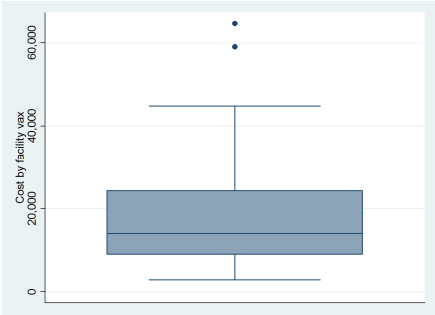
number fell in the northern-west area of 'counter-performance'. The vast majority of facilities fell in the intermediary northern-east and southern-west zones considered as neither performing nor counter-performing (Graph 14).

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

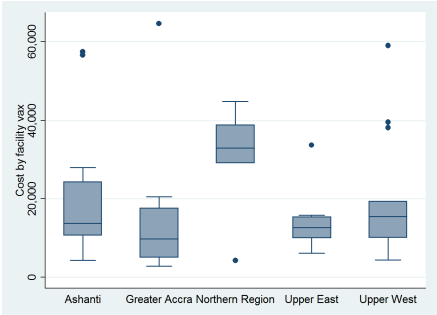


Various Whiskers plots of total economic costs, broken down by variables such as region, area type and facility type are presented (Graphs 15 to 18). These plots show the total economic cost is not normally distributed, because its means differ from medians and also the 25 and 75 percentiles are not 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.

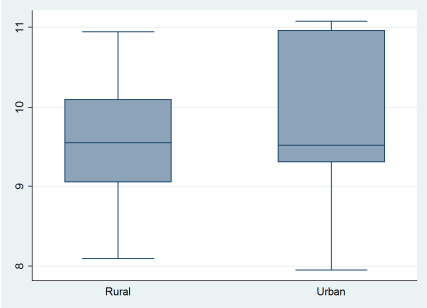
Graph 15: Box and Whiskers plot of Total Economic cost, Ghana



Graph 16: Box and Whiskers plot of Total Economic cost broken down by region, Ghana



Graph 17: Box and Whiskers plot of Total Economic cost broken down by type of area, Ghana



Graph 18: Box and Whiskers plot of Total Economic cost broken down by Type of facility, Ghana

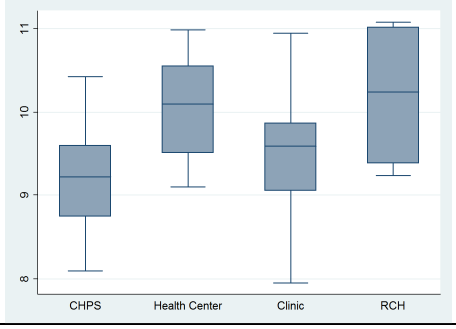


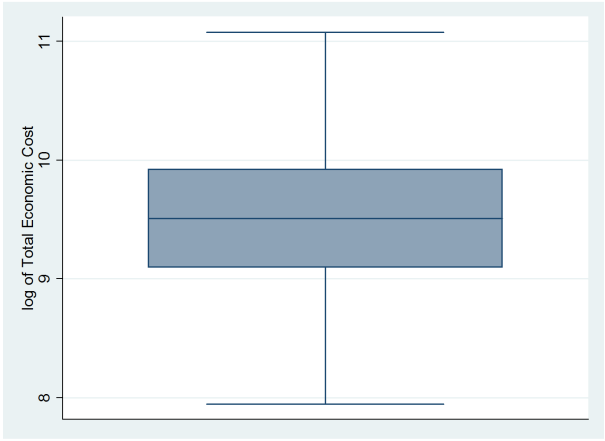
Table 38: Analysis of variances of Total cost, broken down as per some core categorical variables, Ghana

Characteristics	Mean	Std. Dev.	Freq.	ANOVA		Bartlett Test for equal variances	
				F	Prob > F	chi2(3)	Prob > B
1. Type of facility							
CHPS	11,881.84	8,048.84	20	5.36	0.0030**	13.0205	0.005**
Health Center	26,455.30	14,512.31	17				
Clinic	17,414.46	15,997.45	9				
RCH	36,501.16	28,476.34	4				
Total	19,802.23	15,814.30	50				
2. Region							
Ashanti	21,178.14	17,378.58	13	1.16	0.3425	7.2677	0.122
Greater Accra	16,529.47	20,276.02	8				
Northern Region	30,554.87	14,141.94	6				
Upper East	13,986.07	7,606.13	10				
Upper West	19,951.54	16,044.95	13				
Total	19,802.23	15,814.30	50				
3. District							
Asante Akim South	9,653.37	3,283.68	7	3.05	0.0188*	18.7960	0.002**
Atwima Mponua	34,623.71	17,578.65	6				
Bunkpurugu Yunyoo	30,554.87	14,141.94	6				
Ga West	16,529.47	20,276.02	8				
Kassena Nankana	13986.073	7,606.13	10				
Wa Municipal	19951.541	16,044.95	13				
Total	19802.232	15,814.30	50				

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

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



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

	(M0)	(M1)	(M2)	(M3)	(M4)	(M5)	(M6)	(M7)
A. log of Full Immunized Children	0.395***	0.420***	0.360***	0.356***	0.383***	0.391***	0.383***	0.423***
	(4.47)	(5.18)	(3.72)	(4.41)	(4.55)	(4.85)	(5.87)	(4.65)
B. log of Average dedication proportion time	0.432**	0.433**	0.458*	0.422*	0.445*	0.474**	0.429**	0.492*
	(3.37)	(2.94)	(2.63)	(2.25)	(2.41)	(2.79)	(3.14)	(2.65)
C. log of Average monthly wage of staff	0.608	0.609†	0.587	0.633	0.677†	0.505	0.442	0.418
	(1.51)	(1.98)	(1.53)	(1.68)	(1.75)	(1.28)	(1.21)	(1.05)
D. Enough staff to perform RI well (Yes =1/No =0)	0.511**	0.443*	0.448*	0.501**	0.488*	0.530**	0.443**	0.526**
	(3.05)	(2.67)	(2.57)	(2.79)	(2.51)	(3.11)	(3.03)	(2.97)
E. Region (Greater Accra =1/ Others= 0)		-0.438*						
		(-2.03)						
F. Type of facility (Health center used as reference)								
RCH			-0.120					
			(-0.56)					
CHPS			-0.144					
			(-0.57)					
Mission hospital			-0.382†					
			(-1.74)					
G. Ownership (Government =1/ Others=0)				-0.293				
				(-1.16)				
H. Location (Urban=1/Rural=0)					-0.141			
					(-0.66)			
I. User fees (Yes =1/No=0)						-0.188		
						(-1.13)		
J. Cold chain equipment in facility (Yes =1/No=0)							0.312*	
							(2.20)	
K. Existence of Volunteers supporting immunization (Yes =1/No=0)								0.260†
								(1.70)
Constant	3.930†	3.817†	4.418†	4.225†	3.586	4.677*	5.719*	4.730*
	(1.83)	(1.90)	(1.90)	(1.93)	(1.60)	(2.05)	(2.36)	(2.19)
r2	0.549	0.567	0.524	0.499	0.497	0.510	0.568	0.505
r2_a	0.502	0.543	0.440	0.439	0.437	0.451	0.529	0.446
N	48	48	48	48	48	48	48	48
df_r	43	42	40	42	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, 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)

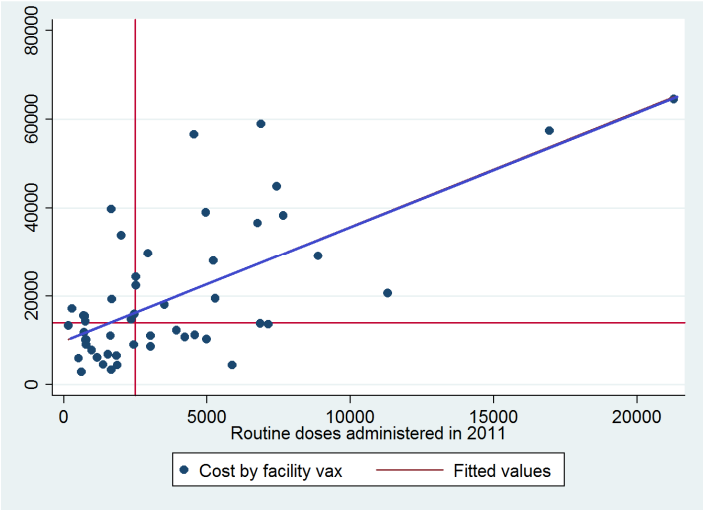
One can perceive from these figures that the total doses administered per FTE was 1 943 in Ghana. Whereas the doses per the total number of fully Immunized children was 10.24 (table 40).

Table 40: Productivity indicators computed for Ghana

Indicators	Ghana
1. Total doses administered in 2011 / FTE	1,943.51
2. Total doses/Total facility staff/working day	1.04
3. Doses per FIC	10.24

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



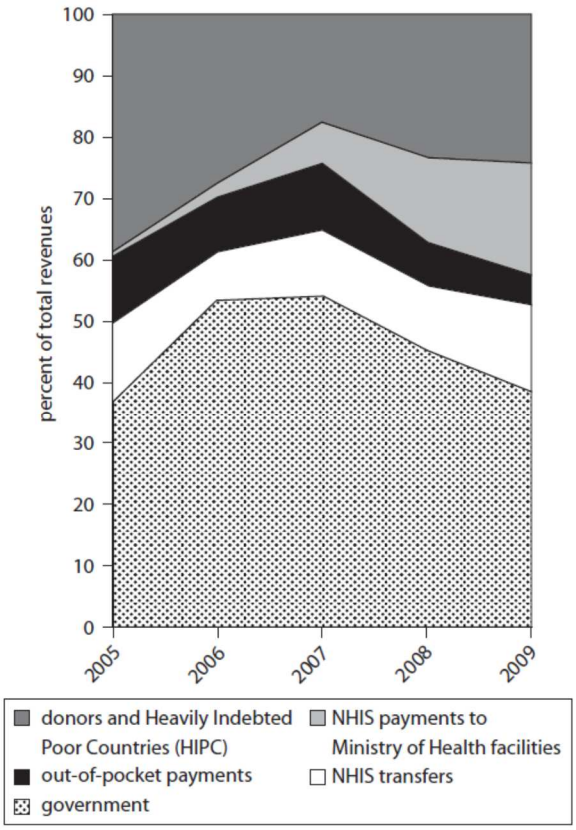
8. Analysis of Financial and commodity flows for routine immunization

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



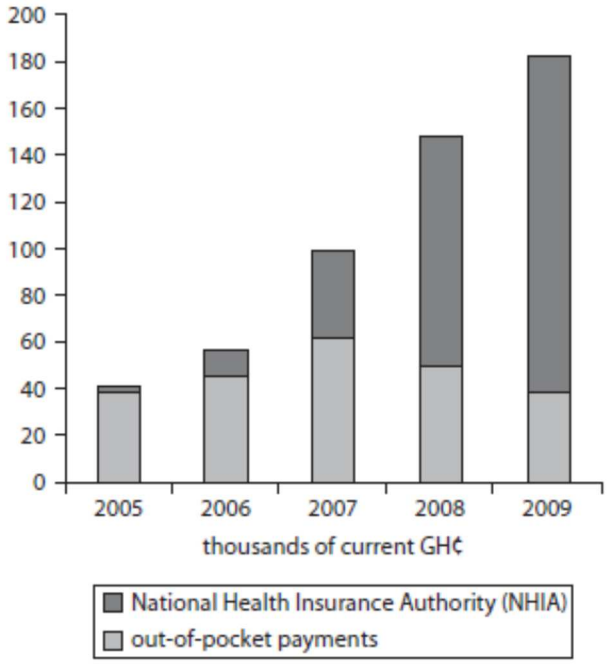
Graph extracted from "health financing in Ghana" (2), Source MOH

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 extracted from "health financing in Ghana" (2), Source MOH

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 41: Financial flow type and categories

Financial flow type	Categories
Funding Source (FS)	Transfers from government domestic revenue; Transfers distributed by government from foreign origin; Social insurance contributions; Compulsory prepayment; Voluntary prepayment; Direct foreign transfers
Financing Agent (FA)	General Government, Insurance Corporations, Other corporations, Non-profit institutions serving households, non-profit institutions serving households, households, Rest of the world (including bilateral and multilateral donors)
Health Financing Mechanism (HF)	Government schemes and compulsory contributory health care financing schemes, Voluntary health care payment schemes (other than OOP), Household out-of-pocket payment, Rest of the world.
Health Provider (HP)	Hospitals, Providers of ambulatory health care, Provider of

[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.

Financial flow type	Categories
	ancillary services, Providers of preventive care, Providers of health care system administration and financing, Rest of the economy, Rest of the world
Health Care Function (HC)	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.
Health Care Provision (FP)	Compensation of employees, Self-employed professional remuneration, materials and services used, consumption of fixed capital, other items of spending on inputs

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)

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

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)

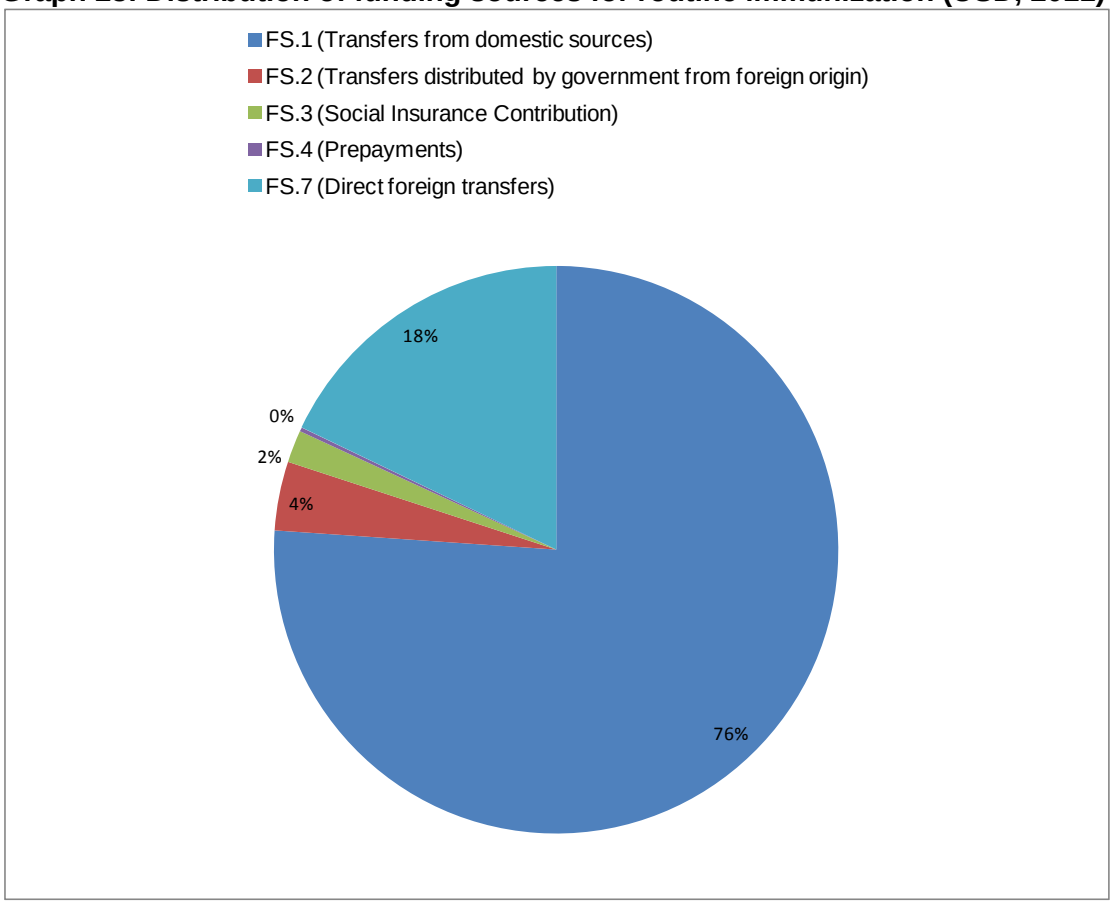


Table 43: Funding sources (FS) to financing agents (FA), 2011

	EPI program	Central MOH	District HA	GHS	Cold Stores	National Surveillance Agency	UNICEF	WHO	Total	Dist
Transfers from government domestic revenue										
FS.1.1 Internal transfers		30 881 135							30 881 135	61.85%
FS.1.1.1 Central transfers	14 686	112 214			2 542 471				2 669 372	5.35%
FS.1.1.2 within local			24 799						24 799	0.05%
FS.1.1.4 Regional transfer			4 416 113						4 416 113	8.84%
Transfers distributed by Government from foreign origin										
FS.2.1.1.1 **USAID**	147 220								147 220	0.29%
FS.2.1.2.1 **UNICEF**	4 473		167 811						172 284	0.35%
FS.2.1.2.2 **WHO**	131 769			665 784		38 510			236 063	0.47%
FS.2.1.3 **GAVI**			351 847	1 057 303					1 409 150	2.82%
Social Insurance contribution and compulsory prepayment										
FS.3 Social Insurance			925 335						925 335	1.85%
FS.4.1 User Fees			114 869						114 869	0.23%
Direct foreign aid in-kind										
FS.7.2.2.2.1 **UNICEF**							51 426		51 426	0.10%
FS.7.2.2.2.2 **WHO**								64 617	64 617	0.13%
FS.7.2.2.2.4 **GAVI**					8 740 169				8 740 169	17.50%
FS.7.2.2.3.3 **World Vision**			80 300						80 300	0.16%
TOTAL	298 147	30 993 349	6 081 075	1 123 087	11 282 640	38 510	51 426	64 617	49 932 852	100%

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)

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

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.

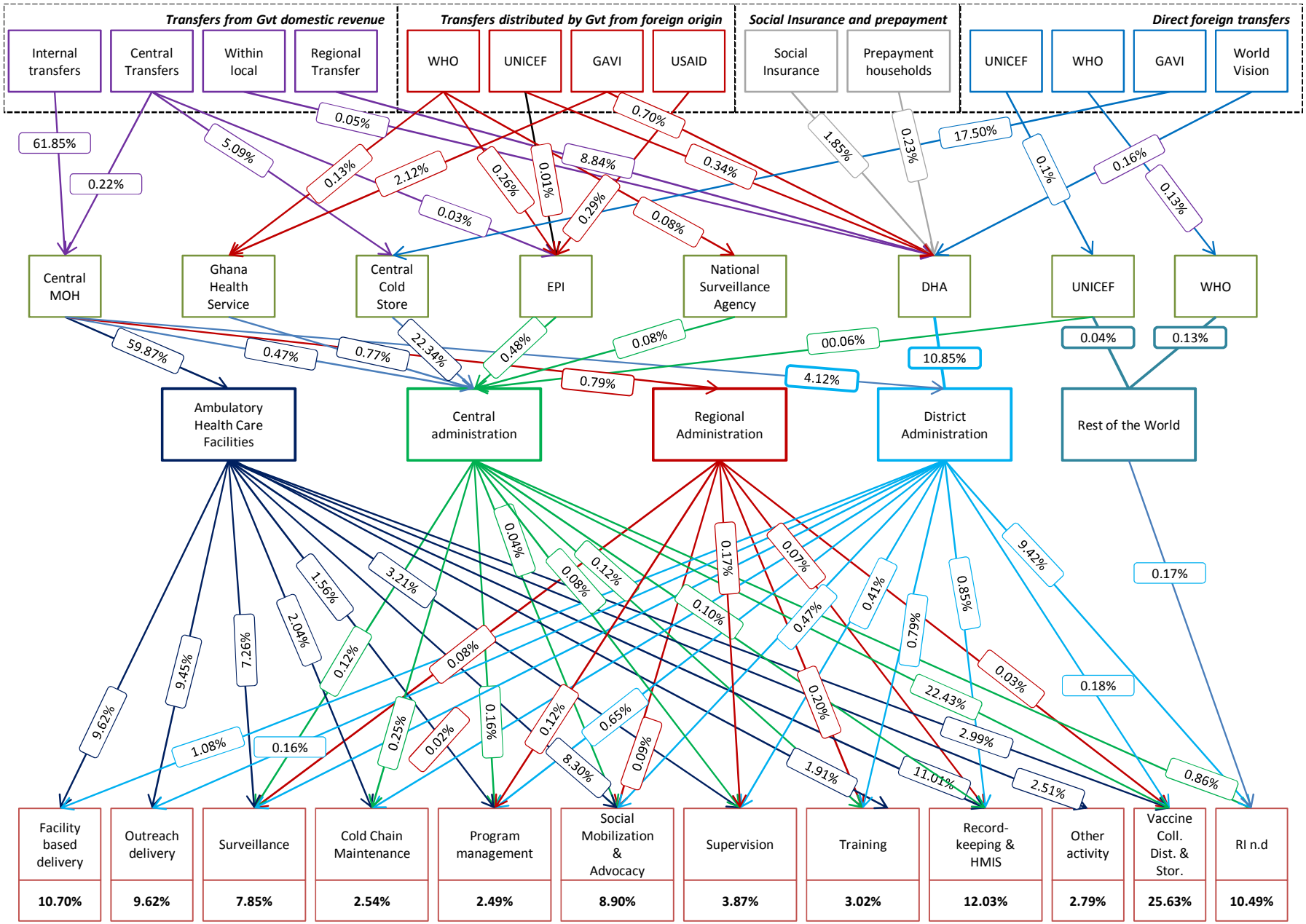
Table 45: Financing agents (FA) to health care financing mechanism (HF) (USD, 2011)

FA / HF	EPI program	Central MOH	DHA	GHS	Central Cold Stores	National Surveillance Agency	UNICEF	WHO	Total
Central government schemes	242 587	32 949 493	1 700 257	387 527	11 282 640	38 524			46 601 028
Community level financing			114 869						114 869
Compulsory contributory health insurance schemes			925 335						925 335
Rest of the world			265 548				51 426	64 617	381 590
State/regional/local government schemes			2 472 060						2 472 060
Total	**242 587**	**32 949 493**	**5 478 069**	**387 527**	**11 282 640**	**38 524**	**51 426**	**64 617**	**50 494 883**

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

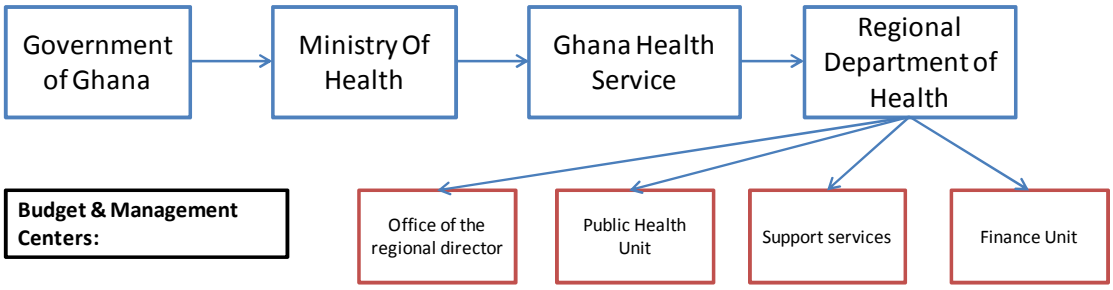
8.6.1.1. Central level perspective

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

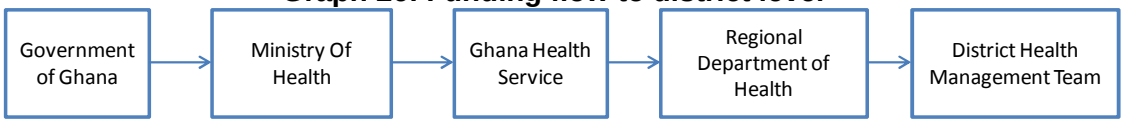


Funds are usually transferred to regions with a memo attached that provides them guidance on how the funds should be spent or to which institution they should be transferred. The RDH then disburses the funds to one of the four Budget and Management Centers (Office of the Regional Director, Public Health 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)[13], 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

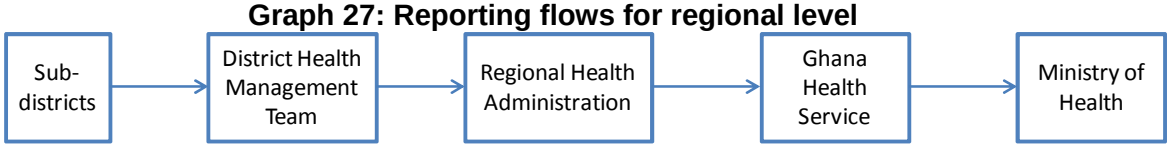
8.6.2.1. Central level

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.

[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 46: routine immunization activities supported by WHO and UNICEF

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

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

Main findings by topic

Nationwide routine immunization costs:

- ✓ The total aggregated costs for the routine immunization program amounted to 53.49 million USD in 2011
- ✓ The cost per dose administered was 5.7 USD
- ✓ The cost per FIC (DTP3-HepB-Hib) by administrative level was 60.30 USD
- ✓ The cost per infant in the country was 52.9 USD
- ✓ The cost per capita was 2.1 USD.
- ✓ 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).
- ✓ The unit cost per FIC (DTP3-HepB-Hib) aggregated is consistent with the unit cost per FIC of the sample
- ✓ Vaccine and injection supplies costs were captured at the central level and accounted for 19% of total costs.
- ✓ 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
- ✓ 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%).
- ✓ Outreach and Fixed delivery costs accounted for 21% of total cost (excluding vaccines)

Administrative offices costs for routine immunization:

- ✓ 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
- ✓ 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%)
- ✓ 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
- ✓ Program management, Surveillance, Supervision and Vaccine collection/distribution were the most important activities in terms of costs at the district health administration level.
- ✓ At regional level, the highest share in total cost is for vaccine/collection/distribution/storage

Routine Immunization facility-level costs:

- ✓ The unit cost per routine dose administered was 5.1 USD
- ✓ The cost per FIC (DTP3-HepB-Hib) was 51.3 USD
- ✓ The cost per infant population in the catchment area was 36.1 USD
- ✓ The main cost driver was salaried labor with 61%
- ✓ 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 vaccines & supplies cost)
- ✓ Almost half of the facility costs (47%) could be attributed to service delivery
- ✓ Outreach service delivery represented 25% of total facility costs and facility-based delivery 22% (including the value of vaccines)
- ✓ Cost of support activities (53%) is mostly driven by record-keeping, social mobilization and surveillance
- ✓ The cost per dose was lower in urban settings (3.2 USD in urban areas; 5.8 USD in rural areas)
- ✓ Outreach services are more mobilized by remote facilities and to target hard-to-reach population
- ✓ The share of volunteer labor is significantly higher in rural settings (4.9% vs. 2.6%)
- ✓ Similarly, the share of transportation and fuel is higher in rural settings

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 inexistent) 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

Main findings by topic
service delivery ✓ The view from donors is different as the main issue concerns the efficient spending of funds received by the recipients ✓ 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 ✓ According to regions, there is a lack of quality in financial reporting from districts

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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 Lonchey 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:

Activity	Definition
Routine facility-based service delivery:	Administering the vaccine to children within the facility/compound.
Outreach service delivery:	Administering the vaccine to children outside of the facility, travelling to and from a place for this purpose.
Record-keeping, Health Management Information System (HMIS), monitoring and evaluation:	Entering and analyzing data, including maintaining stock registers, maintaining records of children vaccinated, completing reports and analyzing, monitoring, and evaluating immunization program data.
Supervision:	Supervising subordinate or peer health or community workers.
Training:	Attending and/or providing immunization-related training.
Social mobilization and advocacy:	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.
Surveillance:	Following-up post-vaccination events and active cases of diseases that are prevented by vaccination.
Vaccine collection, distribution and storage:	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.
Program management:	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.
Cold chain maintenance:	Maintaining the cold chain at the respective level of analysis.
Vehicle maintenance:	Maintaining vehicles (of all types) used for immunization-related activities.
Other:	Other immunization-related activity not covered in the above categories.

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):

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

A4 - Vaccine prices of Ghana routine immunization schedule in 2011

Vaccine	Presentation	Vial Size (doses)	price per dose (USD)
BCG	Lyophilized	20	0.069
Polio	Liquid	20	0.13
Measles 1	Lyophilized	10	0.193
Yellow Fever	Lyophilized	5	0.66
Tetanus Toxoid	Liquid	10	0,085
Pentavalent DTP-HepB-Hib	Liquid	1	2.96

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 follow:

District	Rur. Gvt HC	Urb. Gvt HC	Rur. Miss HC	Urb. CHP	Rur. Gvt CHP	Urb. Gvt DH	Rur. Gvt Cli.	Urb. Gvt Cli.	Rur. Miss Cli.	Urb. MH	Urb. Miss Hosp	TOT	sample approx 50%
Asante Akim South	8	0	0	0	2	1	3	1	0	0	0	15	7
Atwima Mponua	5	0	1	0	2	1	0	0	1	0	0	10	6
Ga West	0	0	0	2	3	0	5	5	0	1	0	17	8
Bunkpurugu Yunyoo	4	0	1	0	6	0	0	0	0	0	1	12	6
Kassena Nankana	1	1	0	0	19	1	1	0	0	0	0	23	10
Wa Municipal	6	0	0	0	20	0	2	2	0	0	0	30	13
	24	1	2	1	52	3	12	9	1	1	1	107	50

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:

District	Rur. Gvt HC	Urb. Gvt HC	Rur. Miss HC	Urb. Gvt CHP	Rur. Gvt CHP	Urb. Gvt DH	Rur. Gvt Cli.	Urb. Gvt Cli.	Rur. Miss Cli.	Urb. MH	Urb.Miss DH	TOTAL
Asante Akim South	3	0	0	0	1	1	1	1	0	0	0	7
Atwima Mponua	2	0	1	0	1	1	0	0	1	0	0	6
Ga West	0	0	0	1	2	0	2	2	0	1	0	8
Bunkpurugu Yunyoo	2	0	1	0	2	0	0	0	0	0	1	6
Kassena Nankana	1	1	0	0	6	1	1	0	0	0	0	10
Wa Municipal	4	0	0	0	7	0	1	1	0	0	0	13
	12	1	2	1	19	3	5	4	1	1	1	50

A6 - List of facilities in the survey

The following facilities were selected as replacement facilities: Nachanta, Doba, Gia, Adomfe, Nnadieso, Bimbagu, Nasua, and Boli.

District		Facility Name	Strata
Asante Akim South	1	Banso CHPS (linked with Ofoase HC*)	Rural Government CHPS
	2	Juaso RCH/FP	Urban Government Clinic
	3	Kyempo Epi Centre	Rural Government Clinic
	4	Juaso District Hospital	Urban Government District Hospital
	5	Banka Health Centre	Rural Government Health Centre
	6	Dwendwenase Health Centre	Rural Government Health Centre
	7	Ofoase Health Centre *	Rural Government Health Centre
Atwima Mponua	8	Ahyiresu CHPS Compound (linked with Gyereso HC*)	Rural Government CHPS
	9	St Peters (atwima Mponua) Clinic	Rural CHAG Clinic
	10	Nyinahin Hospital	Urban Government District Hospital
	11	Anglican Health Centre	Rural CHAG Health Centre
	12	Gyereso Health Center*	Rural Government Health Center
	13	Bayerebon Health Centre	Rural Government Health Center
Ga West	14	Akramaman CHPS	Rural Government CHPS
	15	Nsakina CHPS	Rural Government CHPS
	16	Pokuase CHPS	Urban Government CHPS
	17	Oduman Community Clinic	Rural Government Clinic
	18	Afiaman Outreach Clinic	Rural Government Clinic
	19	Kojo Ashong Community Clinic	Urban Government Clinic
	20	Mayera Faase Community Clinic	Urban Government Clinic
	21	Ga West Municipal Hospital	Urban Government Municipal Hospital
Bunkpurugu Yunyoo	22	Kambagu CHPS (linked with Bunkpurugu HC*)	Rural Government CHPS
	23	Mozio CHPS (linked with Yunyoo HC*)	Rural Government CHPS
	24	Binde Rural Hospital	Urban CHAG Hospital
	25	Nakpanduri Health Centre	Rural CHAG Health Center
	26	Bunkpurugu Heakth Centre *	Rural Government Health Centre
	27	Yunyoo Heakth Centre*	Rural Government Health Centre
Kassena Nankana	28	Biu CHC (linked with Kologo HC*)	Rural Government CHPS
	29	Gongnia Chc (linked with Navrongo HC*)	Rural Government CHPS
	30	Korania CHC (No HC Center in sub district Wuru)	Rural Government CHPS
	31	Nayagnia Chc (No HC in sub district Navrongo East))	Rural Government CHPS
	32	Vunania Chc (No HC in Vunania/Kpania)	Rural Government CHPS
	33	Wuru Chc (No HC Center in sub district Wuru)	Rural Government CHPS
	34	Biu St. Martins Clinic	Rural Government Clinic

District		Facility Name	Strata
	35	War Memorial Hospital	Urban Government District Hospital
	36	Kologo Health Centre*	Rural Government Health Centre
	37	Navrongo Health Centre*	Urban Government Health Centre
Wa Municipal	38	Dondoli CHPS (linked with Wa Central HC*)	Rural Government CHPS
	39	Gbegru CHPS (linked with Charingu HC*)	Rural Government CHPS
	40	Konjiehi CHPS (linked with Charingu HC*)	Rural Government CHPS
	41	Kperisi CHPS (linked with Charingu HC*)	Rural Government CHPS
	42	Kunbiehi CHPS (linked with Wa Central HC*)	Rural Government CHPS
	43	Mangu/Sombo CHPS (linked with Kambali HC*)	Rural Government CHPS
	44	Piisi (wa) CHPS (linked with Bamahu HC)	Rural Government CHPS
	45	Bamahu Health Center*	Rural Government Health Centre
	46	Charingu Health Center*	Rural Government Health Centre
	47	Kambali Health Center*	Rural Government Health Centre
	48	Wa Urban Health Center*	Rural Government Health Centre
	49	Konta North Clinic	Rural Government Clinic
	50	Wa Market Clinic	Urban Government Clinic

A7 - Sample weights by district and facility or other area used in the analysis
Sampling weights = inversed probability of being selected

District	Name of facility	Sampling weight
Asante Akim South	Juaso RCH/DH	29
	Kyempo Epi Centre	87
	Banka Health Centre	68
	Dwendwenase Health Centre	68
	Ofoase Health Centre *	68
	nnadieso	29
	adomfe	58
	TOTAL ASANTE AKIM SOUTH	**319**
Atwima Mponua	Ahyiresu CHPS Compound (linked with Gyereso HC*)	48
	St Peters (atwima Mponua) Clinic	24
	Nyinahin Hospital	24
	Anglican Health Centre	24
	Gyereso Health Center*	60
	Bayerebon Health Centre	60
	TOTAL ATWIMA MPONUA	**240**
Ga West	Akramaman CHPS	24
	Nsakina CHPS	24
	Pokuase CHPS	32
	Oduman Community Clinic	48
	Afiaman Outreach Clinic	48
	Kojo Ashong Community Clinic	40
	Mayera Faase Community Clinic	40
	Ga West Municipal Hospital	16
	TOTAL GA WEST	**272**
Bunkpurugu Yunyoo	Kambagu CHPS (linked with Bunkpurugu HC*)	60
	Nakpanduri Health Centre	24
	Bunkpurugu Heakth Centre *	36
	Yunyoo Heakth Centre*	36
	Bimbagu CHPS	60
	Nasuan Health Center	24
	TOTAL BUNKPURUGU YUNYOO	**156**
Kasena Nankana	Gongnia Chc (linked with Navrongo HC*)	75
	Nayagnia Chc (No HC in sub district Navrongo East))	75
	Vunania Chc (No HC in Vunania/Kpania)	75
	Wuru Chc (No HC Center in sub district Wuru)	75
	Biu St. Martins Clinic	29
	War Memorial Hospital	29
	Kologo Health Centre*	29
	Navrongo Health Centre*	29
	doba	75
	gia	75

District	Name of facility	Sampling weight
	TOTAL KASSENA NANKANA	**414**
Wa Municipal	Dondoli CHPS (linked with Wa Central HC*)	43
	Gbegru CHPS (linked with Charingu HC*)	43
	Kperisi CHPS (linked with Charingu HC*)	43
	Kunbiehi CHPS (linked with Wa Central HC*)	43
	Piisi (wa) CHPS (linked with Bamahu HC)	43
	Bamahu Health Center*	24
	Charingu Health Center*	24
	Kambali Health Center*	24
	Wa Urban Health Center*	24
	Konta North Clinic	32
	Wa Market Clinic	32
	boli CHPS	43
	nachanta CHPS	43
	TOTAL WA MUNICIPAL	**377**
	ALL	2185

A8 - Coding for financial flow analysis : Funding sources

FS. CODE	FS. Descritpion
FS.1	Transfers from government domestic revenue
FS.1.1	Internal transfers and grants
FS.1.1.1	- Internal transfers within central government
FS.1.1.2	- Internal transfers within region/local government
FS.1.1.3	- Grants from central government
FS.1.1.4	- Grants from regional/local government
FS.1.2	Transfers by government on behalf of specific groups
FS.1.3	Subsidies
FS.1.4	Other transfers
FS.2	Transfers distributed by government from foreign origin
FS.2.1	Monetary transfers
FS.2.1.1	- from bilateral organizations
FS.2.1.1.1	- USG bilateral financial transfer
FS.2.1.1.2	- DfiD bilateral financial transfer
FS.2.1.1.3	- JICA bilateral financial transfer
FS.2.1.1.4	- NORAD bilateral financial transfer
FS.2.1.1.5	- Other agency bilateral financial transfer (Specify)
FS.2.1.2	- from multilateral organizations
FS.2.1.2.1	- from UNICEF direct financial transfer
FS.2.1.2.2	- from WHO direct financial transfer

FS. CODE	FS. Descritpion
FS.2.1.2.3	- from PAHO direct financial transfer
FS.2.1.2.4	- from Other multilateral financial transfer (Specify)
FS.2.1.3	- from GAVI Alliance
FS.2.1.4	- from other sources
FS.2.1.4.1	- from BMGF financial transfers
FS.2.1.4.2	- from CHAI financial transfers
FS.2.1.4.3	- from other external/NGO source financial transfers (Specify)
FS.2.2	Commodity transfers
FS.2.2.1	- from bilateral organizations
FS2.2.1.1	- USG bilateral commodity transfer
FS.2.2.1.2	- DfiD bilateral commodity transfer
FS.2.2.1.3	- JICA bilateral commodity transfer
FS.2.2.1.4	- NORAD bilateral commodity transfer
FS.2.2.1.5	- Other agency bilateral commodity transfer (Specify)
FS.2.2.2	- from multilateral organizations
FS.2.2.2.1	- from UNICEF commodity transfers
FS.2.2.2.2	- from WHO commodity transfers
FS.2.2.2.3	- from PAHO commodity transfers
FS.2.2.2.4	- from other external/NGO source commodity transfers (Specify)
FS.2.2.3	- from GAVI Alliance
FS.2.2.4	- from other sources
FS.2.2.4.1	- from BMGF commodity transfers
FS.2.2.4.2	- from CHAI commodity transfers
FS.2.2.4.3	- from other external/NGO source commodity transfers (Specify)
FS.3	Social insurance contributions
FS.3.1	Social insurance contributions from employers
FS.3.2	Social insurance contributions from employees
FS.3.3	Social insurance contributions from self-employed
FS.3.4	Other social insurance contributions
FS.4	Compulsory prepayment
FS.4.1	Compulsory prepayment from households/individuals
FS.4.2	Compulsory prepayment from employers
FS.4.3	Other
FS.5	Voluntary prepayment
FS.5.1	Voluntary prepayment from households/individuals
FS.5.2	Voluntary prepayment from employers
FS.5.3	Other
FS.6	Other domestic revenues not elsewhere classified (n.e.c)
FS.6.1	Other revenues from households n.e.c
FS.6.2	Other revenues from communities n.e.c
FS.7	Direct foreign transfers
FS.7.1	Direct foreign financial transfers

FS. CODE	FS. Descritpion
FS.7.1.1	Direct bilateral transfers
FS.7.1.2	Direct multilateral transfers
FS.7.1.3	Other direct foreign transfers
FS.7.2	Direct foreign aid in kind
FS.7.2.1	Direct foreign aid in goods
FS.7.2.1.1	Direct bilateral aid in goods
FS.7.2.1.2	Direct multilateral aid in goods
FS.7.2.1.3	Other direct foreign aid in goods
FS.7.2.2	Direct foreign aid in kind: services (including TA)
FS.7.2.2.1	Direct bilateral foreign aid in kind
FS.7.2.2.1.1	- from USG bilateral aid in kind
FS.7.2.2.1.2	- from DfID bilateral aid in kind
FS.7.2.2.1.3	- from JICA bilaeral aid in kind
FS.7.2.2.1.4	- from NORAD bilateral aid in kind
FS.7.2.2.1.5	- from other bilateral aid in kind (Specify)
FS.7.2.2.2	Direct multilateral foreign aid in kind
FS.7.2.2.2.1	- from UNICEF aid in kind
FS.7.2.2.2.2	- from WHO aid in kind
FS.7.2.2.2.3	- from PAHO aid in kind
FS.7.2.2.2.4	- from other multilateral aid in kind GAVI Alliance
FS.7.2.2.3	Other direct foreign aid in kind
FS.7.2.2.3.1	- from BMGF aid in kind
FS.7.2.2.3.2	- from CHAI aid in kind
FS.7.2.2.3.3	- from Worldvision direct foreign aid in kind
FS.7.3	Other direct foreign transfers n.e.c
FS.7.9	Any other source not elsewhere classifiec (n.e.c)
FSR.1	Loans
FSR.1.1	Loans taken by government
FSR.1.1.1	Loans from international organizations
FSR.1.1.1.1	Concessional loans
FSR.1.1.1.2	Non-consessional loans
FSR.1.1.1.3	HIPC/Debt relief
FSR.1.1.2	Other loans taken by government
FS.RI.1	Institutional units providing revenues to financing schemes
FS.RI.1.1	Government
FS.RI.1.2	Corporations
FS.RI.1.3	Households
FS.RI.1.4	Non-profit institutions
FS.RI.1.5	Rest of the world
FS.RI.2	Total foreign revenues (FS.2 + FS.7)

A9 - Financing Agents Codes

FA.CODE	FA.Description
FA.1	General Government
FA.1.1	Central Government Agencies
FA.1.1.1	Central Ministry of Health:
FA.1.1.1.1	Central Ministry of Health (DCD / EPI programme)
FA.1.1.1.2	Central Ministry of Health (other programmes)
FA.1.1.1.3	National Medical Stores / Central Cold Stores
FA.1.1.1.4	National Laboratories
FA.1.1.1.5	National Surveillance Agency
FA.1.1.2	Other Central Ministries and Units
FA.1.1.3	National Health Service Agency (GHS)
FA.1.1.4	National Health Insurance Agency
FA.1.2	State/Regional/Local Govt Agents
FA.1.2.1	Provincial Level Ministry of Health
FA.1.2.2	Other Provincial Level Ministries/Departments
FA.1.2.3	District Level Ministry of Health
FA.1.2.4	Other District Level Ministries/Departments
FA.1.3	Social Security Agency
FA.1.3.1	Social Health Insurance Agency
FA.1.3.2	Other social security agency
FA.1.9	All other general government unit
FA.2	Insurance Corporations
FA.3	Other Corporations /Business (other than insurance)
FA.4	Non-Profit Institutions Serving Households
FA.5	Households
FA.5.1	Community organizations/groups
FA.6	Rest of the World
FA.6.1	International Organisations (Multilaterals)
FA.6.1.1	UNICEF
FA.6.1.2	WHO
FA.6.1.3	PAHO
FA.6.1.4	Other multilateral agent 1
FA.6.1.5	Other multilateral agent 2
FA.6.1.6	Other multilateral agent 3
FA.6.2	Foreign Govts (Bilateral Agents)
FA.6.2.1	Govt of USA: PEPFAR, CDC, USAID etc
FA.6.2.2	Govt of United Kingdom:

FA.CODE	FA.Description
FA.6.2.3	Govt of Japan (JICA):
FA.6.2.4	Govt of Norway (NORAD):
FA.6.2.5	Other bilateral agency 1
FA.6.2.6	Other bilateral agency 2
FA.6.2.7	Other bilateral agency 3
FA.6.3	Other Foreign Entities
FA.6.3.1	BMGF
FA.6.3.2	CHAI
FA.6.3.3	Other International Foundation 1
FA.6.3.4	Other International Foundation 2
FA.6.3.5	Other International Foundation 3
FA.9	Any other agents not else where classified

A10 - Health financing mechanism codes

HF.CODE	HF.Description
HF.1	Government schemes and compulsory contributory health care financing schemes
HF.1.1	Government schemes
HF.1.1.1	Central government schemes
HF.1.1.2	State/regional/local government schemes
HF.1.2	Compulsory contributory health insurance schemes
HF.1.2.1	Social health insurance
HF.1.3	Compulsory medical savings accounts
HF.2	Voluntary health care payment schemes (other than OOP)
HF.2.1	Voluntary health insurance schemes
HF.2.2	Non-profit institutions financing schemes (NPISH)
HF.3	Household out-of-pocket payment
HF.3.1	Community level financing
HF.4	Rest of the world
HF.99	Not disaggregated

A11 - Health Providers codes

HP.CODE	HP.Description
HP.1	Hospitals
HP.1.1	General hospitals
HP.1.1.1	General hospitals - public
HP.1.1.1.1	National general hospitals
HP.1.1.1.2	Provincial or regional general hospitals

HP.CODE	HP.Description
HP.1.1.1.3	District hospitals
HP.1.1.2	General hospitals - social security
HP.1.1.3	General hospitals - NGO/private non-profit
HP.3	Providers of ambulatory health care
HP.3.1	Medical practices
HP.3.4	Ambulatory health care centres
HP.3.4.9	All other ambulatory centres
HP3.4.9.1	Government facilities
HP.3.4.9.3.1	PHC Type 1 (Health Centre)
HP.3.4.9.3.2	PHC Type 2 (CHPS)
HP.3.4.9.3.3	PHC Type 3 ()
HP.3.4.9.3.4	PHC Type 4 (Specify)
HP.3.4.9.2	Social security facilities
HP.3.4.9.3	NGO facilities
HP.4	Providers of ancillary services
HP.4.2	Medical and diagnostic laboratories
HP.6	Providers of preventive care
HP.6.1	Country Specific Preventative providers
HP.6.2	Research Providers
HP.6.2.1	Public research institutions
HP.6.2.2	Para-statal (quazi-public) research institutions
HP.6.2.3	Private research institutions
HP.7	Providers of health care system administration and financing
HP.7.1	Government health administrative agencies
HP.7.1.1	National MOH
HP.7.1.2	Provincial MOH
HP.7.1.3	District MOH
HP.7.2	Social health insurance agencies
HP.7.3	Private health insurance administrative agencies
HP.7.9	Other administrative agencies
HP.8	Rest of the economy
HP8.1	Households as providers of home health care
HP.8.9	Other industries n.e.c
HP.9	Rest of the world
HP.99	Not classified elsewhere

A12 - Health Care Functions codes

HC.CODE	HC.Description
HC.1	Curative care

HC.CODE	HC.Description
HC.6	Preventive care
HC.6.1	Information, education and counseling programmes
HC.6.1.1	Social mobilization, advocacy
HC.6.2	Immunization programmes
HC.6.2.1	Facility-based routine immunization service delivery
HC.6.2.2	Outreach routine immunization service delivery
HC.6.2.3	Training
HC.6.2.4	Vaccine collection, storage and distribution
HC.6.2.5	Cold chain maintenance
HC.6.2.6	Supervision
HC.6.2.7	Program management
HC.6.2.8	Other routine immunization programme activity
HC.6.5	Surveillance
HC.6.5.1	EPI Surveillance
HC.6.6	Record-keeping and HMIS
HC.7	Governance and health system financing and administration
HC.99	Not disaggregated
HC.RI.3	Prevention and public health services
HC.RI.3.3	Prevention of communicable diseases

A13 - Health-Care Provisions

FP.CODE	FP.Description
FP.1	Compensation of employees
FP.1.1	Wages and salaries
FP.1.3	All other costs relating to employees
FP.1.3.1	Per diem
FP.2	Self-employed professional remuneration
FP.2.1	Volunteer labour
FP.3	Materials and services used
FP.3.1	Health care services
FP.3.2	Health care goods
FP.3.2.1	Pharmaceuticals
FP.3.2.1.1	Vaccines and other goods
FP.3.2.2	Other health care goods
FP.3.2.2.1	Injection supplies
FP.3.2.2.2	Other supplies
FP.3.3	Non-health care services
FP.3.3.1	Transport
FP.3.3.2	Maintenance
FP.3.3.3	Printing
FP.3.4	Non-health care goods
FP.3.4.1	Utilities and communications
FP.3.4.2	Other
FP.4	Consumption of fixed capital
FP.4.1	Cold chain equipment
FP.4.2	Vehicles
FP.4.3	Other equipment
FP.4.4	Buildings
FP.5	Other items of spending on inputs
FP.5.1	Taxes and customs duties
FP.5.2	Other
FP.99	Not disaggregated/n.e.c

A 14 – Economic and financial costs at facility level, by activity and facility type

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

Facility type \ Activity	Economic	Financial
CHPS	**12 778 USD**	**9 701 USD**
Cold Chain Maintenance	291 USD	291 USD
Other	667 USD	659 USD
Outreach Service Delivery	2 574 USD	1 526 USD
Program Management	121 USD	117 USD
Record-Keeping & HMIS	1 920 USD	1 597 USD
Routine Facility-based Service Delivery	2 098 USD	970 USD
Social Mobilization & Advocacy	1 586 USD	1 309 USD
Supervision	461 USD	447 USD
Surveillance	1 991 USD	1 857 USD
Training	250 USD	189 USD
Vaccine Collection, Distribution, & Storage	818 USD	741 USD
Clinic	**12 885 USD**	**10 056 USD**
Cold Chain Maintenance	157 USD	157 USD
Other	31 USD	31 USD
Outreach Service Delivery	3 434 USD	2 537 USD
Program Management	159 USD	159 USD
Record-Keeping & HMIS	1 399 USD	1 393 USD
Routine Facility-based Service Delivery	2 862 USD	1 348 USD
Social Mobilization & Advocacy	1 867 USD	1 725 USD
Supervision	889 USD	871 USD
Surveillance	1 069 USD	879 USD
Training	233 USD	233 USD
Vaccine Collection, Distribution, & Storage	785 USD	722 USD
Health Centre	**22 989 USD**	**12 573 USD**
Cold Chain Maintenance	536 USD	536 USD
Other	823 USD	722 USD
Outreach Service Delivery	7 485 USD	1 596 USD
Program Management	515 USD	514 USD
Record-Keeping & HMIS	2 160 USD	2 123 USD
Routine Facility-based Service Delivery	5 248 USD	2 223 USD
Social Mobilization & Advocacy	1 729 USD	1 391 USD
Supervision	701 USD	689 USD
Surveillance	1 280 USD	822 USD
Training	689 USD	679 USD
Vaccine Collection, Distribution, & Storage	1 823 USD	1 276 USD
RCH	**26 743 USD**	**15 755 USD**
Cold Chain Maintenance	246 USD	246 USD
Other	16 USD	16 USD
Outreach Service Delivery	5 428 USD	2 047 USD
Program Management	597 USD	597 USD
Record-Keeping & HMIS	4 271 USD	4 119 USD
Routine Facility-based Service Delivery	12 341 USD	5 346 USD
Social Mobilization & Advocacy	905 USD	680 USD
Supervision	754 USD	754 USD
Surveillance	1 369 USD	1 160 USD
Training	344 USD	344 USD
Vaccine Collection, Distribution, & Storage	471 USD	445 USD

A 15 – Nationwide economic total and unit costs by activity (US$, 2011)

Total costs by activity (Economic Costs USD, 2011)

	Facilities	District Health Administration	Regional Health Administration	Central EPI	Total routine immunization costs	Percent Distribution
Cold chain maintenance	1 030 467	111 145	18 095	46 500	1 206 207	2,23%
Other	1 745 983	409 273	61 020	15 971	2 232 246	4,18%
Outreach service delivery	5 488 246	0	0	0	5 488 246	10,16%
Program management	809 867	880 277	158 973	102 229	1 951 346	3,80%
Record-keeping & HMIS	6 107 476	453 237	39 322	13 545	6 613 579	12,25%
Routine facility-based service delivery	5 570 428	0	0	0	5 570 428	10,32%
Social mobilization & advocacy	5 012 898	559 570	45 543	156 756	5 774 767	11,04%
Supervision	1 887 611	678 372	101 658	72 534	2 740 174	5,10%
Surveillance	4 844 307	807 339	78 979	8 905	5 739 530	10,70%
Training	1 161 962	255 951	76 375	19 790	1 514 078	3,03%
Vaccine collection, distribution, & storage	3 335 341	653 302	348 618	10 324 422	14 661 684[14]	27,19%
Total	36 994 586	4 808 465.51	928 582	10 760 651	53 492 285	100%

[14] Includes vaccines and Injection supplies

Cost per routine dose administered by activity (USD, 2011)

	Facilities	District Health Administration	Regional Health Administration	Central EPI	Total routine immunization costs
Cold Chain Maintenance	0,11	0,01	0,00	0,00	0,13
Other	0,18	0,04	0,01	0,00	0,24
Outreach Service Delivery	0,58	0,00	0,00	0,00	0,58
Program Management	0,09	0,09	0,02	0,01	0,21
Record-Keeping & HMIS	0,65	0,05	0,00	0,00	0,70
Routine Facility-based Service Delivery	0,59	0,00	0,00	0,00	0,59
Social Mobilization & Advocacy	0,53	0,06	0,00	0,02	0,61
Supervision	0,20	0,07	0,01	0,01	0,29
Surveillance	0,51	0,09	0,01	0,00	0,61
Training	0,12	0,03	0,01	0,00	0,16
Vaccine Collection, Distribution, & Storage	0,35	0,07	0,04	1,09	1,55
Total per routine dose administered	3,91	0.51	0,10	1,14	5,65

Cost per fully immunized child (DTP-HepB-Hib) by activity (USD, 2011)

	Facilities	District Health Administration	Regional Health Administration	Central EPI	Total routine immunization costs
Cold Chain Maintenance	1,16	0,13	0,02	0,05	1,36
Other	1,97	0,46	0,07	0,02	2,52
Outreach Service Delivery	6,19	0,00	0,00	0,00	6,19
Program Management	0,91	0,99	0,18	0,12	2,20
Record-Keeping & HMIS	6,88	0,51	0,04	0,02	7,46
Routine Facility-based Service Delivery	6,28	0,00	0,00	0,00	6,28
Social Mobilization & Advocacy	5,65	0,63	0,05	0,18	6,51
Supervision	2,13	0,76	0,11	0,08	3,09
Surveillance	5,46	0,91	0,09	0,01	6,47
Training	1,31	0,29	0,09	0,02	1,71
Vaccine Collection, Distribution, & Storage	3,76	0,74	0,39	11,64	16,53
Total per FIC	41,70	5,42	1,05	12,13	60,30

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)

	Soc.Mob.	Imm° Prog	F-based	Outreach	Training	Vacc C°D°St	ColdCh.M	Supervis°	Prog.Mgt	Other	Surveill.	Rec.Keep	n.d	
	HC.6.1.1	HC.6.2	HC.6.2.1	HC.6.2.2	HC.6.2.3	HC.6.2.4	HC.6.2.5	HC.6.2.6	HC.6.2.7	HC.6.2.8	HC.6.5.1	HC.6.6	HC.99	Total
Transfers from government domestic revenue														
Internal transfers	4 469 607		4 857 790	4 773 351	1 403 900	1 627 661	1 163 061	1 932 962	1 213 370	1 407 028	3 951 292	6 037 258		32 837 279
Central transfers		112 214				2 542 471							14 686	2 669 372
Within local		24 799												24 799
Regional transfer		3 153 588	627 052		46 445									3 827 085
Transfers distributed by Government from foreign origin														
USAID						100 315								100 315
UNICEF		167 811					900							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

	Internal Transfer	Within Central	Within local	Grants From Region Local	USAID (dist by Gvt)	UNICEF	WHO	GAVI	Insur	User Fees	UNICEF In-kind	WHO In-kind	GAVI In-kind	World Vision In-kind	
	FS.1.1	FS.1.1.1	FS.1.1.2	FS.1.1.4	FS.2.1.1.1	FS.2.1.2.1	FS.2.1.2.2	FS.2.1.3	FS.3	FS.4.1	FS.7.2.2.2.1	FS.7.2.2.2.2	FS.7.2.2.2.4	FS.7.2.2.3.3	Total
Cold chain equipment					100 315	900					29 029				130 244
Not disaggregated /n.e.c			24 799	3 678 636		167 811	143 958	552 535	925 335	114 869				30 632	5 638 576
Other				19 183											19 183
Other equipment								70 290							70 290
Per diem				46 445			57 012								103 457
Taxes and customs duties		112 214													112 214
Transport				82 821			13 702								96 523
Utilities and communications		14 686					16 318								31 005
Vaccines and other goods		2 542 471											8 740 169		11 282 640
Vehicles								86 459							86 459
Wages and salaries	32 837 279										22 397	64 617			32 924 293
Total	32 837 279	2 669 372	24 799	3 827 085	100 315	168 711	230 990	709 284	925 335	114 869	51 426	64 617	8 740 169	30 632	50 494 883

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)

	EPI program	Central Ministry of Health (other program	Central Ministry of Health:	Community organizations	District Level Ministry of Health	(GHS)	National Laboratories	Central Cold Stores	Local Govt Agents	UNICEF	WHO	Total
Transfers from government domestic revenue												
FS.1.1			33 323 010									33 323 010
FS.1.1.1	14 073		80 897					2 145 658				2 240 629
FS.1.1.3					84 013							84 013
FS.1.1.4					2 627 563							2 627 563
FS.1.4					12 329							12 329
Transfers distributed by Government from foreign origin												
FS.2.1.2.1	62 062											62 062
FS.2.1.2.2	255 971	24 859		4 886		31 790	4 886		126 460			448 853
FS.2.1.3	20 942				79 013	353 249						453 204
Social Insurance contribution and compulsory prepayment												
FS.4.1					123 830							123 830
Direct foreign transfers												
FS.7.2.2.2.1										24 144		24 144
FS.7.2.2.2.2											69 657	69 657
FS.7.2.2.2.4								2 303 993				2 303 993
FS.7.2.2.3.3					36 984							36 984

Total	353 048	24 859	33 403 907	4 886	2 963 732	385 039	4 886	4 449 651	126 460	24 144	69 657	41 10 270

A19 - Financing Agents to Health-Care Providers in 2010

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.

Financing agents to health-care provider (USD, 2010)

	Central Ministry of Health / DCD / EPI program	Central Ministry of Health:	Community organizations/groups	District Level Ministry of Health	National Health Service Agency (GHS)	National Laboratories	National Medical Stores / Central Cold Stores	State/Regional/ Local Govt Agents	UNICEF	WHO	Total
Ambulatory health care centers		32 621 758	4 886								32 626 645
District MOH		428 133		2 557 199							2 985 332
Hospitals								0			0
National MOH	187 405	217 389			297 278	4 845	4 449 651				5 156 568
Providers of health care system administration and financing								55 845			55 845
Provincial MOH		136 627						6 879			143 507
Public research institutions								19 228			19 228
Rest of the world									24 144	69 657	93 801
Total	187 405	33 403	4 886	2 557	297 278	4 845	4 449	81 952	24 144	69	41 080

		907		199			651			657	925

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.

Financing Agents to health care financing mechanism (USD, 2010)

	EPI program	Central Ministry of Health:	Community organizations/groups	District Level Ministry of Health	(GHS)	National Laboratories	National Medical Stores / Central Cold Stores	State/Regional/Local Govt Agents	UNICEF	WHO	Total
Central government schemes	161 228	33 403 907		6 963	297 278	4 845	4 449 651				38 323 872
Community level financing				123 830							123 830
Rest of the world	26 177			36 984					24 144	69 657	156 962
State/regional/local government schemes			4 886	2 389 423				81 952			2 476 262
Total	187 405	33 403 907	4 886	2 557 199	297 278	4 845	4 449 651	81 952	24 144	69 657	41 080 925

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)

	Internal Transfers from Government domestic revenue					Financial donors				In-kind from donors				
	Int. Transf.	Central Gvt	Grants	Local Gvt	other	UNICEF	WHO	GAVI	User fees	UNICEF	WHO	GAVI	World Vision	
	FS.1.1	FS.1.1.1	FS.1.1.3	FS.1.1.4	FS.1.4	FS.2.1.2.1	FS.2.1.2.2	FS.2.1.3	FS.4.1	FS.7.2.2.2.1	FS.7.2.2.2.2	FS.7.2.2.2.4	FS.7.2.2.3.3	Total
HC.6.1.1	4 597 953						4 886							4 602 840
HC.6.2		94 970	84 013	1 466 684	12 329	0	0	321 169	123 830	24 144	69 657		36 984	2 233 780
HC.6.2.1	5 241 933			470 965										5 712 898
HC.6.2.2	5 150 817													5 150 817
HC.6.2.3	1 184 903			308 766		26 275	48 093							1 568 038
HC.6.2.4	1 672 383	2 145 658										2 303 993		6 122 034
HC.6.2.5	1 145 561					1 300								1 146 861
HC.6.2.6	1 885 666					3 474	33 925	13 765						1 936 831
HC.6.2.7	992 169					26 177								1 018 346
HC.6.2.8	1 375 679						0							1 375 679

HC.6.5.1	4 014 644						30 952							4 045 596
HC.6.6	6 061 302						105 904							6 167 206
Total	33 323 010	2 240 629	84 013	2 246 415	12 329	57 227	223 761	334 934	123 830	24 144	69 657	2 303 993	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.

A23 - total cost by facility (USD, 2011)

Facility Name	Area	Type	Total cost (USD)
adomfe	CHPS	rural	6 463,42 USD
afiaman	Clinic	rural	8 560,88 USD
akramaman	CHPS	rural	6 755,76 USD
anglican	Health Centre	rural	24 286,60 USD
ashyiresu	CHPS	rural	19 167,05 USD
bamahu	Health Centre	rural	39 683,04 USD
banka	Health Centre	rural	11 163,67 USD
bayerebon	Health Centre	rural	27 926,71 USD
bimbagu	CHPS	rural	29 660,44 USD
biu	Clinic	rural	11 725,68 USD
boli	CHPS	rural	10 135,88 USD
bunkpurugu	Health Centre	rural	29 059,83 USD
charingu	Health Centre	rural	17 076,66 USD
doba	CHPS	rural	15 860,06 USD
dondoli	CHPS	rural	15 500,13 USD
dwendwenase	Health Centre	rural	8 934,91 USD
ga_west_dh_rch	RCH	Urban	64 553,54 USD
gbegru	CHPS	rural	13 273,09 USD
gia	CHPS	rural	14 214,75 USD
gongnia	CHPS	rural	6 116,24 USD
gyereso	Health Centre	rural	22 328,66 USD
juaso	RCH	urban	13 755,04 USD
kambagu	CHPS	rural	4 337,55 USD
kambali	Health Centre	rural	29 952,10 USD
kojo_ashong	Clinic	Urban	2 836,84 USD
kolongo	Health Centre	Rural	15 335,48 USD
konta_north	Clinic	Rural	19 384,33 USD
kperisi	CHPS	Rural	10 996,23 USD
kumbiehi	CHPS	Rural	7 677,13 USD
kyempo	Clinic	Rural	4 413,81 USD
mayera	Clinic	Urban	14 721,13 USD
nachanta	CHPS	rural	4 467,73 USD
nakpanduri	Health Centre	rural	38 921,29 USD
nasua	Health Centre	Urban	44 843,72 USD
navrongo	Health Centre	Urban	13 574,57 USD
nayagnia	CHPS	rural	8 989,84 USD
nnadieso	Health Centre	urban	12 193,97 USD
nsakina	CHPS	rural	3 281,81 USD
nyinahin	RCH	urban	20 978,35 USD
oduman	Clinic	rural	20 509,00 USD
ofoase	Health Centre	rural	10 648,79 USD
piisi	CHPS	rural	5 922,63 USD
pokuase	CHPS	urban	11 016,83 USD
saint_peters	Clinic	rural	30 398,28 USD
vunania	CHPS	rural	9 986,83 USD
wa_market	RCH	urban	17 997,41 USD
wa_urban	Clinic	Urban	58 988,89 USD
war_memorial	Health Centre	rural	10 243,94 USD
wuru	CHPS	rural	33 813,36 USD

Facility Name	Area	Type	Total cost (USD)
yunyoo	Health Centre	rural	36 506,41 USD

A24 - Distribution of total cost by activity for each facility

Facility Name	Total Cost (USD)	Cold Chain Maintenance	Other	Outreach Service Delivery	Program Management	Record-Keeping & HMIS	Routine Facility-based Service Delivery	Social Mobilization & Advocacy	Supervision	Surveillance	Training	Vaccine Collection
adomfe	9 991	1,89%	0,42%	40,05%	0,73%	8,87%	27,32%	1,95%	5,20%	8,82%	1,20%	3,55%
afiaman	13 234	0,00%	0,00%	45,92%	0,00%	3,93%	2,61%	45,11%	0,00%	0,19%	0,06%	2,17%
akramaman	10 443	1,80%	1,13%	21,79%	0,28%	16,92%	7,93%	10,50%	6,20%	14,88%	2,77%	15,78%
anglican	37 543	1,67%	0,14%	26,34%	0,00%	12,77%	12,12%	27,25%	2,26%	2,52%	0,28%	14,66%
ashyiresu	29 629	5,03%	1,55%	17,49%	1,75%	18,44%	4,76%	36,46%	0,00%	9,40%	1,02%	4,09%
bamahu	61 343	0,26%	0,69%	19,05%	1,21%	16,94%	15,63%	30,69%	4,87%	8,08%	0,51%	2,07%
banka	17 257	0,91%	9,68%	46,64%	0,27%	3,03%	19,03%	1,98%	2,34%	7,13%	1,86%	7,13%
bayerebon	43 170	5,69%	0,90%	18,60%	5,69%	2,30%	24,31%	3,56%	5,69%	4,45%	14,66%	14,16%
bimbagu	45 850	3,22%	34,35%	20,05%	0,53%	1,24%	8,36%	0,63%	1,02%	26,22%	2,62%	1,75%
biu	18 126	3,36%	1,46%	12,79%	1,20%	12,71%	17,20%	13,89%	3,72%	22,31%	2,16%	9,19%
boli	15 668	0,00%	0,01%	8,17%	0,00%	66,10%	0,00%	0,95%	2,88%	16,73%	1,80%	3,36%
bunkpurugu	44 921	2,75%	13,88%	63,06%	3,03%	5,88%	1,65%	3,34%	0,00%	4,19%	0,00%	2,22%
charingu	26 398	1,88%	1,53%	19,76%	2,80%	22,80%	8,96%	18,39%	5,01%	10,44%	1,34%	7,08%
doba	24 517	1,73%	0,04%	17,29%	0,21%	15,53%	17,16%	11,15%	7,57%	12,00%	3,15%	14,17%
dondoli	23 960	0,00%	0,00%	10,26%	2,81%	30,96%	0,00%	20,39%	0,00%	28,04%	0,17%	7,36%
dwendwenase	13 812	2,42%	0,45%	42,54%	0,72%	6,98%	30,34%	2,65%	1,76%	4,83%	3,78%	3,53%
ga_west_dh_rch	99 789	0,22%	0,00%	0,00%	3,69%	26,70%	61,92%	3,51%	1,62%	0,96%	0,75%	0,63%
gbegru	20 518	1,87%	0,00%	16,34%	0,00%	17,00%	0,00%	47,25%	0,00%	16,41%	0,40%	0,73%
gia	21 974	4,68%	0,01%	13,35%	1,20%	17,78%	15,17%	14,11%	3,75%	19,40%	2,94%	7,63%
gongnia	9 455	2,74%	0,34%	10,28%	0,00%	8,18%	30,78%	15,60%	0,00%	19,84%	2,98%	9,25%
gyereso	34 516	2,71%	0,15%	27,59%	6,03%	3,62%	26,85%	18,84%	4,82%	4,40%	0,87%	4,10%
juaso	21 263	2,45%	0,39%	27,83%	0,73%	10,45%	44,62%	2,19%	0,00%	3,53%	2,94%	4,88%
kambagu	6 705	0,00%	0,03%	11,94%	14,12%	8,28%	3,09%	19,99%	4,25%	15,98%	0,85%	21,46%
kambali	46 301	0,22%	1,89%	17,24%	7,27%	22,21%	25,94%	1,34%	8,05%	13,44%	1,34%	1,07%
kojo_ashong	4 385	0,00%	0,96%	8,59%	2,15%	42,96%	17,20%	0,82%	0,00%	18,42%	0,00%	8,91%
kolongo	23 706	3,83%	0,01%	30,12%	0,20%	6,20%	25,83%	10,33%	2,01%	15,88%	2,25%	3,33%
konta_north	29 965	0,00%	0,07%	7,96%	1,03%	17,64%	10,48%	36,00%	9,97%	10,92%	0,90%	5,04%
kperisi	16 998	4,99%	4,74%	43,98%	0,00%	21,89%	0,28%	9,90%	0,00%	10,66%	0,98%	2,57%
kumbiehi	11 868	0,00%	3,72%	13,30%	0,01%	23,69%	6,36%	2,78%	0,00%	47,11%	0,61%	2,42%

Facility Name	Total Cost (USD)	Cold Chain Maintenance	Other	Outreach Service Delivery	Program Management	Record-Keeping & HMIS	Routine Facility-based Service Delivery	Social Mobilization & Advocacy	Supervision	Surveillance	Training	Vaccine Collection
kyempo	6 823	3,60%	0,62%	18,19%	1,07%	10,39%	26,67%	6,09%	5,91%	12,08%	4,33%	11,05%
mayera	22 756	3,49%	0,01%	26,40%	0,84%	9,83%	10,72%	6,95%	12,16%	16,77%	2,95%	9,88%
nachanta	6 906	0,00%	1,14%	7,50%	0,00%	28,62%	0,01%	10,36%	39,59%	9,44%	0,00%	3,35%
nakpanduri	60 166	1,30%	0,85%	16,20%	0,51%	0,39%	29,04%	2,13%	0,06%	1,09%	0,68%	47,75%
nasua	69 321	5,25%	23,83%	43,58%	0,03%	0,44%	18,58%	0,97%	0,58%	3,27%	1,46%	2,01%
navrongo	20 984	0,73%	0,00%	5,32%	0,43%	3,80%	54,55%	7,44%	0,92%	10,94%	2,97%	12,91%
nayagnia	13 897	2,33%	0,01%	8,07%	0,68%	4,66%	15,84%	28,24%	6,21%	16,16%	7,68%	10,12%
nnadieso	18 850	2,35%	0,22%	41,19%	0,68%	16,98%	22,45%	1,70%	1,03%	7,70%	0,64%	5,07%
nsakina	5 073	9,68%	0,04%	61,00%	2,93%	2,93%	10,70%	2,92%	1,06%	5,82%	0,00%	2,92%
nyinahin	32 429	1,54%	0,01%	28,55%	1,68%	14,82%	26,49%	7,77%	6,41%	11,06%	1,44%	0,24%
oduman	31 703	0,19%	0,07%	34,07%	0,59%	0,79%	42,43%	6,16%	9,51%	1,90%	0,39%	3,89%
ofoase	16 461	2,40%	0,50%	27,78%	0,72%	8,67%	33,94%	2,67%	4,87%	6,05%	5,41%	7,00%
piisi	9 155	0,00%	0,39%	10,98%	0,00%	18,97%	3,05%	14,34%	4,46%	47,47%	0,33%	0,00%
pokuase	17 030	5,20%	0,00%	60,59%	4,68%	17,33%	0,13%	0,78%	0,73%	9,38%	0,00%	1,19%
saint_peters	46 990	0,72%	0,28%	53,04%	4,49%	4,49%	8,38%	11,47%	0,12%	4,74%	4,49%	7,78%
vunania	15 438	4,48%	4,82%	11,58%	0,20%	11,72%	17,38%	14,77%	4,02%	10,60%	3,47%	16,98%
wa_market	27 821	1,19%	0,01%	0,00%	0,00%	30,54%	35,85%	7,62%	12,96%	7,36%	0,80%	3,69%
wa_urban	91 187	0,49%	0,02%	12,82%	0,51%	27,18%	43,57%	2,38%	3,35%	5,99%	2,79%	0,89%
war_memorial	15 835	1,47%	0,00%	12,35%	3,06%	8,90%	37,20%	1,53%	8,39%	18,34%	2,34%	6,41%
wuru	52 270	0,07%	0,00%	27,71%	0,13%	11,11%	44,54%	2,77%	4,98%	3,39%	0,75%	4,54%
yunyoo	56 433	1,83%	0,00%	72,27%	1,73%	10,89%	2,93%	3,43%	1,82%	1,98%	0,55%	2,56%

A25- Distribution of total cost by line item for each activity

Facility name	Total Cost (USD)	Building overhead, Utilities, Communication	Buildings	Cold Chain Equipment	Per Diem & Travel Allowances	Salaried Labor	Transport/Fuel	Vaccines	Vehicles	Volunteer Labor
adomfe	9 991	0,00%	0,03%	0,00%	1,62%	71,94%	8,05%	9,29%	6,86%	2,21%
afiaman	13 234	0,00%	0,00%	0,10%	0,00%	91,68%	8,22%	0,00%	0,00%	0,00%
akramaman	10 443	0,00%	0,00%	1,76%	0,00%	80,00%	5,52%	6,02%	4,69%	2,01%
anglican	37 543	0,09%	0,07%	3,00%	0,08%	61,31%	2,45%	30,90%	2,09%	0,00%
ashyiresu	29 629	0,36%	1,80%	0,93%	0,07%	80,69%	0,50%	0,00%	0,66%	15,00%
bamahu	61 343	0,00%	0,29%	1,54%	0,01%	81,24%	1,69%	11,44%	1,44%	2,35%
banka	17 257	0,00%	2,25%	5,23%	0,24%	22,56%	7,57%	49,07%	10,52%	2,56%
bayerebon	43 170	0,90%	0,42%	2,22%	0,00%	59,83%	1,55%	21,25%	2,27%	11,56%
bimbagu	45 850	0,01%	2,86%	0,56%	0,02%	72,24%	0,60%	14,42%	5,13%	4,15%
biu	18 126	0,00%	0,04%	3,05%	0,45%	64,99%	0,05%	5,68%	2,16%	23,58%
boli	15 668	0,00%	0,00%	0,00%	0,08%	88,72%	6,62%	0,00%	3,66%	0,92%
bunkpurugu	44 921	2,68%	0,29%	1,79%	0,00%	25,73%	2,22%	54,81%	8,98%	3,50%
charingu	26 398	0,00%	0,00%	4,62%	0,01%	75,88%	3,89%	7,38%	3,31%	4,91%
doba	24 517	0,00%	3,89%	3,04%	0,25%	80,11%	1,88%	9,00%	0,00%	1,84%
dondoli	23 960	0,00%	0,00%	0,00%	0,00%	90,19%	4,33%	0,00%	3,68%	1,80%
dwendwenase	13 812	0,00%	0,82%	1,87%	1,32%	48,19%	1,67%	40,91%	1,42%	3,80%
ga_west_dh_rch	99 789	0,00%	0,23%	0,00%	0,05%	65,28%	0,00%	34,44%	0,00%	0,00%
gbegru	20 518	0,00%	0,00%	0,46%	0,05%	84,96%	5,00%	0,00%	4,26%	5,26%
gia	21 974	0,00%	0,04%	0,00%	0,01%	83,25%	2,36%	4,11%	0,00%	10,24%
gongnia	9 455	0,32%	21,87%	0,19%	0,02%	73,59%	0,91%	0,00%	0,77%	2,33%
gyereso	34 516	0,09%	0,07%	2,88%	0,09%	58,31%	2,67%	33,62%	2,27%	0,00%
juaso	21 263	0,00%	0,00%	3,46%	0,39%	45,36%	0,00%	48,42%	0,00%	2,37%
kambagu	6 705	0,00%	0,02%	0,00%	0,10%	66,34%	12,03%	0,00%	10,24%	11,27%
kambali	46 301	0,00%	0,11%	0,44%	0,83%	93,86%	2,24%	0,00%	1,91%	0,62%
kojo_ashong	4 385	0,00%	0,01%	0,31%	0,96%	96,66%	0,00%	0,00%	0,00%	2,05%
kolongo	23 706	0,00%	0,00%	2,24%	0,02%	40,52%	0,00%	42,99%	0,00%	14,24%
konta_north	29 965	0,00%	0,00%	0,00%	0,27%	92,20%	3,46%	0,00%	2,95%	1,12%
kperisi	16 998	0,00%	0,00%	0,50%	0,35%	73,51%	6,10%	15,08%	3,38%	1,09%
kumbiehi	11 868	0,00%	0,00%	0,00%	0,34%	80,37%	9,31%	0,00%	5,13%	4,85%

Facility name	Total Cost (USD)	Building overhead, Utilities, Communication	Buildings	Cold Chain Equipment	Per Diem & Travel Allowances	Salaried Labor	Transport/Fuel	Vaccines	Vehicles	Volunteer Labor
kyempo	6 823	0,00%	0,01%	0,00%	0,62%	70,33%	11,70%	0,00%	9,96%	7,39%
mayera	22 756	0,00%	0,06%	0,00%	0,01%	82,70%	0,00%	17,19%	0,00%	0,04%
nachanta	6 906	0,00%	0,01%	0,00%	0,03%	59,19%	15,01%	0,00%	12,78%	12,98%
nakpanduri	60 166	0,84%	0,44%	0,37%	0,00%	9,29%	0,00%	39,27%	48,05%[15]	1,74%
nasua	69 321	0,00%	17,93%	0,29%	0,06%	34,05%	0,03%	38,01%	5,66%	3,98%
navrongo	20 984	0,00%	5,91%	6,49%	0,00%	25,10%	0,00%	48,76%	0,22%	13,51%
nayagnia	13 897	0,00%	5,89%	2,94%	0,23%	51,74%	0,00%	11,99%	0,00%	27,20%
nnadieso	18 850	0,00%	0,00%	0,77%	0,86%	75,80%	4,28%	12,64%	3,64%	2,01%
nsakina	5 073	0,00%	0,00%	0,00%	0,04%	97,12%	2,84%	0,00%	0,00%	0,00%
nyinahin	32 429	0,00%	0,00%	0,00%	0,01%	84,54%	3,55%	0,00%	3,02%	8,88%
oduman	31 703	0,04%	1,51%	1,31%	0,13%	46,03%	0,00%	50,99%	0,00%	0,00%
ofoase	16 461	0,00%	0,71%	5,31%	0,50%	48,36%	4,90%	36,78%	0,00%	3,44%
piisi	9 155	0,00%	0,00%	0,00%	0,02%	77,67%	11,32%	0,00%	6,27%	4,72%
pokuase	17 030	0,00%	0,00%	0,67%	0,00%	57,69%	0,00%	41,65%	0,00%	0,00%
saint_peters	46 990	0,26%	0,00%	2,11%	0,03%	94,79%	0,16%	0,00%	2,15%	0,51%
vunania	15 438	0,00%	0,02%	5,40%	0,00%	93,56%	0,00%	0,00%	0,00%	1,02%
wa_market	27 821	0,00%	0,00%	0,86%	0,01%	77,44%	0,00%	21,70%	0,00%	0,00%
wa_urban	91 187	0,00%	0,00%	0,26%	2,76%	46,55%	1,20%	45,06%	0,66%	3,50%
war_memorial	15 835	0,00%	0,00%	0,52%	0,05%	74,58%	0,00%	24,84%	0,00%	0,00%
wuru	52 270	0,00%	0,01%	1,03%	0,00%	42,68%	0,00%	49,38%	0,00%	6,89%
yunyoo	56 433	0,00%	0,23%	1,81%	0,00%	26,58%	1,63%	67,33%	1,39%	1,02%

[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

	Total Cost (USD)	Cold Chain Maintenance	Other	Outreach Service Delivery	Program Management	Record-Keeping & HMIS	Routine Facility-based Service Delivery	Social Mobilization & Advocacy	Supervision	Surveillance	Training	Vaccine Collection, Distribution, & Storage
asante_akim_south_dha	16 554	1,11%	8,06%	0,00%	7,40%	5,99%	0,00%	2,02%	10,24%	41,41%	12,44%	11,32%
atwima_mponua_dha	44 663	2,93%	18,25%	0,00%	32,86%	4,90%	0,00%	4,34%	2,34%	16,41%	8,95%	9,02%
bunkpurugu_yunyoo_dha	12 067	1,33%	4,96%	0,00%	25,01%	2,52%	0,00%	3,39%	5,45%	22,18%	0,00%	35,17%
ga_west_dha	24 639	2,15%	12,29%	0,00%	3,46%	30,69%	0,00%	1,72%	9,71%	29,82%	1,91%	8,24%
kassena_nankana_dha	18 973	2,07%	2,33%	0,00%	33,11%	2,73%	0,00%	11,67%	4,67%	8,46%	1,64%	33,34%
wa_municipal_dha	50 425	3,70%	2,76%	0,00%	7,26%	17,77%	0,00%	39,31%	10,68%	6,50%	4,40%	7,63%

A27- Region costs distribution by activity

	Total Cost	Cold Chain Maintenance	Other	Program Management	Record-Keeping & HMIS	Social Mobilization & Advocacy	Supervision	Surveillance	Training	Vaccine Collection, Distribution, & Storage
atwima_mponua_rha	135 289	0,15%	0,67%	1,11%	0,36%	0,54%	1,17%	0,42%	0,58%	94,99%
bunkpurugu_yunyoo_rha	61 540	0,15%	0,17%	1,60%	0,10%	0,05%	0,32%	0,50%	0,00%	97,12%
ga_west_rha	57 650	0,01%	0,00%	0,58%	0,12%	0,13%	0,25%	0,66%	0,16%	98,10%
kassena_nankana_rha	72 845	0,18%	2,05%	1,98%	1,19%	0,46%	0,78%	1,41%	1,99%	89,95%
wa_municipal_rha	145 520	1,67%	2,03%	8,15%	1,75%	0,87%	2,09%	4,08%	11,05%	68,31%

A28- Funding sources to health care provisions

Funding sources to health care provisions (USD, 2010)

	FS.1.1	FS.1.1.1	FS.1.1.3	FS.1.1.4	FS.1.4	FS.2.1.2.1	FS.2.1.2.2	FS.2.1.3	FS.4.1	FS.7.2.2.2.1	FS.7.2.2.2.2	FS.7.2.2.2.4	FS.7.2.2.3.3	Total
Cold chain equipment						1 300		138 546						139 846
Not disaggregated/n.e.c			84 013	2 062 033	12 329	27 501	178 460	180 262	123 830				36 984	2 705 412
Other				24 766										24 766
Other equipment								5 104						5 104
Per diem				101 829		24 544	35 503	4 477						166 354
Printing							2 565							2 565
Taxes and customs duties		80 897						4 717						85 614
Transport				57 787		3 881	7 232	1 829						70 729
Utilities and communications		14 073												14 073
Vaccines and other goods		2 145 658										2 303 993		4 449 651
Wages and salaries	33 323 010									24 144	69 657			33 416 811
Total	33 323 010	2 240 629	84 013	2 246 415	12 329	57 227	223 761	334 934	123 830	24 144	69 657	2 303 993	36 984	41 080 925

A29 – Vaccine Volume Calculator for new vaccines introduction in Ghana

Characteristis of vaccines selected for use							Vaccine wastage			Target Group	National immunization schedule Routine vaccinations				
Vaccine	Presentation (dose/vial)	Packed volume national data		Maxi packed volume from data base		Price of vaccine	National vaccine wastage figures	WHO/GAVI indicative wastage rates	Wastage factor	Enter as % of total population	current	current + Penta	Current+PCV10	Current+Rota	Current+MSD
choose from dropdown list	choose from dropdown list	Vaccines (cm³/dose)	Diluents (cm³/dose)	Vaccines (cm³/dose)	Diluents (cm³/dose)	($US/dose)									
BCG	20			1,2	0,7		50	50	2,00		1,0	1,0	1,0	1,0	1,0
OPV	10			2,0			30	25	1,43		4,0	4,0	4,0	4,0	4,0
Measles	10			3,5	4,0		25	40	1,33		1,0	1,0	1,0	1,0	2,0
YF	5			6,5	7,0		25	10	1,33		1,0	1,0	1,0	1,0	1,0
TT	20			2,5			30	25	1,43		1,0	1,0	1,0	1,0	1,0
DTP-HepB-Hib	10			2,6			25	25	1,33			3,0	3,0	3,0	3,0
PCV-10	2			4,8			10	10	1,11				3,0	3,0	3,0
Rota_liq	1			17,1			10	5	1,11					2,0	2,0
										Net volume of OPV at -20°C in higher level stores, per FIC	11,4	11,4	11,4	11,4	11,4
										Net volume of all vaccines except OPV stored at +5°C in higher level stores, per FIC	19,3	29,7	45,7	83,8	88,4
										Net volume of all vaccines, including OPV, stored at +5°C in lower level stores, per FIC	30,7	41,1	57,1	95,2	99,9
										Net volume of vaccines and diluents, stored at +5°C at service points, per FIC	46,8	57,2	73,2	111,3	121,3
										Percent increase of the net vaccine volume compared to Schedule-A in store for -20°C		0%	0%	0%	0%
										% increase of the net vaccine volume compared to Schedule-A in store w/o OPV @+5°C		54%	137%	334%	358%
										% increase of the net vaccine volume compared to Schedule-A in store with OPV @+5°C		34%	86%	210%	225%
										% increase of the net vaccine volume compared to Schedule-A at service delivery		22%	56%	138%	159%