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# Costing and financing analyses of routine immunization and new vaccine introduction in Benin

*AMP  
Final report*

*November 15<sup>th</sup> , 2014*

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## **Acknowledgement**

We would like to thank the following individuals and institutions that contributed to the study: Justin Sossou (Secretary General at the ministry of health) who facilitated study implementation, Scen Afrik (Léon Kessou) who collected the data as well as the partners (WHO, UNICEF, Rotary), Damian Walker (Bill and Melinda Gates Foundation), Logan Brenzel and Darwin Young (consultants Bill and Melinda Gates foundation), and the steering committee members: Carol Levin (University of Washington) Ulla Griffiths (London School of Hygiene and Tropical Medicine) , Mike Hanlon (University of Washington) , Raymond Hutubessy (World Health Organization) , Stephen Resch (Harvard University) , Santiago Cornejo (GAVI).

We thank the participants of the dissemination workshop in Cotonou (06<sup>th</sup> February 2014): the Secretary General of Ministry of Health, Planning director, National Immunization Agency director, the director of primary health care, director of logistics of the National Immunization Agency, Human Resource director, Director of the Mono-Couffo Zone, Director of 'Atlantique-Littoral' zone, Medical officer from 'Atlantique Littoral', Secretary of the national consultative committee for immunization, UNICEF representative and AMP representative.

This report is based on research funded by the Bill & Melinda Gates Foundation. The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation.

## 1. Summary

### 1.1. Purpose of the study

This study was part of a multi-country study on EPI costing and financing of routine immunization and new vaccines (EPIC), 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 was to undertake analyses of: the costs, funding flows of routine immunization programs and new & underutilized vaccine introduction (NUVI), and determinants of costs and productivity at the facility level in Benin. There was a need for updated global estimates that included pentavalent vaccines as part of routine immunization.

### 1.2. Routine immunization costs

#### **Methods**

Methods were based on internationally accepted approaches, drawing upon a common methodological approach. In terms of the costing analysis, the scope of the analyses was the routine national immunization program, from the central level to the vaccine delivery sites. The study scope included the health facilities that provide routine immunization services to children and their related sub-national administrative units at district and regional level. The selected perspective of the study was the government health service. A stratified random sampling approach was used for the district and facility selection.

For routine immunization we estimated annual costs for 2011, the last fiscal year for which data were available. National immunization days were outside of the study scope. The main focus was on annual economic costs, i.e., the value of resources paid for 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.

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. District (Zone Office) and region (Departmental Directorate of Health) weighted averages were multiplied by the number of districts and regions. Vaccines were assessed at central level for the aggregated cost calculation.

Fully Immunized Child (FIC) is 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 were part of the routine immunization schedule in 2011: BCG, OPV, DTP HepB Hib, yellow fever and pneumococcal vaccine. In 2011 Benin introduced the monodose 13-valent pneumococcal conjugate vaccine using a three-dose schedule, with vaccine at 6-10-14 weeks, in their routine immunization schedule.

#### **Key results**

The total costs for the routine immunization (nationwide) amounted to US\$ 14.62 million in 2011. The routine EPI cost per dose was US\$ 3.53, the cost per FIC US\$ 43.86, and the cost per infant population in the country US\$ 42.03. The cost per capita was US\$ 1.50. When excluding PCV, total cost amounted to US\$ 9.22 million and US\$ 2.22 per dose.

In terms of total nationwide delivery cost for routine immunization (i.e. excluding vaccines), facility level represented the bulk of total cost at 82%; district level 9%; regional level 5%; and central level 5%. At central level, costs were driven by social mobilization, supervision and vaccine management. At regional level, the activities of vaccine management, program management and supervision consumed most of the resources. At district level, costs were driven by vaccine management, supervision and surveillance. At facility level, the three most important delivery costs were vaccine management, fixed-based delivery and record-keeping.

Recurrent line items accounted for 71% of the aggregated costs. Salaried labor was the main cost driver, accounting for 42% of total routine delivery costs. The remaining substantial cost items, expressed as a percentage of total routine immunization costs, were: cold chain capital costs (18%); cold chain operational costs (13%); vehicles (9%) and overheads (8%).

Within the sampled facilities (urban=20; rural=26), the weighted average unit cost per vaccine dose administered was US\$ 1.92. The cost per Fully Immunized Child – FIC – (DTP3-HepB-Hib) was US\$ 24.96.

The weighted economic cost for routine immunization was US\$ 14,994 per health facility in 2011 within the sampled facilities. When vaccine cost was excluded, the delivery cost fell to US\$ 5,345. In terms of facility-level activities, fixed-based service delivery was the most important cost driver, accounting for 55% of total cost, followed by outreach service delivery (18%) and vaccine management (13%). The fact that vaccine cost was incorporated into these two activities (fixed-based and outreach) partially explains this skewed cost distribution. When vaccine costs were excluded, vaccine management became the main cost drivers, accounting for 36% of total operational cost. Fixed and outreach service delivery accounted for another 19% and 9% of total delivery cost. Record-keeping (12%) and social mobilization (9%) also came out as important cost drivers.

In comparing different types of health facilities, health centers (US\$ 24.24) and clinics (US\$ 31.49) were the most efficient in terms of cost per FIC compared to NGO mission facilities (US\$ 40.87) and. When vaccine costs were excluded, the remaining costs of the three types of health facilities were not significantly different (the variation was less than 5%). Unit cost per infant and capita according to urban rural status were lower in urban areas than in rural ones. This can be explained by the health facility catchment (covered infant population and total population), which in general is three times higher in urban areas than rural areas, and which increases attendance at immunization sessions.

### **Key messages**

- ✓ Three-quarters of the delivery costs (i.e. excluding the vaccines) at facility level were due to personnel and cold chain.
- ✓ Unit cost per infant and capita according to urban rural status showed higher efficiency per unit of output (doses, FIC) in urban areas than in rural ones.
- ✓ The high share of recurrent costs at facility level highlights the need for both sustainable and continuous financing of the immunization program in Benin.
- ✓ Our study found the cost of routine immunization in Benin to be higher than recent estimates in the comprehensive multi-year plan for the main components (salaried labor, maintenance, cold chain, vehicles). The cost was higher for all items (except transportation), which could imply that current cMYP tool results underestimate the critical resources used for routine immunization (in particular delivery costs).

### **1.3. New and underutilized vaccine introduction (NUVI) costs**

#### **Methods**

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 additional workload for the utilization of cold chain equipment following new vaccine introduction was estimated in order to assess the incremental economic cost of cold chain equipment.

Major activities that have been undertaken for the introduction of new vaccines and reported by the country (Benin, 2011) included public awareness, training for the parties involved, national launch ceremony of the pneumococcal vaccine, supervision of immunization activities and training at all levels.

### **Key results**

The estimated total incremental economic cost for the introduction of new vaccine (PCV13) was US\$ 2.9 million when counting vaccine cost, and US\$ 0.8 million without vaccine cost. Non-vaccine costs were mostly driven by the utilization of cold chain (49%); per-diems and allowances for meetings and trainings (24%); and salaried labor (20%).

The total incremental economic cost of NUVI per dose of new vaccine administered (n= 494,836) was US\$ 5.9 per dose and US\$ 8.4 per child. Delivery economic cost represented US\$ 1.64 cost per PCV dose administered compared to GAVI introduction grant of US\$ 0.80. Delivery cost per child amounted to US\$ 2.33. Comparing the incremental NUVI economic unit costs (per dose, per child and per capita) with vaccine cost, the unit cost without vaccine was 3.6 times lower. Incremental fiscal costs (including the value of vaccine received) amounted to US\$ 5.5 million.

### **Key messages**

- ✓ Vaccine costs were by far the largest cost driver of new vaccine introduction costs, accounting for 75%, mainly due to the higher cost of the PCV vaccine compared to the other vaccines in the routine schedule.
- ✓ In terms of non-vaccine costs, the main cost drivers of new vaccine introduction were cold chain, per-diems and allowances and salaried labors, which highlights the importance of health system components (supply chain system and human resources).
- ✓ The incremental economic impact of PCV introduction on the utilization of existing cold chain cost was significant at all levels.
- ✓ In terms of activities, vaccine management and social mobilization together used 75% of resources.

#### **1.4. Financing of the routine immunization program**

### **Methods**

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 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 Benin: the Government of Benin, internally generated funds, and development partners (multilateral or bilateral donors).

### **Key results**

The routine immunization program received US\$ 11.7 million in 2011, including shared funding and salaries. The difference with results of the cost analysis can be explained by the exclusion of the facility level in resource tracking; and by potentially shared items that were captured in the cost analysis but not in the funding flow due to different methodological approaches. This funding was provided mostly through external sources, which accounted for 71.7% of support. Of domestic sources, transfers were channeled through the central government, which accounted for 27.4% of total funds (including salaries). Internally generated funds (IGF) from communities, reported at district level, accounted for 0.8% of total funds received. Most of the external financing was provided through the GAVI Alliance, with US\$ 5.7 million, representing 48.6% of total support received. GAVI support for pneumococcal vaccine represented 51.6% of the total funding flow amount. The second-most important funder was UNICEF, with 18.2% of total support received. Minor support was provided by Rotary Club International (2.5%), WHO (1.3%) and AMP (1%). Most funds spent for routine immunization were executed at the central level, with the central MOH executing 49% of total routine immunization expenditures (mostly driven by salaries). Funds executed at district level accounted for 29% of total spending.

### **Key messages**

- ✓ The result of the funding analysis outlines the large proportion of financing by external donors (72%), confirmed by recent comprehensive multi-year plan estimates.
- ✓ Substantial efforts are still required to increase routine immunization financing from domestic sources.
- ✓ In coming years, Benin is likely to introduce new vaccines (HPV, rotavirus). Additional and reliable resources will be required to ensure the financial sustainability of the immunization program over the long run. In this respect, the results of this study can provide updated estimates of the full use of resources in the current schedule, the cost of scaling-up, and cost of introducing additional vaccines in the future.

#### 1.5. Determinants of routine immunization costs at facility level

### **Methods**

We conducted regressions to assess the determinants of routine immunization costs at facility level. The dependent variable was total immunization costs (i.e. routine delivery cost plus vaccine cost). The explanatory variables included total number of children vaccinated against DTP3-Hib-Hep B used as a proxy for fully immunized children, proportion of time spent on immunization for the staff involved in immunization, average wage of staff, and whether the health facility had enough staff for routine immunization.

### **Key results**

A 1% increase in FIC was associated with a 0.63% increase in total facility immunization cost, while the average wage was not associated with the total immunization cost.

### **Key message**

- ✓ Some specific variables strongly influence total immunization cost per facility
- ✓ The number of fully immunized children was positively associated with total facility immunization cost.
- ✓ Our results highlight the importance of full costing approaches in economic evaluations due to the significant contribution of human resource costs to total cost

#### 1.6. Conclusion

Our study found a cost of routine immunization higher than recent estimates in Benin of the comprehensive multi-year plan (1). The cost was higher for all items (except transportation) which could imply that current cMYP tool results may underestimate the resources used for routine immunization. Results confirm that the actual delivery cost (i.e. excluding the vaccines) at facility level was driven by personnel costs and cold chain at three quarters. The high share of recurrent costs at facility level highlights the need for both sustainable and continuous financing for the immunization program in Benin. The higher cost of vaccines in rural facilities can be explained by higher wastage rates in these facilities.

The result of the funding analysis outlines the large proportion of financing by the external donors (83%), confirmed by recent cMYP estimates. In the coming years, Benin is likely to introduce new vaccines. According to cMYP, MenAfriVac is scheduled in 2016, HPV in 2017 and rotavirus in 2018, which will require additional and reliable resources to ensure financial sustainability of the immunization program over the long run. In this respect, the results of this study can provide updated estimates of the full use of resources in the current schedule, the cost of scaling-up, and cost of introducing additional vaccines in the future.

## 2. Background

The background information below was extracted and summarized from the last comprehensive multiyear plan of the immunization program.

### 2.1. Benin geography and population

Benin has a physical area<sup>1</sup> of 114,763 km<sup>2</sup>. There are three climate areas in the country<sup>2</sup>. The “north” part has a dry tropical climate, with a dry season and a rainy season (with frequent epidemics of meningitis and yellow fever). The “center” part is characterized by a tropical and semi-humid climate. Finally, the “south” part has a tropical humid climate, with two rainy seasons (from April to June and September to October) and two dry seasons (from July to August and November to March). There are frequent floods in the southern areas and the risk of outbreaks of diarrheal diseases that are associated.

The population of Benin was estimated at 9,671,591 inhabitants<sup>3</sup> in 2013 of which 50.87% were women. Children under 5 years of age were estimated at 1,714,148, which accounts for 17.72% of the total population. About 54.2% of the population lives in the rural areas. Benin has 12 departments (Atacora, Donga, Borgou, Alibori, Zou, Collines, Mono, Couffo, Atlantique, Littoral, Ouémé, and Plateau), 77 communes, 546 districts and 3,557 villages or town districts<sup>4</sup>.

### 2.2. Health system structure in Benin

Benin's health system is composed of four administrative levels. From the highest (central) to lowest (operational) levels, they are:

- **Central government** – National Agency for Immunization (Agence Nationale de Vaccination – ANV),
- **Provincial level** – Departmental Directorate of Health (Direction Départementale de Santé – DDS),
- **District level – health zone** (Zone de Santé – ZS); health facility level – health center, dispensaries/maternalities, hospitals.

### 2.3. Routine immunization in Benin

Thirteen doses are provided through the EPI program to children before their first birthday: BCG, OPV, DTP HepB-Hib, YFV and PCV13 (table 1).

**Table 1. Routine EPI vaccine schedule in Benin in 2011**

Age	Vaccine type
Birth	BCG, OPV0
6 weeks	OPV1, DTP-HepB-Hib1, PCV13
10 weeks	OPV2, DTP-HepB-Hib2, PCV13
14 weeks	OPV3, DTP-HepB-Hib2, PCV13
9 months	Measles 1, yellow fever
Pregnant women	Tetanus at first contact
	Tetanus one month after and two weeks after birth

There are two vaccination strategies in Benin: the fixed and the outreach strategy. Health centers with low immunization coverage have more frequent catch up campaigns.

<sup>1</sup> National Geographic Institute, estimation from 1998.

<sup>2</sup> Extracted and summarized from the cMYP 2014-2018.

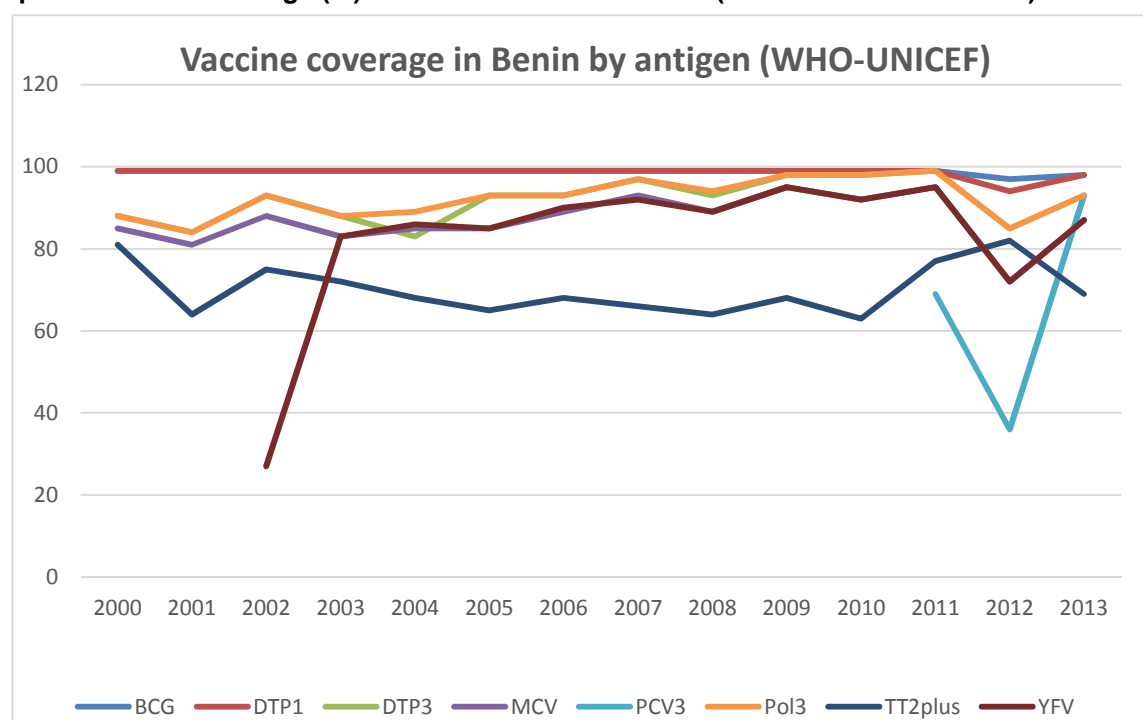
<sup>3</sup> Population forecast on the basis of data from RGPH-3, INSAE, January 2013.

<sup>4</sup> Law n° 97-028 from 15th January 1999

## 2.4. Vaccine coverage trend in Benin

Coverage rates (WHO-UNICEF estimates) by vaccine are detailed in graph 1. Most antigens have increased their coverage between 2000 and 2011.

**Graph 1. Vaccine coverage (%) in Benin from 2000 to 2013 (WHO-UNICEF estimates)**



## 2.5. Introduction of new vaccines in Benin

In 2011 Benin introduced the monodose 13-valent pneumococcal conjugate vaccine (Pevnar 13) using a three-dose schedule with vaccine at 6-10-14 weeks, in their routine immunization schedule (cf. table 1).

## 2.6. Current knowledge on costs of routine immunization in Benin

The most up-to-date data on costs can be extracted from the last cMYP 2014-2018 with a 2012 baseline. The cost for routine immunization at this baseline amounted to US\$ 10.5 million, representing US\$ 36.2 per child having received the third dose of DTP vaccine (table 2). The estimated population in the cMYP was 9 276 414 (9 780 000 in our study) and FIC was 290 370 (334 044 in our study).

**Table 2. Reference indicators from cMYP 2014-2018, baseline 2012**

Indicator for reference year	US\$
<b>Total immunization costs in baseline</b>	<b>19 101 578</b>
Immunization campaigns	8 601 329
Routine immunization	10 500 249
by inhabitant	1.1
by child DTP3	36.2
% vaccine and injection equipment	61.0
% government funding	46.7
% total health expenses	3.8
% total health expenses by the government.	10.1
% GDP	0.08

### 3. Methods

#### 3.1. Routine immunization costs

##### 3.1.1. *Perspective and key assumptions*

The current study takes the perspective of government health services<sup>5</sup>. The time horizon of the routine immunization analysis covers the fiscal year of 2011.

##### 3.1.2. *Sampling*

###### a) The choice of district (randomized stratified sampling)

Health zones in Benin are grouped into 4 strata based on their population density and the number of administered pentavalent vaccine doses:

- Low population density and low administered doses
- Low population density and high administered doses
- High population density and low administered doses
- High population density and high administered doses

We equally grouped these health zones' into 4 geographic zones: Cotonou, South, Center and North.

Inside each stratum we randomly picked health zones for our sample. When a geographic zone had already been selected in the precedent draw, it would be excluded in the next, in order to ensure diverse geographic areas would be included.

We resulted in the following four health zones:

- Health Zone of Porto-Novo/Sèmè-Kpodji/Aguégués (South)
- Health Zone of Cotonou 2/ Cotonou 3 (Cotonou)
- Health Zone of Parakou/N'Dali (North)
- Health Zone of Savalou/Bantè (Center)

Given the small number of health facilities found in these health zones, we included 4 other health zones. This was done by randomly picking up the neighboring districts around the above selected health zones. This method aimed to avoid an overly large geographic dispersion and facilitate the implementation of surveys.

The following 4 health zones were added into our sample:

- Health Zone of Akpro
- Health Zone of Cotonou 1/4
- Health Zone of Tchaourou
- Health Zone of Dassa Zoumé

###### b) The choice of health facilities (randomized stratified sampling)

Inside each selected health zone, health facilities were regrouped according to rural/urban area and facility type (health center, clinic<sup>6</sup>, NGO mission facility). Hospitals have been deleted from the analysis because activities related to immunization were performed in only one of them. For a margin of error of 12%; and a confidence level of 90.5% with a total number of facilities of 695, the recommended sample size was 46. Private for-profit facilities were outside the study scope.

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<sup>5</sup> And therefore excludes indirect or households costs.

<sup>6</sup> Clinics refers to 'dispensaire/maternité'

The ratio of the number of health centers in rural zones vs. urban zones was 1.97 (78/36). In order to represent this ratio in our sample, we choose 1 urban health center for every 2 rural ones. For certain health zones, Cotonou for example, there was no rural health center. In such cases we chose only urban health centers. For Tchaourou and Savalou health zones, there was only one urban health center. They were put into our sample. For health facilities and clinics, we conducted a random sampling without replacement. Table 3 and 4 shows the distribution of final samples by type of health facility and by region (See also Annex 2 for the detailed sample).

**Table 3. Final sample selected by district and location of Benin**

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
Porto Novo	5	11	45.5%	3	19	15.8%
Akpro	4	16	25.0%	3	6	50.0%
Cotonou 2-3	3	3	100.0%	3	2	150.0%
Cotonou 1-4	1	1	100.0%	4	4	100.0%
Parakou N'Dali	2	5	40.0%	2	8	25.0%
Tchaourou	4	7	57.1%	2	2	100.0%
Savalou banté	4	18	22.2%	1	1	100.0%
Dassa Zoumé	4	16	25.0%	2	2	100.0%
Total	27	77	35.1%	20	44	45.4%

**Table 4. Final sample of health facilities by type of health facility**

	Rural	Urban	Total by health facility
Health center	23	16	39
Dispensary / maternity (Clinic)	3	2	5
NGO / mission facility		2	2
<b>Total by urban/rural regions</b>	<b>26</b>	<b>20</b>	<b>46</b>

The table of sample weights used in the analysis is available in appendix 3.

### 3.1.3. Data collection (instruments and process)

#### 3.1.3.1. Survey units

The different sites for data collection included all health system levels ranging from central level to the sub-district one. Especially with regards to data used for the current study, information was mostly collected at the facility level. The sub-district level has primary healthcare facilities that provide immunization services (owned by the government or NGOs), including health centers, and dispensaries/maternalities.

#### 3.1.3.2. 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 Benin context. The interviewers received six days of training on the questionnaires in Cotonou (Benin). The objectives were to (i) present the study to the interviewers, (ii) discuss and adjust the different questionnaires of the study, (iii) perform a pre-testing of the questionnaires in the field and, (iv) finalize operational planning of the data collection.

The pre-test of the questionnaires was performed in areas which were not part of the study sample. Diverse 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.

#### 3.1.3.3. Field data collection

Directed interviews and the document review were conducted to collect data on the inputs used by the routine immunization program and for vaccine introduction activities. The data collection at facility, district and regional levels was conducted by interviewers with dedicated questionnaires at each level. 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.

#### 3.1.3.4. Supervision of data entry

Supervisors conducted activities such as (i) reviewing first surveys completed followed by random selection out of all final surveys, (ii) sending feedback for corrections to interviewers, (iii) supporting the interviewers when issues arose by proposing corrections to resolve them (through a dedicated document).

#### 3.1.3.5. Sharing of files by interviewers

Interviewers emailed supervisors 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 (facility).

### 3.1.4. *Data quality and verification process*

Corrections were proposed by the supervisors and for action (if required) by interviewers. Frequent opportunities between interviewers and supervisors were set up to exchange on the problems identified and on the review of the initial surveys completed.

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

### 3.1.5. *Cost calculation*

The cost calculations were derived from the common methodological approach of the project (2). Costs were first calculated by line item based on the item approach, but also through the past spending approach.

#### 3.1.1. *Cost calculation by input classification*

##### 3.1.1.1. Paid labor

Paid labor was estimated based on the percentage of total working time spent on routine immunization activities. Staff salaries were collected in the surveyed facilities and administrative unit.

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

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

##### 3.1.1.3. Vaccines and injection supplies

Vaccine costs were based on the doses utilized at the end of 2011. Vaccine costs were allocated to outreach or facility-based service delivery levels based on the number of doses administered in each strategy in the facility. As PCV13 was introduced during the investigation period (2011), its cost will be included into the cost of vaccine for routine immunization (nationwide analysis only and not for the facility level analysis).

#### 3.1.1.4. Transport and fuel

Transportation costs were estimated based on the number of kilometers for each vehicle in 2011. The number of kilometers was collected in vehicle log books or estimated by respondents. This figure was apportioned by the share of use for routine immunization, and 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.

#### 3.1.1.5. Cold chain energy costs

Expenditures on cold chain energy costs were collected at all levels using the past spending approach.

#### 3.1.1.6. Overheads, utilities and communication

Overheads, utilities and communication were estimated based on the facility or administration total overhead expense.

#### 3.1.1.7. Cold chain equipment and vehicles

Cold chain equipment cost calculations were based on the replacement price of the equipment, percentage of use for immunization (based on survey response), and useful life years (provided by respondents).

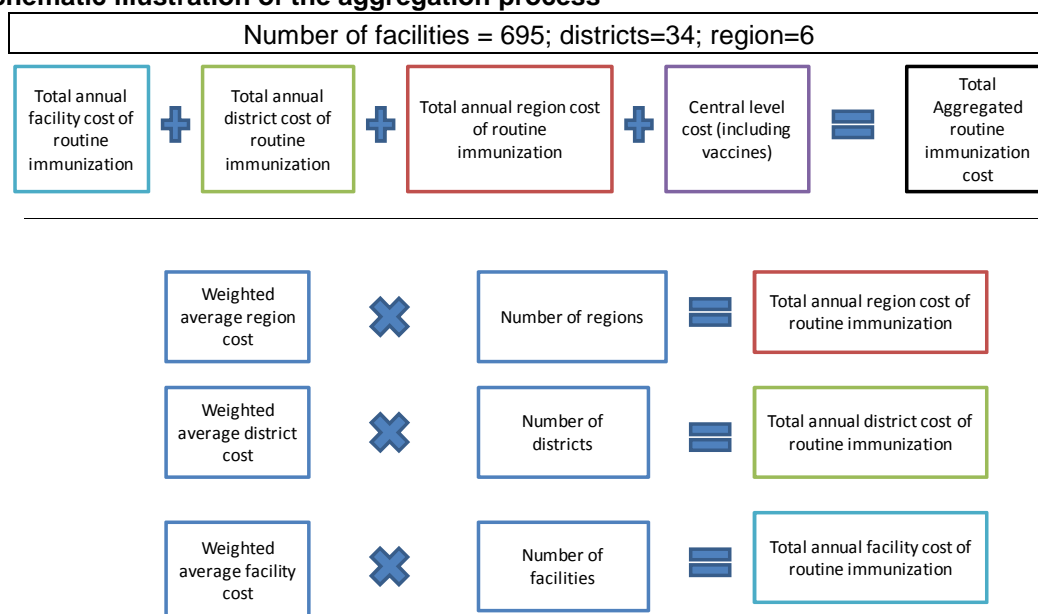
### 3.1.2. *Aggregation of costs*

The routine immunization cost for the full country was estimated by aggregating the average routine immunization costs at each administrative level. Four administrative levels were considered. From the bottom to the top level, they were health facilities, district level (health zone), regional level (health department) and central level. At facility level, sampling weight corresponded to the product of the inverse probability of a district being selected and that of a facility being selected once the district to which it belonged has been chosen. The facility weighted average cost (without vaccine costs) was then multiplied by the number of facilities in the study scope (n=695). (See Annex 2. for the details of sampling weight and Annex 3 for information on unit prices used in our study).

At district level (health zone), the sampling weight corresponded to the inverse probability of a district being selected. The weighted average costs (without vaccine costs) were then multiplied by the number of districts (n=34).

At regional level (health department), 4 out of the 6 regions/departments were involved in our sample. Each region (health department) contains two districts (health zones). Inside each region, the numbers of vaccine doses administrated in 2011 by the two districts was added. The weighting coefficient at region/department level was the proportion of the sum of vaccine doses administrated in 2011 per region over the total doses administrated in 2011 in our sample. The assumptions were 1) administrated doses represented the demand for vaccination; 2) the cost of related activities varied in proportion to the demand for vaccination; and 3) the selected regions/departments were representative in terms of the distribution of this demand over the country. The total cost of routine immunization at regional level was obtained by multiplying the weighted average cost (without vaccine cost) by the total number of health departments (6).

Finally, the central level RI cost was evaluated based on the data obtained from the National Agency of Vaccination (ANV). Information on the cost of vaccine, as well as that of vaccine injection and security supplies was also added at this level. The assumption was that the vaccine costs registered at facility or district level might be already counted in the vaccine cost evaluated by ANV. To avoid the duplication of data, only the vaccine cost estimated at central level was taken into account (Graph 2). Vaccine costs were then reallocated to the facility level and to the activities of outreach and fixed based delivery at facility level, based on the proportion of vaccine costs for the two strategies at facility level.

**Graph 2. Schematic illustration of the aggregation process**

### 3.2. New vaccine introduction costs

The methodology for the NUVI costing was the one derived from the common approach (2). In our database, information on activities for the introduction was registered from the introduction (July 2011) until the end of the year (December, 2011). Our calculation for the cost of the introduction of new vaccines was based on this period. Major activities that have been undertaken for the introduction of new vaccine and reported by the country (Benin, 2011) included:

- Public awareness;
- Training for the parties involved;
- Ceremony health for the national launch of the pneumococcal vaccine;
- Supervision of immunization activities;
- Training at all levels and records published

Based on this information, we classified costs due to activities such as training, social mobilization and supervision, as well as the cost of start-up, and the remaining activity costs linked to new vaccines, as ongoing cost. The cost of the new vaccine and its supplies were estimated solely at central level (EPI).

The introduction of new vaccine does increase the utilization of existing equipment. In the dataset, no information was registered relating to the incremental increase of equipment due to new vaccine introductions. We used the estimation of WHO Logistics Planning Tool (2013) with Benin's data (cf. annex 7) to evaluate the increase of workload of cold chain equipment (at facility<sup>7</sup>, district & region<sup>8</sup>. and national<sup>9</sup>).

### 3.1. Productivity analysis

The productivity analysis consisted of ranking health facilities according to their cost-effectiveness performance. The productivity analysis was performed by computing different productivity indicators such as the total doses

<sup>7</sup> Calculation formula: new volume of all vaccines & diluents, stored at 5°C at service delivery, per FIC after vs. before introduction of PCV13 = 91.6/48.3

<sup>8</sup> Calculation formula: new volume of all vaccines, stored at 5°C at lower level stores, per FIC after vs. before introduction of PCV13 = 75/31.7

<sup>9</sup> Calculation formula: new volume of vaccines without OPV stored at 5°C at higher level stores, per FIC after vs. before introduction of PCV13=70.3/27

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 was completed by the quadrant exploration, which helped to graphically assess the performance of the facilities. Productivity is thought of as the relationship between units of output per unit of input. In this vein, the following productivity indicators were explored, evaluated and summarized. These were:

- Total doses administered/ 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

### 3.2. Determinant analysis

The determinant analysis of immunization costing was a cross-country study with the 46 health facilities of Benin in our sample. It consisted of identifying factors that were driving routine immunization costs, as well as their magnitude. The independent variables of the determinant analysis were the total costs for providing routine immunization services. The potential explanatory characteristics were both continuous and categorical variables. They range from intrinsic factors related to child features (coverage doses) to extrinsic characteristics associated to facility settings, vaccine supply and management systems, and some variables of the catchment area of the facilities.

The study aimed to identify the determinants of routine immunization cost, as well as perform the productivity analysis of health facilities. Ultimately, the determinants analysis intended to come up with sound analyses and compelling results. These would be used to simulate various scenarios and fine-tune immunization management systems at all levels with regards to activity planning, process management, and decision-making. In this way the binding constraints and enablers could be fairly well known and foreseen prior to undertaking further activities. The productivity analysis would allow for the proper classifying of facilities through quadrant analysis.

In all, beyond the 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.

A two-stage sampling approach was used for drawing samples.

#### Stage One

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

Equation 1: 
$$n_0 = \frac{Z^2 * p * q}{e^2}$$

Where a normal distribution was assumed, and:

$n_0$  = sample size;

$Z^2$  = area under the normal curve (1.96 for 95% CI);

$p$  = estimated proportion of an attribute that is present in the population (assume 0.5);

$q = 1 - p = 0.5$ ;

The resulting sample size was  $(1.96)^2(0.5)(0.5)/(0.1)^2 = 96$

#### Stage Two

Assume that the population of facilities was small. The sample size could then be adjusted, because a given sample size would provide proportionately more information for a small population than for a large population.

Equation 1 
$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

Where:

$n_0$  = initial sample size and  $N$  = population size.

Assuming approximately 100 primary care facilities in the geographical areas were sampled, the resulting sample size would 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,  $CQ_i$  is the total facility immunization cost (including vaccine cost);  $FIC_i$  the Fully Immunized Child number expressed as a measure of production outcome;  $FTE_i$  the proportion of time dedicated to immunization by immunization staff as a quantity input measure judged likely to be a key driver of facility cost;  $P_i$  the average wage of staff as a price measure; and  $Z_i$  a measure of quality based on a yes or no answer to the question, “Do you have enough staff to conduct routine immunization well?”. Log transformation was performed for quantitative variables because this allowed these variables to have a normal distribution. The coefficients of the explanatory variables in log transformation indicated the elasticity of the vaccination cost relative to the corresponding explanatory variables.

Using the above as the base model, we developed several linear regression models, starting from the theoretical model and adding control variables one by one (all categorical), and assessed the behavior of the model. The control variables used were the ‘urban or rural location’, ‘type of health facility’, and ‘region’. The covariates ‘existence of users’ fees, ‘existence of volunteers supporting immunization’, and ‘existence of cold chain equipment’ are not included in the regression model because their terms were invariant. After performing each model, post estimation diagnostics were computed to check the validity of each model. The various tests computed were the Linktest test to ascertain whether the model was well specified; the Ramsey RESET 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.

### 3.3. Funding flow analysis

This part of the study focused on an analysis of 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.

### 3.4. Methods for the quantitative analyses of financial and commodity flows

#### 3.4.1. Data collection

Specific questionnaires on funding flow for routine immunization were developed and administered to the following institutions:

- Central national immunization program
- External partners providing support to immunization (UNICEF, WHO, Rotary Club)
- Regional offices
- District offices

The following data was collected with each of these institutions:

- Amount in budget
- Amount received
- Amount spent

#### 3.4.2. Coding and analysis

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 5).

**Table 5. 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; other revenues from household/communities; 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 healthcare financing schemes, voluntary healthcare payment schemes (other than OOP), household out-of-pocket payment, rest of the world.
Health services provider (HP)	Hospitals, providers of ambulatory healthcare, provider of ancillary services, providers of preventive care, providers of healthcare system administration and financing, rest of the economy, rest of the world
Healthcare 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.
Healthcare 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 as well as corresponding details are provided in Annex 7.

### 3.4.3. *Aggregation*

Aggregation was only done for domestic funding sources. This was because funding from external sources generally has specific destinations and should not be generalized across the whole country. For domestic funding at district and region levels, a weighted average of funding flow was generated based on the aggregation method.

### 3.5. Ethical issues

We only collected institutional data. This study was exempted from an Internal Review Board (IRB) process. 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.

### 3.6. Limitations of the approaches

#### 3.6.1. *Routine immunization*

No hospital was included in the cost calculation at facility level, despite the fact that four hospitals were chosen in our initial survey. The reason not to include them was that only one in four had registered routine immunization activities. Consequently, the final evaluation of total RI cost may potentially been underestimated.

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

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, etc) were verified with interviewers and corrected accordingly in order to minimize bias.

Expenses for cold chain were collected at the national level. Costs related to staff time spent on cold chain and vehicle maintenance was assessed at all levels. In addition, the costs of disposal of residual stocks of vaccines have not been taken into account.

In some facilities, if some planned activities were not conducted (for example the number of outreach conducted) this would lower its cost. Therefore, in some cases, a lower total cost could imply a lack of resources for the activities.

#### 3.6.2. *New vaccines introduction*

The preparatory activities at central level related to the introduction (pre introduction) were not available in the dataset. This limitation may underestimate part of the start-up cost of the new vaccine introduction, in particular at central level (cMYP application, development of tools and other materials).

#### 3.6.1. *Funding flow analysis*

The results provided were based on the sample, meaning that not all of the Benin departmental and district health zone offices were included in the funding flow analyses. If departmental and district health offices that were not chosen in the study sample had received funds from external financing organizations, these sums were not included in our funding analyses. In other words, the present funding analysis might underestimate the actual sum of funding that Benin received in 2011.

## 4. Routine immunization costs

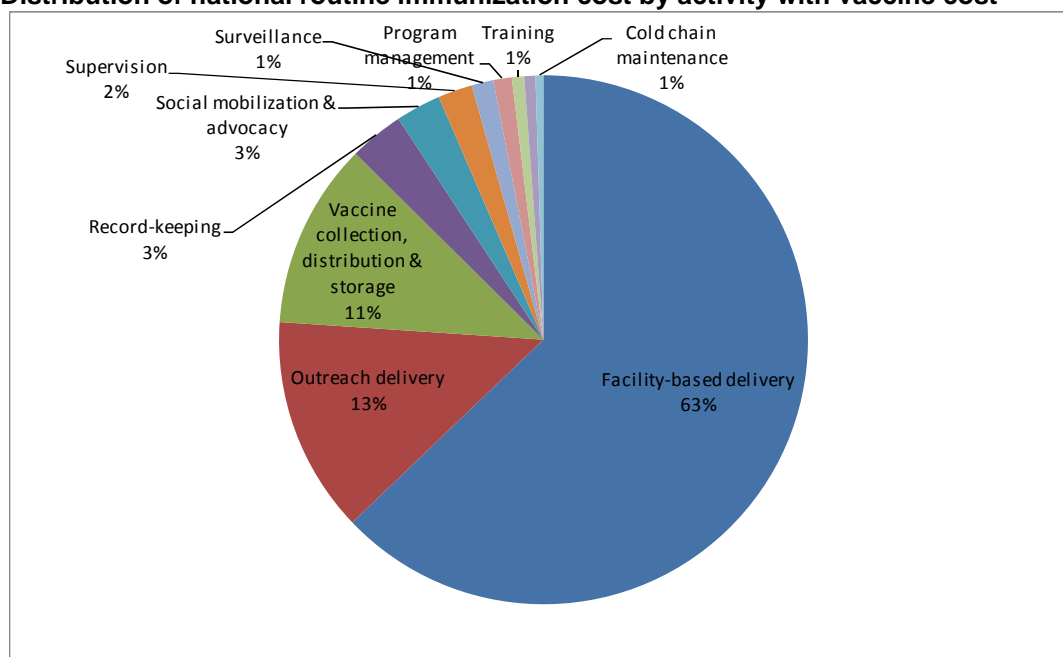
### 4.1. Nationwide routine immunization costs

#### 4.1.1. Nationwide routine immunization cost profile

##### Nationwide cost profile by activity

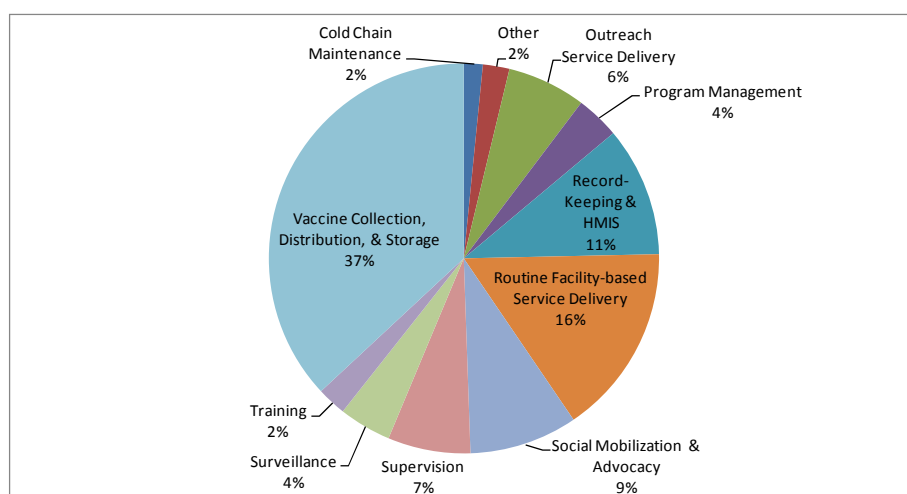
Total RI economic costs of Benin in 2011 amounted to US\$ 14,651,390. This represented 8.44% of general government expenditure on health and 0.20% of Gross Domestic Product (General Government Health Expenditure and gross domestic product data were extracted from 'Health Expenditure Series', WHO). Service delivery costs accounted for 76% of total cost (with 63% for fixed-based delivery and 13% for outreach delivery). Vaccine collection, distribution and storage accounted for 11% of the total cost. When excluding PCV cost, the total amount was US\$ 9,227,004 and US\$ 2.22 per dose.

**Graph 3. Distribution of national routine immunization cost by activity with vaccine cost**



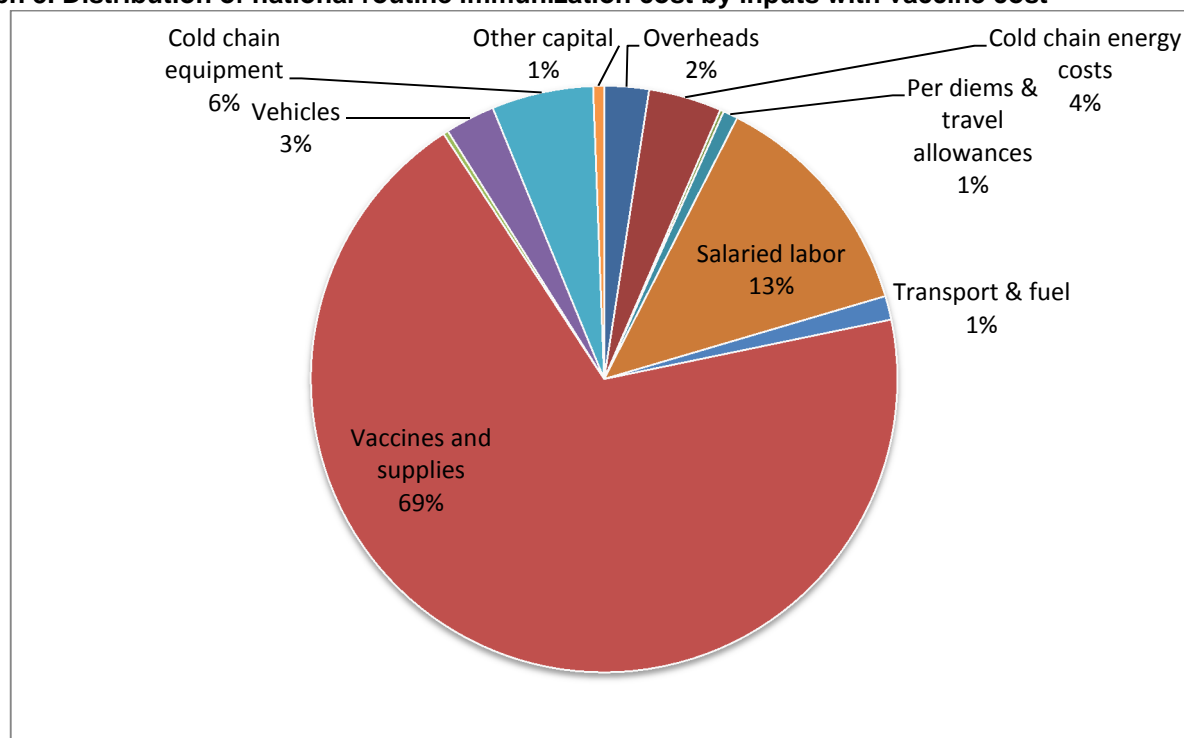
If the vaccine cost was excluded, the share of vaccine collection, distribution and storage increased to 37%. Fixed and outreach service delivery accounted for 16% and 6% respectively.

**Graph 4. Distribution of national routine immunization costs by inputs  
(Excluding vaccines and supplies cost)**



The distribution of costs among inputs was skewed towards five terms: vaccines & supplies, labor, cold chain equipment, and vehicle. The vaccines and supplies cost was US\$ 10,113,007, representing 69.2% of total cost. Salaried labor was the second-biggest cost driver, accounting for 12.7% with vaccine cost (41.3% without vaccine cost), followed by cold chain equipment, 5.6% with vaccine cost, and 18% without vaccine cost (Graph 5).

**Graph 5. Distribution of national routine immunization cost by inputs with vaccine cost**



#### 4.1.2. Total routine immunization cost profile by administrative level

The routine immunization costs at the four administrative levels are summarized in table 6. Within the total nationwide delivery cost for routine immunization, facility level represented the bulk of total cost with 82%, district level 9% regional level 5% and central level 5%.

At central level the cost was driven by social mobilization, supervision and vaccine management. At regional level, the activities of vaccine management, program management and supervision consumed most of the resources. At district level, the costs were driven by vaccine management, supervision and surveillance. At facility level, the three most important costs were fixed-base delivery, outreach and vaccine management.

**Table 6. Summary of economic delivery costs by activities**

Activity	Facility	District	Region	ANV	National total	Percent distribution
Cold chain maintenance	56 969	1 688	3 896	7 981	70 533	0.5%
Other	69 055	6 605	3 683	20 646	99 989	0.7%
Outreach service delivery	317 267	0	0	0	317 267	13.2%
Program management	87 523	26 250	27 590	22 537	163 901	1.1%
Record-keeping & HMIS	458 373	12 638	12 543	4 128	487 681	3.3%
Routine facility-based service delivery	715 316	0	0	0	715 316	62.9%
Social mobilization & advocacy	330 239	12 261	16 574	45 457	404 532	2.8%
Supervision	142 494	102 635	21 244	41 797	308 169	2.1%
Surveillance	87 841	54 282	35 234	19 104	196 460	1.3%
Training	96 873	9 348	3 275	2 045	111 540	0.8%
Vaccine collection, distribution, & storage	1 352 565	163 897	104 872	41 632	1 662 966	11.4%
<b>Total cost</b>	<b>3 714 513</b>	<b>389 603</b>	<b>228 910</b>	<b>205 326</b>	<b>4 538 353</b>	<b>100%</b>

At central level, the main cost drivers were vehicles, salaried labor and other equipment. At district level, the costs were driven by cold chain energy, salaried labor and vehicles. At regional the three main inputs in proportion of total cost were cold chain energy, salaried labor and cold chain equipment. At facility level, the costs were driven by vaccines, salaried labor and cold chain (table 8).

**Table 7. Total routine immunization economic costs of Benin by line item (\$2011) with vaccine cost at national level**

Line Items	Facility	District	Region	ANV	Total routine immunization costs	Percent distribution
Building overhead, utilities, communication	320 165	5 202	24 486	10 574	360 427	2.5%
Cold chain energy costs	376 833	131 818	69 384	11 739	589 774	4.0%
Other	20 896	0	3 309	5 323	29 528	0.2%
other recurrent	663	0	0		663	0.0%
Per Diem & travel allowances	99 382	6 460	8 250	4 311	118 403	0.8%
Salaried Labor	1 660 628	107 304	67 767	59 451	1 895 150	12.9%
Transport/fuel	164 238	11 322	3 290	13 473	192 323	1.3%
Vaccine injection & safety supplies		0	0	0	0	0.0%
Vaccines	10 113 007	0	0	0	10 113 007	69.0%
Vehicles maintenance	40 273	0	0		40 273	0.3%

<b>Subtotal recurrent</b>	<b>12 796 085</b>	<b>262 106</b>	<b>176 486</b>	<b>104 872</b>	<b>13 339 548</b>	<b>91.0%</b>
Vehicles	217 051	103 408	22 466	59 602	402 527	2.7%
Cold chain equipment	766 024	20 465	27 334	7 486	821 308	5.6%
Other equipment	48 361	3 653	2 625	33 367	88 006	0.6%
<b>Subtotal capital</b>	<b>1 031 436</b>	<b>127 526</b>	<b>52 425</b>	<b>100 455</b>	<b>1 311 841</b>	<b>9.0%</b>
<b>Total immunization cost</b>	<b>13 827 521</b>	<b>389 632</b>	<b>228 911</b>	<b>205 327</b>	<b>14 651 390</b>	<b>100%</b>

#### 4.1.3. Nationwide unit cost for routine immunization

In this part, we calculated the unit costs per selected outputs of vaccination. Table 9 shows the main outputs and corresponding unit cost. Unit cost per child dose was US\$ 3.53. The unit cost per DTP3 vaccinated children was US\$ 43.76. The unit cost per infant was US\$ 41.93, and the unit cost per capita was US\$ 1.49.

**Table 8. Nationwide routine unit cost (\$ 2011)**

<b>Benchmarks</b>	
<b>- Total immunization cost</b>	<b>14 651 390</b>
- Total doses administered	4 147 136
- Total DTP3 vaccinated children <sup>1</sup>	334 044
- Infant population <sup>2</sup>	348 577
- Total population <sup>3</sup>	9 780 000
- Cost per dose	3.53
- Cost per DTP3 vaccinated children	43.86
- Cost per infant	42.03
- Cost per capita	1.50

1. Data source: Registered at ANV level in the database of this study
2. Data source: Annual Program Report of Benin (2011) from the site of GAVI
3. Data source: From the site of WHO

Table 10 further decomposes unit cost by activities. Fixed-based service delivery cost is 2.22 US\$ per dose and 26.42 US\$ per child against 0.47 US\$ per dose and 5.55 US\$ per child for outreach service delivery. Vaccine collection, distribution & storage cost 0.40 US\$ per dose and 4.77 US\$ per child.

**Table 9. Routine unit cost by activities (nationwide)**

<b>Nationwide RI delivery cost</b>	<b>14 651 390</b>		
Total infant population	348 577		
Total doses administered	4 147 136		
<b>Benchmarks</b>	<b>%</b>	<b>per dose</b>	<b>per child</b>
Cold chain maintenance	0.5%	0.02	0.20
Other	0.7%	0.02	0.29
Outreach service delivery	13.2%	0.47	5.55
Program management	1.1%	0.04	0.47
Record-keeping & HMIS	3.3%	0.12	1.40
Routine fixed-based service delivery	62.9%	2.22	26.42
Social mobilization & advocacy	2.8%	0.10	1.16
Supervision	2.1%	0.07	0.88
Surveillance	1.3%	0.05	0.56
Training	0.8%	0.03	0.32
Vaccine collection, distribution & storage	11.4%	0.40	4.77
<b>Total immunization cost</b>	<b>100%</b>	<b>3.53</b>	<b>42.03</b>

#### 4.2. Routine immunization costs at EPI offices (central, region and district)

The RI costs of EPI offices were presented by administrative level (central, region and district) and for a given administrative unit, excluding the cost of vaccines and supplies. The total cost for central EPI office was US\$ 205 326 in 2011. At the central EPI office, the activities of social mobilization, supervision and vaccine management consumed the majority of resources, accounting respectively for 22%, 20% and 20% of the national immunization agency's total cost in 2011.

At regional level, the average RI cost was US\$ 38 065 where the activity of vaccine management took the majority (46%), followed by surveillance (15%), and supervision (9%). At district level (bureau de zone), the average RI economic cost per health zone was US\$ 11 459. The main activities in terms of resource consumption at this level were vaccine management (42%) supervision (26%), and surveillance (14%).

This structure reflects the main responsibilities of health zone offices, which are to ensure the supply of vaccines; supervise the operational vaccine activities; and ensure surveillance related to immunization (Table 11). The substantial share taken by cold chain at region and district offices can be explained by their critical role played in the cold chain system. The relatively higher share of supervision costs at district level was consistent with the fact they have more responsibilities to supervise the proper implementation of immunization activities at facility level.

**Table 10. Total RI economic costs at EPI offices by activities**

Activities	Central N=1		Region N=6		District N=34	
<b>Total immunization economic cost</b>	<b>205 326</b>		<b>38 152</b>		<b>11 459</b>	
<i>Ranges (Min-Max)</i>	-	100%	(29 398-45 288)		(5 867-16 365)	100%
Cold chain maintenance	7 981	3.9%	649	1.7%	50	0.4%
Other	20 646	10.1%	614	1.6%	194	1.7%
Program management	22 537	11.0%	4 598	12.1%	772	6.7%
Record-keeping & HMIS	4 128	2.0%	2 090	5.5%	372	3.2%
Social mobilization & advocacy	45 457	22.1%	2 762	7.2%	361	3.2%
Supervision	41 797	20.4%	3 541	9.3%	3 019	26.3%
Surveillance	19 104	9.3%	5 872	15.4%	1 597	13.9%
Training	2 045	1.0%	546	1.4%	275	2.4%
Vaccine collection, distribution, & storage	41 632	20.3%	17 479	45.8%	4 820	42.1%

The main inputs at central level were salaried labor and vehicles at 29% each. The main inputs at regional level were cold chain equipment (42%), salaried labor (30%), and overheads (11%). At district level, cold chain equipment<sup>10</sup> (including cold chain energy costs) was the primary cost driver, accounting for 39% of total RI cost, followed by salaried labor, 27%, vehicles, 26%. Other inputs only incurred marginal economic costs.

When comparing cost distribution among inputs (table 12) at district and region levels, the main cost drivers were similar: labor, vehicles, cold chain equipment, and building overheads. However, at region level the share of cold chain equipment and overheads was higher than at district level, while the expenditure on vehicles was much higher at district level than at region level. The latter can be explained by the fact more transportation was required for district level activities.

<sup>10</sup> Cold chain equipment cost was not registered at health zone of cotonou 2&3 and Parakou N'Dali. Building overhead was only registered at health zone Dassa Glazoue.

**Table 11. Total routine immunization economic cost by line item (\$2011) at Benin EPI offices**

	Central	Region N=4	District 'Zone Office' N=4
<b>Total</b>	<b>205 326</b>	<b>38 152</b>	<b>11 459</b>
<i>Range (Min-Max)</i>	-	(29 398-45 288)	(5 867-16 365)
Overheads	10 574	4081	153
Other	5 323	551	0
Per diem & travel allowances	4 311	1375	190
Salaried labor	59 451	11295	3156
Transport/fuel	13 473	548	333
Vehicles	59 602	3744	3041
Cold chain equipment**	19 225	16120	4479
Other equipment	33 367	437	107

**Note:** \* Here, cost for each region is weighted by the proportion of the dose administered in the region over the total administered doses in our sample. As such, the "Total" column is the sum of preceding costs for each region. The total immunization cost by region is not directly comparable. \*\*Cold chain equipment cost here includes yearly cold chain energy costs.

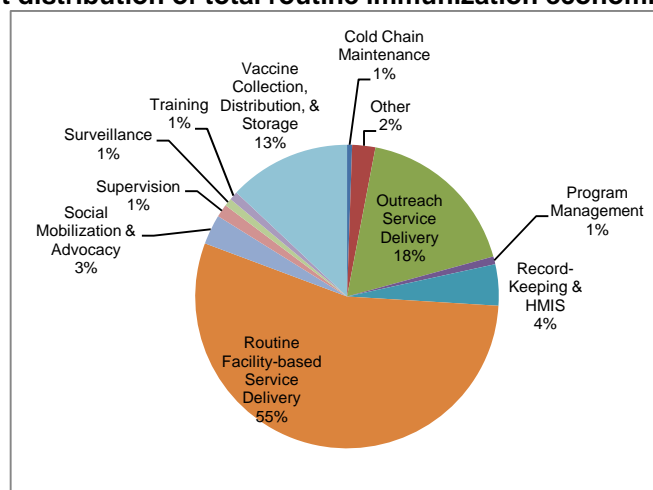
### 4.3. Routine immunization costs at facility level

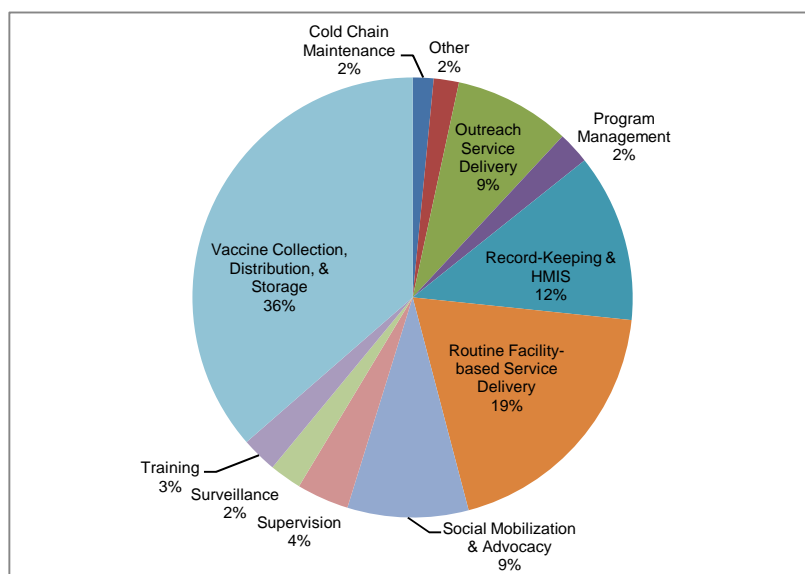
The weighted economic cost for routine immunization was US\$ 14,994 per health facility in 2011 within the sampled facilities. When vaccine cost was excluded, the delivery cost fell to US\$ 5,345. Comparing economic cost with financial cost, financial cost was slightly lower than economic cost, US\$ 14,842 vs. US\$ 14,994 (annex 4). The similarity is explained by the methodology where only the treatment of capital items differs between economic and financial costs.

#### 4.3.1. Facility cost profile by activity, facility type and urban/rural status

##### **Facility cost profile by activity**

In terms of activities, routine facility-based service delivery was the most important cost driver, accounting for 55% of total cost, followed by outreach service delivery (18%). The fact that vaccine cost was incorporated into these two activities partially explains this skewed cost distribution. When vaccine costs were excluded, vaccine collection, distribution and storage became the main cost driver, accounting for 36% of total operational cost. Fixed and outreach service delivery accounted for another 19% of total operation costs. Record-keeping and social mobilization also emerged as important cost drivers (12% and 9% for each) (Graph 6 and 7).

**Graph 6. Percent distribution of total routine immunization economic costs by activity**

**Graph 7. Routine immunization economic delivery costs distribution by activities - without vaccines****Facility cost profile by facility type****Table 12. Total routine immunization economic delivery costs by activity by facility type (\$2011) (without vaccine costs)**

Activities	Health center		Clinic ('dispensary/ Maternity')		NGO/ Mission facility		Weighted average	
	N=39		N=5		N=2			
Total costs	5357	100%	5209	100%	5478	100%	5345	100%
Cold chain maintenance	88	1.64%	27	0.52%	80	1.46%	82	1.53%
Other	101	1.89%	65	1.25%	232	4.24%	99	1.86%
Outreach service delivery	477	8.90%	324	6.23%	24	0.44%	456	8.54%
Program management	130	2.43%	106	2.04%	14	0.26%	126	2.36%
Record-keeping & HMIS	652	12.17%	761	14.60%	460	8.40%	660	12.34%
Routine facility-based service delivery	1041	19.43%	984	18.89%	621	11.34%	1029	19.26%
Social mobilization & advocacy	482	9.00%	480	9.22%	31	0.57%	475	8.89%
Supervision	194	3.62%	340	6.53%	21	0.38%	205	3.84%
Surveillance	137	2.56%	45	0.86%	0	0.00%	126	2.36%
Training	134	2.50%	204	3.91%	41	0.75%	139	2.61%
Vaccine collection, distribution & storage	1921	35.86%	1873	35.96%	3 953	72.16%	1946	36.41%

**Facility cost profile by urban/rural setting**

In absolute terms, the costs of training, record-keeping & HMIS, and supervision was 2 to 5 times higher in urban areas than in rural area, while the cost of outreach service delivery was twice as high in rural areas compared with urban areas (table 14).

**Table 13. Routine immunization economic costs by activity by location (\$2011)**

Activities	Urban N=20	% Distribution	Rural N=26	% Distribution	Urban/rural
<b>Total Facility Immunization Cost</b>	<b>17278</b>	<b>100%</b>	<b>13796</b>	<b>100%</b>	<b>1.25</b>
Cold chain maintenance	116	0.67%	64	0.46%	1.82
Other	361	2.09%	371	2.69%	0.97
Outreach service delivery	1626	9.41%	3202	23.21%	0.51

Activities	Urban N=20	% Distribution	Rural N=26	% Distribution	Urban/rural
Program management	99	0.58%	140	1.01%	0.71
Record-keeping & HMIS	1262	7.31%	343	2.49%	3.68
Routine facility-based service delivery	10147	58.73%	7190	52.11%	1.41
Social mobilization & advocacy	538	3.12%	442	3.20%	1.22
Supervision	446	2.58%	79	0.57%	5.68
Surveillance	160	0.93%	109	0.79%	1.48
Training	237	1.37%	88	0.64%	2.68
Vaccine collection, distribution, & storage	2284	13.22%	1769	12.82%	1.29

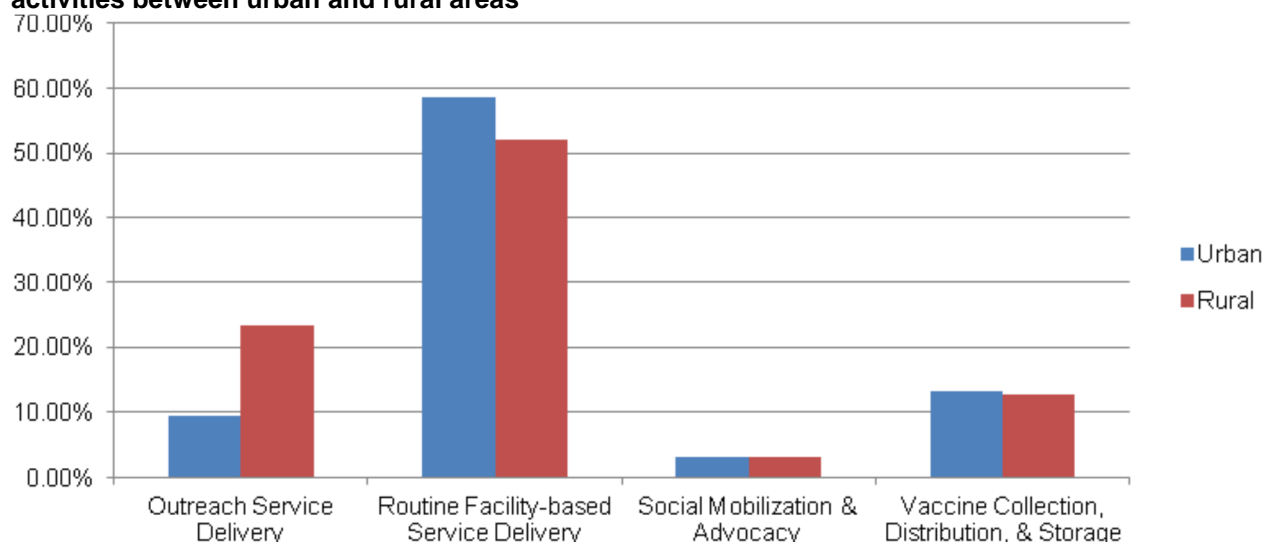
In terms of the distribution of RI cost by activities, routine facility-based service delivery was highest in both urban and rural areas. The share of outreach service delivery in terms of total RI cost was more than 2 times higher in rural areas than in urban areas. This was consistent with the fact that outreach strategies (administration outside the facility compound) were more frequent and required more resources in rural facilities compared to urban facilities. Vaccine collection, distribution and storage, and social mobilization, on the contrary, absorbed more resources in urban areas than rural areas. This distribution figure corresponds to the preceding notion that rural areas spend more on vaccine and transport while urban areas spend more on salary and cold chain equipment (Graph 8).

According to table 15, the delivery cost was higher in urban health centers. Rural health centers had a lower cost.

**Table 14. Routine immunization delivery costs (excluding vaccines and supplies) by location and type (\$2011)**

Facility type	Rural	Urban
Health center	4247	7480
Maternity	4971	5923
NGO/mission facility	-	5478

**Graph 8. Comparison of distribution (in %) of total routine immunization costs among the four main activities between urban and rural areas**

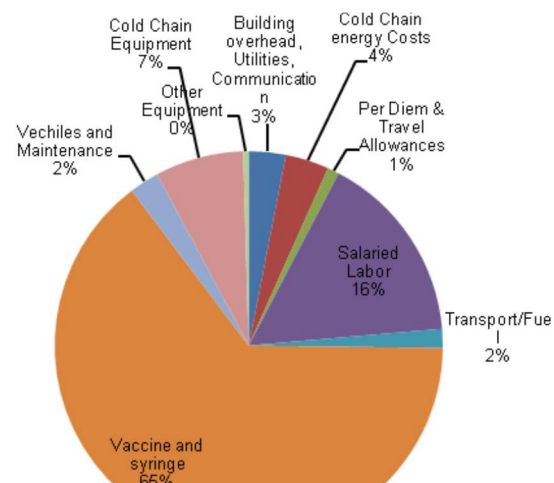


#### 4.3.2. Facility cost profile by input, facility type and urban/rural status

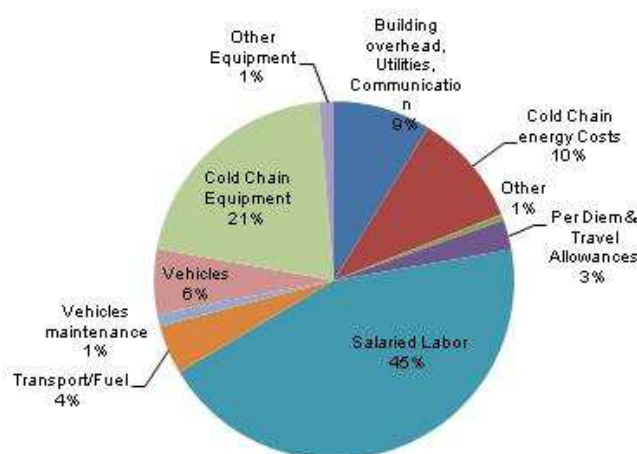
##### **Facility cost profile by input**

The cost of vaccines and supplies take the largest share of total routine immunization costs (65%). The second-biggest share was for salaried labor (16% counting vaccine costs and 45% without vaccine costs), followed by cold chain equipment and energy consumption (7% with vaccine cost and 21% without vaccine cost) (Graph 9 and 10). These results show that delivery cost (i.e. excluding the vaccines) is mostly driven by personnel and cold chain (equipment and energy cost), which together account for three-quarters of facility costs.

**Graph 9. Percent distribution of costs by input**



**Graph 10. Percent distribution of costs by input without vaccine costs**



##### **Facility cost profile by facility type**

On average, health centers and clinics had similar RI costs while NGO/mission facilities had slightly lower RI costs. The difference between the RI costs of the three types of health facilities came mainly from the cost of vaccine and supplies. Once vaccine cost was excluded, the average RI cost was similar across the three types of health facilities. The type of facility and ownership (government or NGO) did not seem to impact on the weighted average cost across facility type.

Comparing input costs across different types of health facility in absolute terms, health centers had the highest costs for salaried labor, per diem & travel allowances; clinics had the highest expenditure on building overheads, transport/fuel, and vehicles; NGO health facilities had the highest expenditure on cold chain equipment and energy costs (Table 16).

**Table 15. Average routine immunization economic costs by input and facility type (\$2011)**

Line item	Health center N=39	Clinic N=5	HF for NGO Mission N=2	Weighted average	Percent distribution
Salaried Labor	2 455	1948	1178	2389	15.94%
Per Diem & travel allowances	150	98	0	143	0.95%
Vaccines and supplies	9660	9836	7829	9 649	64.35%
Overheads	454	568	190	461	3.07%
Cold chain energy costs	525	645	961	542	3.62%
Transport and fuel	213	488	23	236	1.58%

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Vehicles maintenance	60	46		58	0.39%
Other	35	5	0	31	0.20%
<b>Subtotal recurrent</b>	<b>13551</b>	<b>13634</b>	<b>10181</b>	<b>13510</b>	<b>90.10%</b>
Vehicles	295	528	0	312.3	2.08%
Cold chain equipment	1100	839	2921	1102.2	7.35%
Other equipment	70	43	205	69.6	0.46%
<b>Subtotal capital</b>	<b>1465</b>	<b>1411</b>	<b>3126</b>	<b>1484</b>	<b>9.90%</b>
<b>Total cost</b>	<b>15 016</b>	<b>15 045</b>	<b>13 307</b>	<b>14 994</b>	<b>100%</b>
<b>Total delivery cost (excl. vaccines)</b>	<b>5 357</b>	<b>5 209</b>	<b>5 478</b>	<b>5 345</b>	<b>100%</b>

### Facility cost profile by urban/rural setting

In absolute terms, urban RI cost was higher than rural RI cost (urban vs. rural ratio = 1.25). When comparing inputs, the cost of transport/fuel reported in rural areas was twice as high as those in urban areas, while the cost of salary and office equipment (noted as "other equipment" in the database, including printers, computers, photocopiers, etc.) were almost tripled in urban regions relative to rural regions. The cost of vaccines however was similar (Table 17).

**Table 16. Total routine immunization economic costs by input by location (\$2011)**

Line Items	Urban N=20	% Distribution	Rural N=26	% Distribution	Urban/Rural Ratio
Overheads	367	2.12%	510	3,70%	<b>0.72</b>
Cold chain energy costs	511	2.96%	559	4,05%	<b>0.91</b>
Other	32	0.17%	31	0,22%	<b>0.96</b>
Per diem & travel allowances	184	1.06%	122	0,88%	<b>1.51</b>
Salaried labor	4114	23.81%	1485	10,76%	<b>2.77</b>
Transport / fuel	145	0.84%	284	2,06%	<b>0.51</b>
Vaccines and supplies	9988	57.81%	9472	68.65%	<b>1.05</b>
Vehicles maintenance	41	0.24%	67	0.49%	<b>0.61</b>
<b>Subtotal recurrent</b>	<b>15381</b>	<b>89.03%</b>	<b>12529</b>	<b>90.81%</b>	<b>1.23</b>
Vehicles	282	1.63%	328	2.38%	<b>0.86</b>
Cold chain equipment	1480	8.57%	904	6.551%	<b>1.64</b>
Other equipment	134	0.78%	36	0.26%	<b>3.74</b>
<b>Subtotal capital</b>	<b>1896</b>	<b>10.97%</b>	<b>1268</b>	<b>9.19%</b>	<b>1.50</b>
<b>Total</b>	<b>17278</b>	<b>100%</b>	<b>13797</b>	<b>100%</b>	<b>1.25</b>

The costs of vaccine and its supply was the biggest cost driver, representing 58% and 69% respectively of total RI cost for urban and rural areas. Once vaccine and supply cost was excluded from total RI cost, the remaining operational cost was halved and divided by 3 for urban and rural areas, amounting to US\$ 7290 and US\$ 4325 respectively (Table 18).

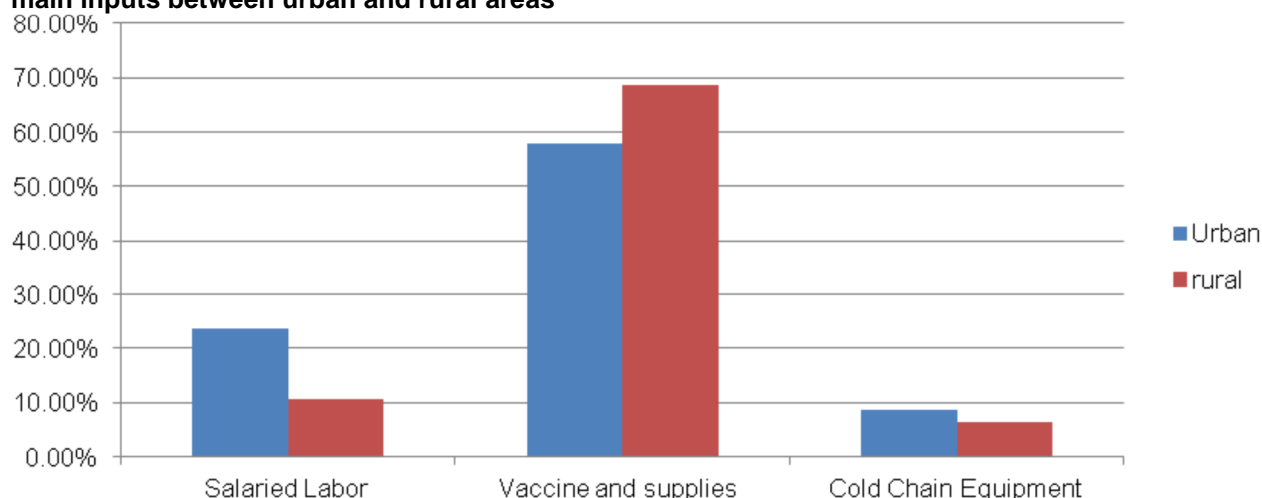
**Table 17. Total routine immunization economic costs by input and location (\$2011) without vaccine costs**

Line Items	Urban N=20	% Distribution	Rural N=26	% Distribution
Building overhead. Utilities, communication	367	5.03%	510	11.79%
Cold chain energy costs	511	7.01%	559	12.92%
Other	29	0.40%	31	0.71%
other recurrent	3	0.04%	0	0.00%

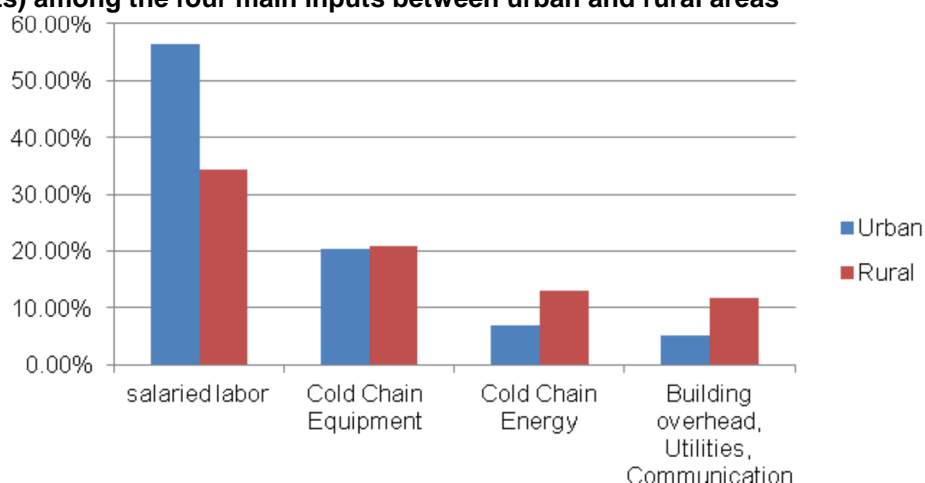
Line Items	Urban N=20	% Distribution	Rural N=26	% Distribution
Per diem & travel allowances	184	2.52%	122	2.81%
Salaried labor	4114	56.44%	1485	34.34%
Transport & fuel	145	1.99%	284	6.57%
Vehicles maintenance	41	0.56%	67	1.55%
<b>Subtotal Recurrent</b>	<b>5393</b>	<b>73.99%</b>	<b>3057</b>	<b>70.68%</b>
Vehicles	282	3.87%	328	7.59%
Cold Chain Equipment	1480	20.30%	904	20.91%
Other Equipment	134	1.84%	36	0.83%
<b>Subtotal Capital</b>	<b>1896</b>	<b>26.01%</b>	<b>1268</b>	<b>29.32%</b>
<b>Total Facility Immunization</b>	<b>7290</b>	<b>100.00%</b>	<b>4325</b>	<b>100.00%</b>

In terms of the distribution of RI costs among inputs, urban and rural areas are similarly ranked. Vaccine and its supplies, salaried labor, and cold chain equipment costs were the three main cost drivers. Once vaccine and supply costs were excluded, cold chain equipment, energy and building overheads were included in the list of main cost drivers. Graphs 11 and 12 compare the share of main cost drivers in terms of total RI cost between urban and rural areas. In rural areas, vaccine accounted for a larger share. Meanwhile for the three remaining primary cost drivers (vaccine supplies, salaried labor, and cold chain equipment), urban area took proportionally more resources than rural areas. Once vaccine and supply costs were excluded, salaried labor became the most significant cost in urban areas compared to rural areas, while cold chain energy costs and building overheads absorbed more resources in rural areas than urban areas.

**Graph 11. Comparison of the distribution (in %) of total routine immunization costs among the three main inputs between urban and rural areas**



**Graph 12. Comparison of the distribution (in %) of routine immunization delivery costs (without vaccine and its supplies costs) among the four main inputs between urban and rural areas**



### 4.3.3. Unit costs analysis

We chose four outputs as benchmarks to evaluate routine immunization unit cost: total doses administered in the reference period, children who received the third dose of DTP (referred to as Fully Immunized Child – FIC); children of less than 1 year old (referred to as infant population); and total population (referred to as capita).

The average unit cost per vaccine dose was US\$ 1.92. The cost per child receiving DTP3 was US\$ 24.96. Unit cost per infant was US\$ 19.01 and the unit cost per capita was US\$ 0.75 (table 19). All estimated unit costs at the facility level were lower than national estimations. Differences can be explained by limited sample size and potential bias linking to extrapolation of FIC to national estimates. The difference between the cost per capita from the sample and nationwide estimates could be explained by unreliable catchment population estimates at facilities (identified as an issue in the last cMYP). In addition, the nationwide estimate provides all levels, including central, region and districts.

#### 4.3.3.1. Unit cost by facility type

In comparing different types of health facilities, health centers (US\$ 24.24) and clinics (US\$ 30.51) were the most “efficient” in terms of cost per FIC compared to mission NGOs facilities (US\$ 40.40). Once vaccine costs were excluded, the remaining costs of the three types of health facilities were not significantly different (the variation was less than 5%). Clinics and health centers showed the lowest unit cost per vaccine dose and per DTP3 vaccinated child.

**Table 18. Comparison of outputs and benchmark unit economic costs by facility type**

Benchmark	Health center N=39	Clinic N=5	HF for NGO mission N=2	Weighted average
<b>Total Facility Immunization Cost</b>	<b>15016</b>	<b>15045</b>	<b>13307</b>	<b>14994</b>
Total child doses	7915	7341	4546	7796
Total DTP3-vaccinated children	619	493	329	601
Infant population	802	586	1299	789
Total population covered	20194	14777	32481	19868
Cost per dose	1.90	2,05	2,93	1.92
Cost per DTP3-vaccinated child	24.24	30,51	40,40	24.96
Cost per infant	18.73	25,66	10,25	19,01
Cost per capita	0.74	1,02	0,41	0,75

**Note:** \*1. Child doses are the weighted average used doses registered in our database.

\*2. Infant is defined as children of less than one year old.

#### 4.3.3.2. Unit cost by urban/rural status

The unit cost per infant and per capita according to urban rural status showed there was a higher cost-efficiency in urban areas than in rural ones. This could be explained by the health facility catchment (covered infant population and total population) which in general was three times higher in urban areas than in rural areas, which increased attendance to immunization sessions (Table 20).

**Table 19. Comparison of outputs and benchmark unit economic costs by urban/rural areas**

Benchmark	Urban N=20	Rural N=26	Weighted Average
<b>Total Facility Immunization Cost</b>	<b>17278</b>	<b>13797</b>	<b>14994</b>
Total Child Dose	11808	6548	7796
Total DTP3 Vaccinated Children	932	498	601
Infant Population	1346	497	789
Total Population Covered	33695	12616	19868
Cost per Dose	1.46	2.11	1.92
Cost per DTP3 Vaccinated Child	18.53	27.7	24.96
Cost per Infant	12.84	27.76	19.01
Cost per capita	0.51	1.09	0.75

When calculating RI cost without taking into account vaccine and its supplies, the unit cost per vaccine dose, per DTP3, per child and per capita was lower in urban region than in rural areas.

**Table 20. Comparison of outputs and benchmark unit economic delivery costs by urban/rural areas (without vaccines and supplies)**

Benchmark	Urban N=20	Rural N=26	Weighted Average
<b>Total Cost</b>	<b>7290</b>	<b>4325</b>	<b>5345</b>
Total Child Dose	11808	6548	7796
Total DTP3 Vaccinated Children	932	498	601
Infant Population	1346	497	789
Total Population	33695	12616	19868
Cost per Dose	0.62	0.66	0.69
Cost per DTP3 Vaccinated Child	7.82	8.69	8.89
Cost per Child	5.31	8.70	6.71
Cost per capita	0.21	0.34	0.27

**Table 21. Total Full Time Equivalents (FTE) by type of facility and salaried labor cost distribution by activity (weighted averages)**

Activities	Health Center	Clinic	NGO Mission
<b>Sample (n)</b>	<b>39</b>	<b>5</b>	<b>2</b>
<b>FTE</b>	1.54	1.03	1.22
<b>Distribution of salaried labor costs by activity</b>			
Cold Chain Maintenance	3.57%	1.38%	6.83%
Other	0.76%	0.86%	2.29%
Outreach Service Delivery	12.80%	7.03%	2.03%
Program Management	3.00%	2.62%	1.22%
Record-Keeping & HMIS	26.56%	39.04%	39.07%
Routine Facility-based Service Delivery	23.90%	21.35%	36.56%
Social Mobilization & Advocacy	7.29%	3.64%	2.65%
Supervision	6.28%	11.06%	1.30%
Surveillance	5.58%	2.30%	0.00%
Training	4.94%	7.38%	3.50%
Vaccine Collection, Distribution, & Storage	5.32%	3.34%	4.54%
All	100.00%	100.00%	100.00%

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**Table 22. Full Time Equivalents (FTE) by facility types**

Line Items	Health Center	Clinic	NGO Mission
Sample (n)	5	2	39
Total FTEs	1.54	1.03	1.22
Doses	7915	7 341	4 546
Doses/FTE	5140	7118	3721
FTE per dose delivered	0.0002	0.0001	0.0003

## 4.3.3.3. Non HR analysis at facility level

When excluding human resources costs, the weighted average facility cost amounted to USD 2,995; 0.38 USD per vaccine dose administered; 3.75 USD per infant and 4.92 USD per FIC.

**Table 23. Non HR costs and delivery costs at facility level by facility type (total, per dose, per child, per FIC)**

Non HR analysis (total and delivery costs)				
Facility type	Total cost	Total, non-HR cost	Delivery cost	Total, non-HR delivery cost
Health Centers	15016	12561	5357	2901
Dispensary	15045	13097	5209	3261
NGO facility	13307	12128	5478	4300
<b>All facilities</b>	<b>14994</b>	<b>12605</b>	<b>5345</b>	<b>2955</b>

Non HR analysis (unit cost per dose)				
Facility type	Cost per dose	Non-HR cost per dose	Delivery cost per dose	Non-HR delivery cost per dose
Health Centers	1.90	1.59	0.68	0.37
Dispensary	2.05	1.78	0.71	0.44
NGO facility	2.93	2.67	1.21	0.95
<b>All facilities</b>	<b>1.92</b>	<b>1.62</b>	<b>0.69</b>	<b>0.38</b>

Non HR analysis (unit cost per child)				
Facility type	Cost per child	Non-HR Cost per child	Delivery cost per child	Non-HR delivery cost per child
Health Centers	18.73	15.67	6.68	3.62
Dispensary	25.66	22.33	8.88	5.56
NGO facility	10.25	9.34	4.22	3.31
<b>All facilities</b>	<b>19.01</b>	<b>15.98</b>	<b>6.78</b>	<b>3.75</b>

Non HR analysis (unit cost per FIC)				
Facility type	Cost per FIC	Non-HR cost per FIC	Delivery cost per FIC	Non-HR delivery cost per FIC
Health Centers	24.24	20.28	8.65	4.68
Dispensary	30.51	26.56	10.56	6.61
NGO facility	40.40	36.82	16.63	13.05
<b>All facilities</b>	<b>24.96</b>	<b>20.98</b>	<b>8.90</b>	<b>4.92</b>

#### 4.4. Comparison with comprehensive multi-year plan estimate

The costing study estimates were higher than the cMYP estimates (cMYP / study ratio < 1) for all inputs except for the transportation category (table 22). The vaccine cost was higher in our costing study compared to the cMYP estimate. The personnel cost was US\$ 1 466 453 in the 2012 cMYP and US\$ 1 860 071 in the costing study. This difference shows that current estimates are approximately 25% below our study estimates. It also shows that study results in terms of personnel involvement may provide useful information to update the cMYP<sup>11</sup> as it is based on facility and administrative offices surveys. Transportation costs were higher in the cMYP. This could be explained by the fact cMYP uses standard proxies of distance travelled to generate transportation costs, whereas this study collected the actual fuel costs at the different levels (for the different activities requiring transportation). Capital costs were systematically higher in the costing study for vehicles, cold chain equipment and other capital, highlighting the fact these may be underestimated in current cMYP. It should be noted that the cMYP costing tool mixed the classification by inputs with the classification by activities, while the actual costing study distinguished these two analysis angles. This explains the limitations in directly comparing the two estimates.

**Table 24. Comparison with updated cMYP by line item**

	cMYP 2012 (baseline)	Costing study (2011)	cMYP/study ratio
<b>Recurrent costs</b>			
Vaccine and supplies	6 407 378	10 113 007	0.63
Salaries	1 466 453	1 860 071	0.79
Per-diems	n/a	118 403	-
Transportation cost	301 007	192 323	1.56
Maintenance and overhead	37 785	360 427	0.10
Trainings	n/a	-	
Social mobilization	n/a	-	
Disease surveillance	n/a	-	
Program management	n/a	-	
Other cost	-	30 191	
Cold chain energy costs	-	589 774	
Other recurrent			
<b>Capital costs</b>			
Vehicles	165 035	402 527	0.41
Cold chain equipment cost	147 615	821 308	0.18
Other capital equipment cost	45 932	88 006	0.52

**\*Data source:** cMYP 2012 baseline for Benin

<sup>11</sup> In the last cMYP, the time dedicated by the staff to the various activities of this program differed from 81.8% at national level, to 22.0% at department level, to 14.00% at health area level and 24.5% at health center level. Our study results imply that personnel involvement is 26% higher than previously estimated in cMYP.

## 5. Cost Analysis of new vaccines introduction

### 5.1. Total incremental new vaccine introduction costs

The estimated total economic cost for the introduction of new vaccine (PCV13) was US\$ 2.93 million and US\$ 0.81 million excluding vaccine cost. The fiscal cost amounted to US\$ 5.52 million with vaccine and US\$ 94 997 without vaccine (Table. 23). It should be noted these results may underestimate the full incremental cost as the pre-introduction activities were not captured in the analysis.

### 5.2. Unit costs of new vaccine introduction (per dose, per child)

The total incremental economic cost of new vaccine introduction per dose was US\$ 5.93 per dose and US\$ 8.42 per child. When comparing incremental economic unit costs (per dose, per child and per capita) with vaccine costs, the unit costs without vaccine were 3.6 times lower. Comparing fiscal unit costs with economic unit costs, the former was 1.87 times lower than the latter when vaccine cost was counted.

This information offers two axes of reflection: 1) the immediate demand for financing (cash flow) due to the introduction of new vaccine is relatively low: US\$ 0.19 per dose, US\$ 0.27 per child and US\$ 0.01 per capita. 2) The difference between economic cost and fiscal cost cannot be ignored. In other words, even if the short-term funding demand is relatively low, the country will bear a higher economic cost following the introduction of new vaccines. Supplementary resources should be organized to meet this demand (Table 23).

**Table 25. New vaccine introduction unit economic and fiscal costs per benchmark**

Outputs				
Total doses of new vaccine administered (PCV)	494 836			
Infant population	348 577			
Total population	9 780 000			
Unit cost by benchmark	Economic cost		Fiscal cost	
	With vaccine	Without vaccine	With vaccine	Without vaccine
Total NUVI cost	2 936 406	813 494	5 519 383	94 997
- Incremental NUVI unit cost per dose	5.93	1.64	11.15	0.19
- Incremental NUVI unit cost per child	8.42	2.33	15.83	0.27
- Incremental NUVI unit cost per capita	0.30	0.08	0.56	0.01

**Note:**

1. Data source: Administrated doses for new vaccine (PCV) provided by UNICEF country office in Benin
2. Data source: Annual Program Report of Benin (2011) from the site of GAVI
3. Data source: From the site of WHO

### 5.3. New vaccine introduction costs by activity

Regarding the distribution of costs among the activities, we looked at the economic cost for the introduction of new vaccines excluding vaccine costs. The estimated start-up cost (additional activities due to resources) without vaccine was US\$ 252 157, accounting for one-third of NUVI cost. Ongoing costs (incremental costs following introduction that will reoccur yearly) accounted for two-thirds of costs excluding vaccine.

Excluding vaccine costs, vaccine management (collection, distribution & storage) accounted for half of the new vaccine introduction cost (51.39%); followed by the costs for social mobilization & advocacy (26%); record-keeping & HMIS (6.39%). The routine facility-based service delivery (ongoing) here includes the salaried labor costs at health facility level; though no such cost is registered at district, regional or central level. It represents 4.5% of total cost without vaccine.

**Table 26. Incremental economic and fiscal costs for new vaccine introduction by activities (\$2011) without vaccine cost**

Activities	National economic cost for NUVI	National cost per PCV dose administered	Distribution
Cold chain maintenance	3 476	0.01	0.43%
Other	24 105	0.05	2.96%
Outreach service delivery	17 576	0.04	2.16%
Program management	7 907	0.02	0.97%
Record-keeping & HMIS	50 598	0.10	6.22%
Routine facility-based service delivery	35 843	0.07	4.41%
Social mobilization & advocacy	205 758	0.42	25.29%
Supervision	19 978	0.04	2.46%
Surveillance	15 147	0.03	1.86%
Training	26 421	0.05	3.25%
Vaccine collection, distribution & storage	406 685	0.82	49.99%
<b>Total NUVI delivery cost</b>	<b>813 494</b>	<b>1.64</b>	<b>100.00%</b>
<i>Total start-up costs</i>	252 157	0.51	8.59%
<i>Total ongoing costs</i>	561 337	1.13	19.12%
<i>Vaccine cost</i>	2 122 912	4.29	72.30%
<b>Total NUVI cost</b>	<b>2 936 406</b>	<b>5.93</b>	<b>100.00%</b>
<i>NUVI costs per month</i>	489 401	0.99	

**Note:** \*start-up costs include: social mobilization & advocacy, supervision, training

#### 5.4. New vaccine introduction costs by input

Vaccine cost amounted to US\$ 2.12 million, and was by far the largest cost driver, accounting for 73% of economic cost and 97% of fiscal cost. The economic cost, beside that of vaccine cost, mainly resulted from the incremental use of existing inputs (human resources and cold chain equipment). The fiscal cost excluding the vaccine cost mainly came from the per diem and travel allowances for specific introduction activities (Table 25).

**Table 27. Incremental economic and fiscal costs for NUI by line item (\$2011)**

Line item	Economic costs	% distribution	Fiscal costs	%
Salaried labor	161 645	5.50%		
Per diem & travel Allowances	192 361	6.55%	32 347	0.59%
Vaccines	2 122 912	72.30%	5 424 386	98.28%
Other	29 485	1.00%	51 672	0.94%
<b>Subtotal recurrent</b>	<b>2 506 403</b>	<b>85.36%</b>	<b>5 508 405</b>	<b>99.80%</b>
Cold chain equipment	396 838	13.51%	0	
Other equipment	10 978	0.37%	10 978	0.20%
<b>Subtotal capital</b>	<b>407 816</b>	<b>13.89%</b>	<b>10 978</b>	<b>0.20%</b>
<b>Total NUVI Cost</b>	<b>2 936 406</b>		<b>5 519 383</b>	

**Note:** \* other equipment here refers to the material costs for social mobilization. Office equipment was excluded from the cost evaluation of new vaccine.

## Discussion

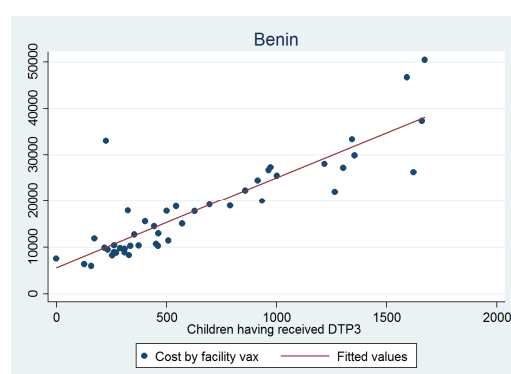
If the exiting health system is under employed, the incremental economic cost could be absorbed by increasing the use of existing resources. However, if the existing resources are already fully employed, the burden of supplemental economic cost could be translated into a deterioration of service quality. Finally, the costs of new vaccine introduction are likely to be underestimated as preparatory activities are not captured in this analysis.

## 6. Productivity analysis

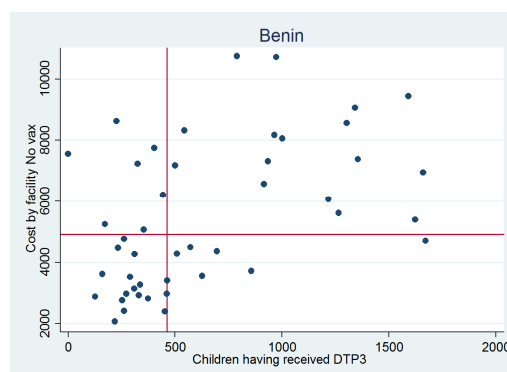
### 6.1. Quadrant analysis

Graphical analysis of data helps illustrate trends with regards to the total cost per number of children to have received the third dose of pentavalent (FIC). The graphs show upward trends. Some outliers stand out from the set of facility scatter points (Graph 13). When the same findings were made on quadrant scatter plots, the outliers previously identified were confirmed. However, one should be cautious when directly comparing productivity (especially outliers) of facilities that can be biased due to a lack of quality of some output variables<sup>12</sup> and also by the limited sample size.

**Graph 13. Total economic routine immunization costs and children having received DTP3**



**Graph 14. Quadrant analysis of total economic cost (axis) vs. DTP3-vaccinated children (x axis)**



<sup>12</sup> Limited data quality regarding immunization output indicators and population (incorrect transcription of routine data and no command of the target population were highlighted as a problem in the last cMYP).

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 6 out of 46 surveyed facilities (13.04%) fell in the south-east area of cost-effectiveness; 7 (15.21%) fell in the north-west sector of counter-performance, and 16 and 17 facilities fell in the north-east and south-west sectors, respectively.

## 6.2. Statistical analysis

The total doses administered per FTE were 6,722. The number of doses per staff per day was 3.54 whereas the total doses per total number of Fully Immunized Child was 13.90 for Benin. The wastage rates for pentavalent and polio were 10% and 12% respectively (Table 26).

**Table 28. Productivity indicators computed for Benin**

Indicators	Benin
1. Total doses administered/ FTE	6,722.09
2. Total doses/Total facility staff/working day	3.54
3. Total doses/FIC	13.90
4. Wastage rate of pentavalent	9.87%
5. Wastage rate of polio	11.49%

## 7. Analysis of determinants of routine immunization costs

### 7.1. Descriptive statistics

Sample distributions are described in Table 27 for categorical variables and Table 28 for continuous variables. It is notable that the completeness rates are satisfying for surveys in the two countries and for almost all the variables. Of the facilities in Benin, 91% are government- owned, while 56% of surveyed facilities in Benin belonged to rural settlements. Cold chain equipment existed in 100% of facilities in Benin. Grid electricity was used as an energy source in 68% of facilities, while kerosene was still used in 30% of facilities. No volunteers supporting immunization were registered in Benin.

**Table 29. Percent distribution of some core categorical characteristics of the surveyed health facilities in Benin**

Characteristics	Percentage
District (n = 46)	
Akpro	15.22%
Cotonou 1&4	10.87%
Cotonou 2&3	13.04%
Dassa Zoumé	13.04%
Parakou N'Dali	6.52%
Porto Novo	17.39%
Savalou Banté	10.87%
Tchaourou	13.04%
Region (n = 46)	
Center	23.91%
Cotonou	21.74%
North	19.57%
South	34.78%
Type of facility (n = 46)	
Health center	80.43%
Mission facility	6.52%
Clinic	13.04%
Ownership (n = 46)	

Characteristics	Percentage
Government	91.30%
NGOs/religious organization	8.70%
Type of area (n = 46)	
Rural	56.52%
Urban	43.48%
Existence of Volunteers supporting immunization (n = 46)	
No	100%
Cold chain equipment in facility (n = 46)	
Yes	100%
Existence of users' fees? (n = 46)	
No	100%
Energy supply for cold chain (n = 46)	
Grid electricity	67.39%
Solar energy	2.17%
Kerosene	30.43%
Adequate staff to perform RI well? (46)	
Strongly agree & agree	45.65%
Others responses	54.35%

The indicators were all weighted and provided with their standard deviation values. The average total economic cost per facility for Benin was US\$ 14,993.99, SE = 1,563.07, while the average total costs, excluding vaccine cost, was US\$ 5,344.62, SE = 425.76 (table 28). The average number of Fully Immunized Children (number of children having received third dose of DTP3) per facility was 600.80, SE = 72.85. The average Full Time Equivalent (FTE) representing the time spent by all facility staff on routine immunization was 1.49, SE = 0.16 per facility in Benin. The average total routine doses administered in 2011 by facility in Benin was 7,796.04, SE = 813.31. The average number of staff per facility was 15.52, SE = 2.41 per facility and the average number of campaign per facility organized in 2011 was 4.09, SE = 0.09.

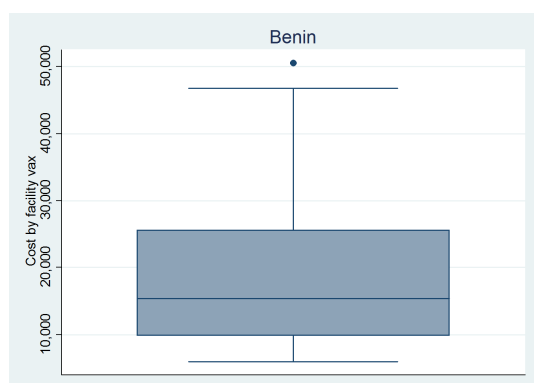
**Table 30. Distribution of facilities as per some core continuous variables surveyed in Benin**

Characteristics	Weighted mean	Std. err.
Total routine immunization costs (US\$) Excluding hospitals	14,993.99	1,563.07
Total routine immunization cost, excluding vaccine costs (US\$) Excluding hospitals	5,344.62	425.76
Children having received DTP-HepB-Hib dose 3 (defined as a fully immunized child)	600.80	72.85
Number of days of interruption due to flood	-	-
Total full-time equivalents working on routine immunization	1.49	0.16
Proportion of time on RI for personnel involved in immunization	40.07%	3.74%
Routine doses administered in 2011	7796.04	813.31
Total number of staff per facility	16.39	4.12
Number of campaigns in 2011	4.07	0.10
Average wage of staff per facility	139.33	9.25

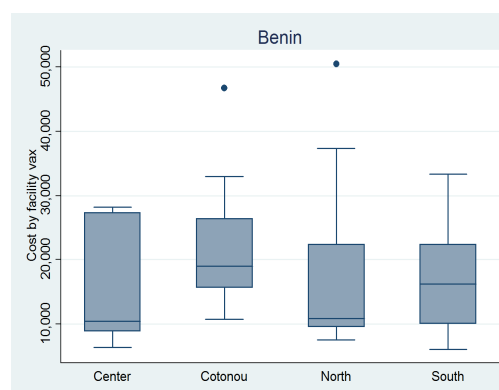
Various Whiskers plots of total economic costs, broken down by variables such as region, area type and facility type are presented in Graphs 15a, 15b, 15c and 15d. These plots show the total economic cost is not normally distributed, because its means differ from medians and also the 25 and 75 percentiles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

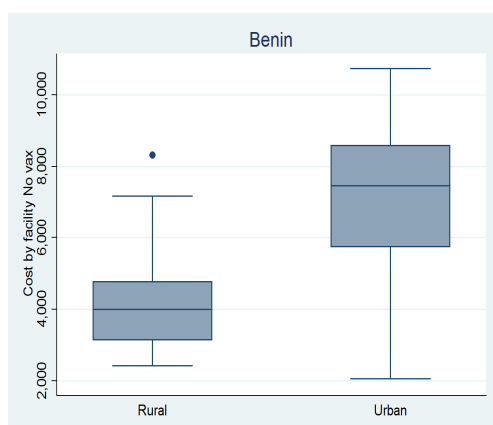
**Graph 15a: Box and Whiskers plot of total economic cost**



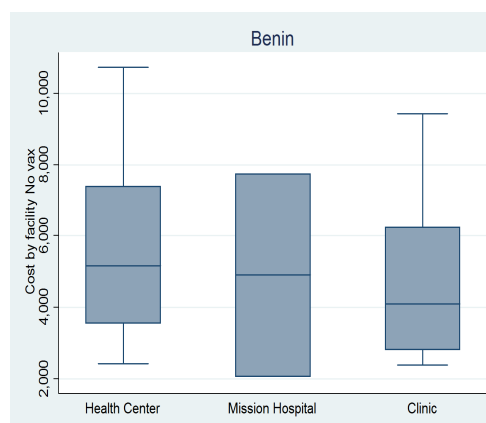
**Graph 15b: Box and whiskers plot of total economic cost broken down by region**



**Graph 15c: Box and whiskers plot of total economic cost broken down by type of area**



**Graph 15d: Box and whiskers plot of total economic cost broken down by type of facility**

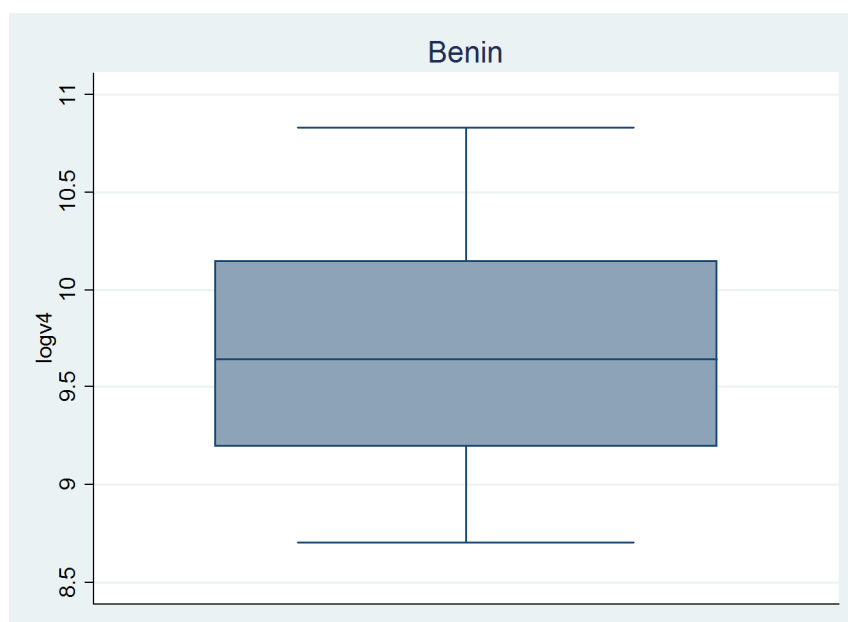


These graphical findings are confirmed by both the ANOVA test of comparison of means and the Bartlett test for equal variances (table 29), for which variances are quite often unequal, while the means differ from one another (apart from the comparison of the total cost per ownership, whereby the differences observed are not statistically significant at 5%).

**Table 31. Analysis of variances of total cost, broken down as per some core categorical variables**

Characteristics	Mean	Std. Dev.	Freq.	ANOVA		Bartlett test for equal variances	
				F	Prob >	chi2(3)	Prob
<b>1. Type of facility</b>							
Health center	18,699.92	10,163.53	38	0.32	0.73	2.01	0.36
Mission facility	12,734.01	4,049.40	2				
Clinic	17,390.69	14,500.68	6				
Total	18,269.76	10,501.54	46				
<b>2. Region</b>							
Center	15,822.56	8,611.68	11	0.87	0.46	4.43	0.22
Cotonou	22,960.28	11,468.56	10				
North	18,754.47	14,398.54	9				
South	17,010.85	8,211.46	16				
Total	18,269.76	10,501.54	46				
<b>3. Type of area</b>							
Rural	14,532.007	8,944.78	26	8.91	0.005	0.601	0.438
Urban	23,128.85	10,580.57	20				
Total	18,269.76	10,501.54	46				

Due to the fact the total economic cost distribution curve is not normally distributed, the log transformation function of this variable shows a nearly normal distribution, with the mean matching the median and 25 and 75 percentiles located roughly the same distance, respectively, from the beginning and the end of the distribution (Graph 11).

**Graph 16. Box and Whiskers plot of log of total economic cost, outliers removed**

## 7.2. Regression results

Table 30 displays the final regression models performed upon health facilities. The theoretical model is (M0) while the subsequent ones are those with controlling covariates.

**Table 32: Final linear regression model evaluating the association of different variables with total immunization costs (in log transformation) in Benin**

	(M0)	(M1)	(M2)	(M3)
A. log of Fully Immunized Children	0.634*** (9.37)	0.649*** (11.85)	0.639*** (8.71)	0.622*** (9.23)
B. log of average proportion of time dedicated	0.0791 (0.90)	-0.0110 (-0.17)	0.0700 (0.72)	-0.000789 (-0.01)
C. log of average monthly wage of staff	0.0307 (0.37)	0.0269 (0.38)	0.0354 (0.42)	0.0216 (0.27)
D. Adequate staff to perform RI well (Yes =1/No =0)	-0.0834 (-1.54)	-0.0865 (-1.64)	-0.0833 (-1.51)	-0.0657 (-1.29)
E. Region (Cotonou =1/ Others= 0)		-0.278 (-1.66)		
F. Type of facility (health center used as reference)				
Mission hospital			-0.00608 (-0.08)	
Clinic			0.132 (1.13)	
G. Location (Urban =1/Rural=0)				0.158 (1.51)
Constant	5.596*** (6.13)	6.231*** (6.45)	5.527*** (5.65)	5.592*** (6.74)
r <sup>2</sup>	0.835	0.858	0.836	0.845
r <sup>2</sup> <sub>a</sub>	0.819	0.840	0.811	0.825
N	45	45	45	45
df <sub>r</sub>	40	39	38	39

*t* statistics in parentheses

<sup>†</sup>  $p < 0.1$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

The covariate ‘total number of Fully Immunized Children’ is, statistically, strongly related to the ‘total immunization costs’ across various models. Moreover, a 1% increase in FIC was associated with an average 0.63% increase of the ‘total facility immunization cost’, according to the theoretical model (M0). Overall, the magnitude of the increase was less than 1%. The others covariates of the base model, nor the control factors were not associated with the total immunization costs.

## 8. Analysis of financial and commodity flows for routine immunization

### 8.1. Background on immunization financing in Benin

Since 1996, the government has assured the purchase of its traditional vaccines with domestic funding (through the independent vaccine initiative) and has had a specific budget line for the purchase of vaccines (1).

In Benin, the Heavily Indebted Poor Country (HIPC) initiative, and the Multilateral Debt Relief Initiative (MDRI) were designed to leverage resources in the fight against poverty (5). In this respect, EPI in Benin has received funds derived from HIPC since 2000 (1) which have been used to purchase traditional vaccines and injection supplies. Benin EPI has received support from the GAVI Alliance since August 2002.

According to the last cMYP update, domestic funding represented 28% of EPI funds. The funding profile for immunization is detailed in the table below (table 31).

**Table 33. Mapping of funding sources for routine immunization in 2012 (source: cMYP)**

Funder	Supported immunization inputs
Domestic sources	Traditional vaccines Salaries Per-diem for outreach Surveillance and monitoring
External / GAVI	New & underused vaccines Injection supplies
External / (UNICEF, WHO and other partners)	Training Disease control Surveillance Program management

With regards to co-financing performance, Benin has been classified as a highly committed country (6). Benin started its mandatory co-financing of yellow fever vaccine in 2008, and pentavalent and pneumococcal vaccine in 2011. Benin has provided a timely payment of the co-financing obligation; in 2008, it even voluntarily co-financed a higher number of doses of yellow fever vaccine than the minimum required; in 2010 it similarly voluntarily co-financed pentavalent vaccine.

### 8.2. Results of the quantitative analysis

#### 8.2.1. Specifications of the Benin context

Funding sources, financing agents, healthcare financing mechanism, healthcare providers, healthcare functions and provisions are detailed in the below table 32.

**Table 34. Financial flow type and categories specific to the Benin context**

Financial flow type	Categories
Funding source (FS)	Domestic funding: <ul style="list-style-type: none"> <li>- Internal transfers within central government</li> <li>- Other revenues from communities</li> <li>- Other transfers</li> </ul> Funding with foreign origin: <ul style="list-style-type: none"> <li>- From GAVI Alliance</li> <li>- From UNICEF direct financial transfer</li> <li>- From WHO direct financial transfer</li> <li>- From AMP</li> <li>- From Rotary Club International</li> </ul>

Financial flow type	Categories
Financing agent (FA)	General government: <ul style="list-style-type: none"> <li>- National Agency for Immunization</li> <li>- Provincial level Ministry of Health (DDS)</li> <li>- District level Ministry of Health (ZS)</li> </ul>
Health financing mechanism (HF)	Central government schemes, community-level financing, Non-profit institution financing schemes (NPISH); rest of the world.
Health services provider (HP)	Provincial MOH, district MOH, other administration agencies, district hospitals, PHC facilities, research providers
Healthcare 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.
Healthcare provision (FP)	Compensation of employees, self-employed professional remuneration, materials and services used, consumption of fixed capital, other items of spending on inputs.

### 8.2.2. *Funding source to financing agent (FS to FA)*

This part of analysis shows the transmission of funds from sources (financing sources – FS) to the agents who will be in charge of its distribution (financing agents - FA).

According to estimation, the total financing for routine immunization that the whole country obtained in 2011 was US\$ 11,746,145. Foreign funds contributed to 72% of the total and domestic funds 28%. GAVI funding alone presents 49% of total finance in 2011, and UNICEF presents another 18%. Domestic resources came principally from the central government and consumed about 27% of total sources (Table 33). The high share of external support in 2011 was linked to funding for the PCV vaccine from the GAVI Alliance, or indeed, of the total funding for routine immunization.

In 2010, the total financing for routine immunization that the whole country obtained was US\$ 9,966,270. Foreign funds contributed to 65% of the total and domestic funds 35%. GAVI funding alone accounted for 36% of total financing in 2010, while UNICEF accounted for another 22%.

The main financing agents in Benin were health offices at different administrative levels. The central immunization agency (ANV) has an essential role in the distribution of funding sources. Department and district health offices primarily get funding from central government. Nevertheless, they can also directly receive funding from international organizations.

**Table 35. Financing source to financing agents in 2011 (US\$)<sup>13</sup>**

	District	Region	Central EPI (ANV)	Total	% Distribution
<i>Transfers from domestic revenue</i>					
<b>FS.1.1.1. Internal transfers within central government</b>	119 544	130 673	2 969 796	3 220 013	27.41%
<b>FS.6.2. Other revenues from communities n.e.c</b>	76 863	13 690	0	90 553	0.77%
<b>FS.1.4. Other transfers</b>	15 935			15 935	0.14%
<i>Transfers distributed by government from foreign origin</i>					
<b>FS. 2.1.2.1. UNICEF</b>	232 406	70 898	1 831 581	2 134 885	18.18%
<b>FS. 2.1.2.2. WHO</b>		2 000	154 016	156 016	1.33%
<b>FS. 2.1.3 GAVI</b>			5 712 374	5 712 374	48.63%
<b>FS.RI.1.5. AMP</b>			116 370	116 370	0.99%
<b>FS.2.1.4.3. Rotary club int</b>			300 000	300 000	2.55%
General Total	<b>444 747</b>	<b>217 261</b>	<b>11 084 137</b>	<b>11 746 145</b>	

<sup>13</sup> **Note:** \*1. BZ - Health Zone Office (Bureau de Zone) - represents all health zone offices that have received UNICEF's grant in 2011. \*2. DDS- Department Health Zone Office (District) – represents all departmental health zones that have received UNICEF's grants in 2011.

Table 36. Financing source to financing agents in 2010 (US\$)

	District	Region	Central EPI (ANV)	Total	Distribution
<i>Transfers from domestic revenue</i>					
<b>FS.1.1.1. Internal transfers within central government</b>	85 997	147 391	3 172 476	3405864.32	34.17%
<b>FS.6.2. Other revenues from communities n.e.c</b>	66 368	9 857	0	76224.932	0.76%
<b>FS.1.4. Other transfers</b>	5 553	0	0	5553.33333	0.06%
<i>Transfers distributed by government from foreign origin</i>					
<b>FS. 2.1.3 GAVI</b>			3632954	3 632 954	36.45%
<b>FS. 2.1.2.1. UNICEF</b>	248 491	2700	1971635	2 222 826	22.30%
<b>FS. 2.1.2.2. WHO</b>			399 633	399 633	4.01%
<b>FS.RI.1.5. AMP</b>			23 214	23 214	0.23%
<b>FS.2.1.4.3. Rotary Club International</b>			200 000	200 000	2.01%
General Total	<b>406 410</b>	<b>159 948</b>	<b>9 399 912</b>	<b>9 966 270</b>	100%

8.2.3. *Financing agent to healthcare provider*

In this part, we investigate what kind of health providers (HP) finally benefit from the funding available for vaccination in the country. In order to be able to follow the same aggregation strategy, funding movements with domestic sources are separated from those with foreign sources. For the former, aggregation based on weighted average, for the latter simple addition is used. Central MOH and District MOH execute most of resources.

**Table 37. Financing agent to healthcare provider in 2011 (USD)**

Étiquettes de lignes	BZ/PRK		BZ/SABA		BZ		DDS A/L		DDS B/A		DDS O/P		DDS Z/C		DDS		ANV		Aggregated total <sup>*3</sup>	% Distribution
	D <sup>*1</sup>	F <sup>*2</sup>	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F		
District MOH																	1 344 248	2 090 679	3 434 927	29.24%
Gvment health adm agencies																		5 827 474	5 827 474	49.61%
Research provider																		97 208	97 208	0.83%
District Hospital	4 854		1 406																125 959	1.07%
PHC Facility																	1 625 548		1 625 548	13.84%
PHC Type 1	3 391					157 016												98 980	332 859	2.83%
PHC Type 2			840			75 390									45 234				130 144	1.11%
Administration							18 759		25 203		21 865	27 664	30 320						172 027	1.46%
Sampling weight	8		4				0		0		0		0						11 746 145	100.00%
weighted sum	5 497		749			232 406	3 095		6 301		8 024	27 664	6 640							

**Note:** \* 1 D: domestic funding; \*2 F: Foreign funding; \*3 Aggregated total = aggregated total for domestic funding + simple tot for foreign funding.

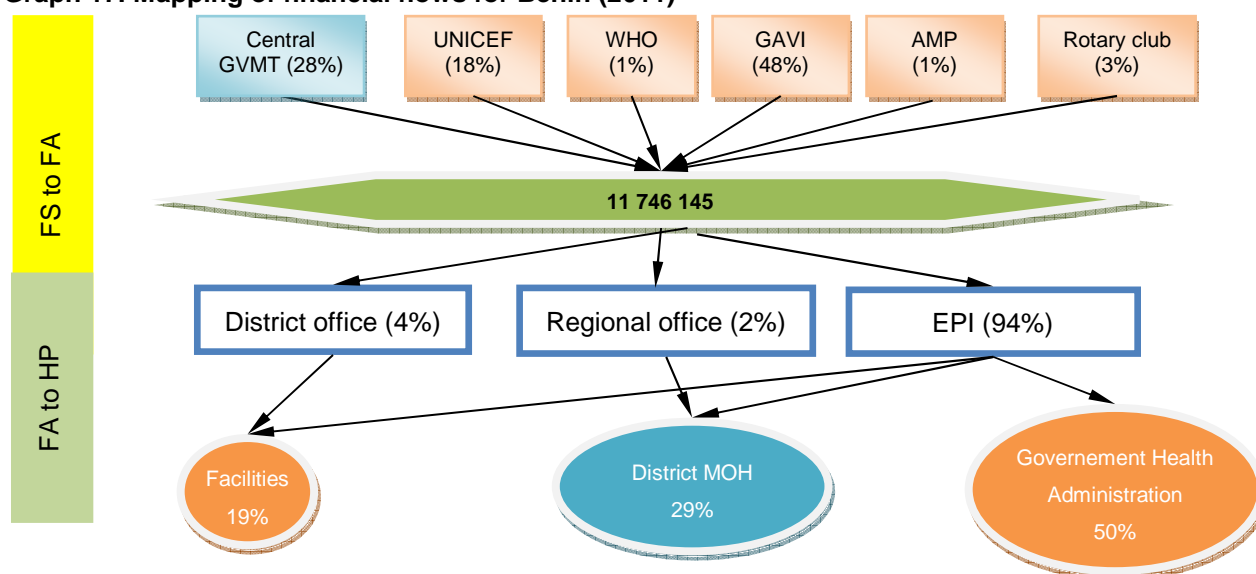
**Table 38. Financing agent to healthcare provider in 2010 (USD)**

F.Agents	BZ/PRK		BZ/SABA			BZ	BZ	DDS A/L		DDS B/A		DDS O/P		DDS Z/C			ANV	Total	Distribution
	D	F	D	F	D	F	F	F	D	F	D	F	D	F	D	D	F		
District hospitals	6 302		490															148 399	1.49%
District MOH																	489 309	489 309	4.91%
Gov health adm agencies																1 546 928	3 824 784	5 371 712	53.90%
PHC Facility																	3 538 891	3 538 891	35.51%
PHC Type 1 (Specify)						149 275	54 000											203 275	2.04%
PHC Type 2 (Specify)			840			45 216												54 736	0.55%
Administration									17 129		1 576				38 462			69 861	0.70%
Provincial MOH											28 360	2 700	19 607		1 273			90 087	0.90%
Sampling weight	8		4						0		0		0		0				0.00%
<b>Total général</b>		<b>6 302</b>		<b>1 330</b>		<b>194 491</b>	<b>54 000</b>		<b>17 129</b>		<b>29 936</b>		<b>22 307</b>		<b>39 735</b>		<b>7 774 364</b>	<b>9 966 270</b>	100.00%

The results highlight a high donor dependency on the routine immunization program. This high share of external support in immunization is confirmed by the cMYP estimates whereby the share of internal funding also represented 28%.

The estimate from the funding flow analysis was below (approximately 20%) the one from the costing study which highlighted that the funding flow exercise might not capture the same level of information as in a full costing approach. In particular, the funds internally generated by facilities, and which are not transferred to the upper levels, were not included in the funding flow analysis. Another explanation is that direct external funding has not been aggregated for this analysis, which may underestimate the actual amount of funds received by decentralized units. Finally, potential shared items were captured in the cost analysis but not in the funding flow one due to different methodological approaches can also explain the difference.

**Graph 17. Mapping of financial flows for Benin (2011)**



## 9. Policy implications

The policy implications were discussed during a dissemination workshop of the study results held at the Ministry of Health in Cotonou, Benin on 6 February, 2014. A summary transcript of the implications mentioned during the meeting is written below.

First, the report and related data provides a wealth of information for informing policy-makers. National stakeholders in Benin were invited to take ownership of this opportunity. It was mentioned that this work should serve as a starting point for further efforts to improve the traceability of expenses and use of funds. In addition, the study provides a framework for measuring efficiency of health providers. This type of study highlights the potential benefits of regular monitoring of the resources used, as well as performance.

The study results show that although immunization services are provided for free, they incur a high cost. Policies should consider that human resources are critical and that the time spent has a significant impact on facility costs. The importance of retaining and motivating health staff working on immunization in the facilities was mentioned as a critical success factor for the program. Results also showed there were still substantial efforts required to increase routine immunization financing from domestic sources. Although limited domestic funding, the amount of resources to perform routine immunization activities is being consumed for immunization. However, a lack of resources for conducting outreach (due to deficient equipment) was mentioned for some facilities.

The results of the study provide material to conduct advocacy for routine immunization financing beyond the health sector. To perform efficient advocacy, the results of this study should be presented in a simplified manner.

Regarding future work, it was mentioned that similar studies should be conducted with larger sample sizes. This type of study could be repeated every few years to see the evolution of the program costs and performance. It was also advised to conduct a similar study focusing on the indirect costs for households. Additional work on productivity in terms of health services should be replicated to other programs to inform decision-making. The data available from this study could also be tapped further and beyond its initial purpose-specific components (cold chain investment, additional efforts in targeted health zones, etc). Taking ownership of the study and its data provides an opportunity in terms of transfer of knowledge for the country.

## 10. Conclusion

The total costs for the routine immunization (nationwide) amounted to US\$ 14.62 million in 2011. The routine EPI cost per dose was US\$ 3.53, the cost per FIC US\$ 43.86, and the cost per infant population in the country US\$ 42.03. The cost per capita was US\$ 1.50. When excluding PCV, total cost amounted to US\$ 9.22 million and US\$ 2.22 per dose.

In terms of total nationwide delivery cost for routine immunization (i.e. excluding vaccines), facility level represented the bulk of total cost at 82%; district level 9%; regional level 5%; and central level 5%. At central level, costs were driven by social mobilization, supervision and vaccine management. At regional level, the activities of vaccine management, program management and supervision consumed most of the resources. At district level, costs were driven by vaccine management, supervision and surveillance. At facility level, the three most important delivery costs were vaccine management, fixed-based delivery and record-keeping.

Comparing different types of health facilities, health centers (24.24 USD) and clinics (30.51 USD) were the most efficient in terms of cost per FIC compared to mission NGOs facilities (40.40 USD). Once excluded vaccine costs, the remaining costs of the three types of health facilities are not significantly different (the variation is less than 5%). Clinics and health centers shows the lowest unit cost per vaccine dose and per DTP3 vaccinated child. Unit cost per infant and per capita according to urban rural status showed higher cost-efficiency in urban areas than in rural ones. This can be explained by the health facility catchment (covered infant population and total population), which in general was three times higher in urban areas than rural areas, and which increased attendance at immunization sessions.

In Benin, the variable number of FIC was statistically strongly related to the total economic costs.

The main limitations regarding the study were the following: limited sample size, and in some cases output data collected might not be fully reliable due to record-keeping and monitoring issues. Also, hospitals were not included in the cost analysis, which may underestimate the full cost of routine immunization in the country.

Our study found a cost of routine immunization higher than the most recent cMYP estimate in Benin (1). The cost was higher for all items (except transportation) which could imply that current cMYP may underestimate the resources used for routine immunization. Vaccine was the main cost driver. Another key finding confirmed that the delivery cost (excluding vaccines) at facility level was driven by personnel costs and cold chain at three quarters. The high share of recurrent costs at facility level highlights the need for both sustainable and continuous financing for the immunization program in Benin.

The result of this funding analysis outlines the large proportion of financing by external donors (83%), confirmed by recent cMYP estimates (72%). In coming years, Benin is likely to introduce new vaccines. According to cMYP, MenAfriVac is scheduled in 2016, HPV in 2017 and rotavirus in 2018. These introductions will require additional and reliable resources both for the vaccine and delivery cost in order to ensure sustainability of the immunization program performance over the long run. In this respect, the results of this study can provide updated estimates of the full use of resources in the current schedule, the cost of scaling up, and the cost of introducing additional vaccines in the future.

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**Annex 1. Cost by activity and facility type****Total Routine Immunization Economic Costs by Activity by Facility Type (\$2011) - with vaccines**

Activities	Health Center	Clinic	Mission NGO facility	Weighted Average	% Distribution
Cold Chain Maintenance	88	27	80	82	1%
Other	387	201	232	368	2%
Outreach Service Delivery	2826	1478	24	2660	18%
Program Management	130	106	14	126	1%
Record-Keeping & HMIS	652	761	460	660	4%
Routine Facility-based Service Delivery	8065	9530	8449	8207	55%
Social Mobilization & Advocacy	482	480	31	475	3%
Supervision	194	340	21	205	1%
Surveillance	137	45	0	126	1%
Training	134	204	41	139	1%
Vaccine Collection, Distribution, & Storage	1921	1873	3953	1946	13%
<b>Total Facility Immunization Cost</b>	<b>15016</b>	<b>15045</b>	<b>13307</b>	<b>14994</b>	<b>100.00%</b>

**Annex 2. Sampling frame for Benin****Table 2: Final sample selected by district and location in Ghana and Benin**

District	Sampled urban facilities	% of total urban facilities sampled	Average population covered by one facility	Sampled rural facilities	% of total rural facilities sampled	Average population covered by one facility
	Urban			Rural		
Benin						
Akpro	2	25%	20082	3	50%	11402
Cotonou 2-3	5	100%	44239			
Cotonou 1-4	5	100%	35618			
Dassa Zoumé	2	25%	24035	4	100%	8041
Parakou N'Dali	1	40%	35955	3	25%	11260
Porto Novo	3	46%	23292	5	16%	12113
Savalou banté	1	22%	26624	4	100%	15602
Tchaourou	1	57%	27909	5	100%	14514

Total number of health facilities in the selected health zones by type and by urban/rural area

Health Zones	Health Center		Clinic		HF for NGO/ Mission Urban	Total
	Urban	Rural	Urban	Rural		
Porto Novo	9	17	0	2	2	30
Akpro	16	3	0	3	0	22
Cotonou 2-3	0	2	2	0	1	5
Cotonou 1-4	0	4	0	0	1	5
Parakou N'Dali	5	6	0	2	0	13
Tchaourou	7	1	0	1	0	9
Savalou banté	18	1	0	0	0	19
Dassa Zoumé	16	2	0	0	0	18

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<b>Total</b>	<b>71</b>	<b>36</b>	<b>2</b>	<b>8</b>	<b>4</b>	<b>121</b>
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Number of health facilities included into our sampling by urban/rural areas

Health Zones	Health Center		Clinic		HF for NGO/ Mission Urban	Total
	Urban	Rural	Urban	Rural		
Porto Novo	4	2	0	1	1	8
Akpro	4	2	0	1	0	7
Cotonou 2-3	0	3	2	0	1	5
Cotonou 1-4	0	4	0	0	1	5
Parakou N'Dali	2	1	0	1	0	4
Tchaourou	4	1	0	1	0	6
Savalou banté	4	1	0	0	0	5
Dassa Zoumé	4	2	0	0	0	6
<b>Total</b>	<b>22</b>	<b>15</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>46</b>

Departmental Directorates and Office Zones of the sample

Health Zones	Departmental Directorates	Office Zones
Porto-Novo/Sèmè-Kpodji/Aguégués	DDS Oueme	BZS Porto-Novo
Akpro-missérété/Avrankou/Adjarra		BZS Akpro
Cotonou 2/ Cotonou 3	DDS Littoral	BZS Cotonou 2-3
Cotonou 1/Cotonou 4		BZS Cotonou 1-4
Parakou/N'Dali	DDS Borgou	BZS Parakou
Tchaourou		BZS Tchaourou
Savalou/Bantè	DDS Zou Collines	BZS Savalou
Dassa-Zoumè/Glazoué		BZS Dassa

**Annex 3. Sampling weights**

Facility Name	Health Zone	urban/rural facility	Type of facility	weight 1 = - Probability of a district being selected inside of each stratum (L)	weight 2 = - Probability of a health facility being selected inside of each district (M)	Double probability (L*M)	sampling weights = 1/ (L*M)
CS Djèrègbé	Porto Novo	Rural	CS	1	0.44	0.44	2.25
CS Kraké	Porto Novo	Rural	CS	1	0.44	0.44	2.25
CS HOUEDOMEY	Porto Novo	Rural	CS	1	0.44	0.44	2.25
CS AVLAGBODJI	Porto Novo	Rural	CS	1	0.44	0.44	2.25
Tokpota	Porto Novo	Urban	CS	1	0.12	0.12	8.5
CS Zèbou	Porto Novo	Urban	CS	1	0.12	0.12	8.5
Disp Djéffa	Porto Novo	Rural	Dispensary	1	0.50	0.50	2
Hôpital El-fateh	Porto Novo	Urban	Mission NGO facility	1	0.50	0.50	2
CS Ouanho	Akpro	Rural	CS	0.5	0.25	0.13	8
CS Kouti	Akpro	Rural	CS	0.5	0.25	0.13	8
CS Sado	Akpro	Rural	CS	0.5	0.25	0.13	8
CS Honvié	Akpro	Rural	CS	0.5	0.25	0.13	8
CS AVRANKOU	Akpro	Urban	CS	0.5	0.67	0.33	3
CS ADJARRA	Akpro	Urban	CS	0.5	0.67	0.33	3
Disp Danto	Akpro	Rural	Dispensary	0.5	0.33	0.17	6
Matern Cotonou II	Cotonou 2&3	Urban	Dispensary	0.25	1.00	0.25	4
CS AYELAWEDJE	Cotonou 2&3	Urban	CS	0.25	1.00	0.25	4
CS Gankpodo	Cotonou 2&3	Urban	CS	0.25	1.00	0.25	4
DISPENSAIRE AGBATO	Cotonou 2&3	Urban	Dispensary	0.25	1.00	0.25	4
Ste Marie Les anges	Cotonou 2&3	Urban	Mission NGO facility	0.25	1.00	0.25	4
CS AIDJEDO	Cotonou 1&4	Urban	CS	0.33	1.00	0.33	3
CS Placodji	Cotonou 1&4	Urban	CS	0.33	1.00	0.33	3
CS AHOUANSORI	Cotonou 1&4	Urban	CS	0.33	1.00	0.33	3
CS COTONOU1	Cotonou 1&4	Urban	CS	0.33	1.00	0.33	3
CS FAYCAL	Cotonou 1&4	Urban	FS Mission ONG	0.33	1.00	0.33	3
CS Sirarou	Parakou N'Dali	Rural	CS	0.13	0.40	0.05	20
CS Gbé gourou	Parakou N'Dali	Rural	CS	0.13	0.40	0.05	20
CS Parakou	Parakou N'Dali	Urban	CS	0.13	0.17	0.02	48
Disp Témé	Parakou N'Dali	Rural	Dispensary	0.13	0.50	0.06	16
CS ALAFIAROU	Tchaourou	Rural	CS	0.5	0.57	0.29	3.5
Kabo	Tchaourou	Rural	CS	0.5	0.57	0.29	3.5
CS Kika	Tchaourou	Rural	CS	0.5	0.57	0.29	3.5

**BENIN SAMPLING WEIGHTS (II)**

Facility Name	Health Zone	urban/rural facility	Type of facility	weight 1 = - Probability of a district being selected inside of each stratum (L)	weight 2 = - Probability of a health facility being selected inside of each district (M)	double proba (L*M)	sampling weights = 1/(L*M)
CS Tchaourou	Tchaourou	Urban	CS	0,5	1,00	0,50	2
Disp Sanson	Tchaourou	Rural	Dispensary	0,5	1,00	0,50	2
CS Tchatchou	Tchaourou	Rural	CS	0,5	0,57	0,29	3,5
Pira	Savalou Banté	Rural	CS	0,25	0,22	0,06	18
CS Djaloukou	Savalou Banté	Rural	CS	0,25	0,22	0,06	18
CS AGOUA	Savalou Banté	Rural	CS	0,25	0,22	0,06	18
Gouka	Savalou Banté	Rural	CS	0,25	0,22	0,06	18
CS Savalou	Savalou Banté	Urban	CS	0,25	1,00	0,25	4
CS Gbaffo	Dassa Zoumé	Rural	CS	0,5	0,25	0,13	8
CS Kèrè	Dassa Zoumé	Rural	CS	0,5	0,25	0,13	8
CS Tré	Dassa Zoumé	Rural	CS	0,5	0,25	0,13	8
CS ASSANTE	Dassa Zoumé	Rural	CS	0,5	0,25	0,13	8
CS Dassa	Dassa Zoumé	Urban	CS	0,5	1,00	0,50	2
CS Glazoué	Dassa Zoumé	Urban	CS	0,5	1,00	0,50	2

CS=Health Center, HDZ=District Hospital,

**Annex 4: Financial costs****Total routine immunization financial Costs at facility level (USD 2011)**

Line Item	Health Center	Clinics	NGO Facility	Weighted Average
Building overhead, Utilities, Communication	454	568	190	461
Cold Chain energy Costs	525	645	961	542
Other	34	0	0	30
other recurrent	1	5		1
Per Diem & Travel Allowances	150	98	0	143
Salaried Labor	2455	1948	1178	2389
Transport/Fuel	213	488	23	236
Vaccine Injection & Safety Supplies	185	191	237	186
Vaccines	9475	9645	7592	9463
Vehicles Maintenance	60	46		58
Subtotal Recurrent	13551	13634	10181	13510
Vehicles	272	484		288
Cold Chain Equipment	979	743	2671	982
Other Equipment	63	38	184	63
Subtotal Capital	1315	1265	2856	1332
<b>Total Facility Immunization Cost</b>	<b>14866</b>	<b>14899</b>	<b>13037</b>	<b>14842</b>

**Total Routine Immunization District Health Office Financial Costs by Line Item (\$2011)**

	COTONOU 2&3	Dassa Glazoue	Parakou N'Dali	Savalou Banté	Weighted avg
Building overhead, Utilities, Communication	0	1376	0	0	153
Other	0	0	0	0	0
Per Diem & Travel Allowances	57	120	339	60	190
Salaried Labor	2733	4109	2513	4387	3156
Transport/Fuel	180	599	509	0	333
Subtotal recurrent	2969	6203	3361	4447	3831
Vehicles	2793	798	4277	399	2699
Cold Chain Equipment	0	16770	0	11459	4410
Other Equipment	104	198	85	60	96
Subtotal capital	2897	17766	4363	11918	7205
<b>Total Immunization Economic Cost</b>	<b>5867</b>	<b>23969</b>	<b>7724</b>	<b>16365</b>	<b>11036</b>

**Annex 5. The list of price used in costing study**

	Unit price (or per dose)		PRICE in including all charges/taxes (including freight charges)	
	USD	FCFA	USD	FCFA
<b>Price of equipments used</b>				
<u>Cars</u>				
1 pick-up 4x4 Nissan Hardbody 5.	16 900,00		19435, 00	
<u>Motorbikes</u>				
Yamaha 125	1 532,00		1 762,00	
Yamaha 200	3 649,55		4197	
<u>Replacement parts for motorbikes</u>				
Tire				5 000
Tube				5 000
Dent				7 500
Chain				4 500
Bulb				600
Cylinder				32 000
Skate				6600
<u>Replacement parts for vehicles</u>				
Oil filter				4500
<u>Refrigerator and refrigeration equipment</u>				
Electrolux refrigerator	2319			
Refrigerator, Dometic RCW50EG,	3 146,38			
Kerosene refrigerator (Vestfrost MF214 PIS)	600,00			
Horizontal refrigerator (Dometic) TCW2000	3 497,42			
<u>Accessories</u>				
Insulated body				
"Vaccine carrier, storage capacity 1.5-3L	15,74		18,10	
"Icepack, 0.3 liter capacity	0,63			
Dial thermometer	1,34		1,54	
<b>Price of vaccines and syringes</b>				
BCG single dose	1,30		1,5	
Polio 10 doses	0, 18		0,21	
Pentavalent	2.95		3.33	
Pneumococcal conjugate vaccine	3.52			
VAR	1,30		1,5	
VAT	0,09		1,03	
VAA	0,66			
Syringes A-D,0,5ml,emb sép/BTE-100 \$	0,05		0,057	
Syringes for reconstitution				
Safety box of 25	0,54		0,62	

	Unit price (or per dose)		PRICE in including all charges/taxes (including freight charges)	
<b>Price per m<sup>2</sup> of buildings</b>				
1 m <sup>2</sup> of building				250 000
<b>Other prices</b>				
1 kw per hour				115
1 km on taxi car	Indicatif			25
1 km on taxi motorbike	indicatif			55
Voltage regulator				25 000
Incinerator (Monford)				1 300 000
Electric Steam Sterilizer (poupinel)				
Sterilization box	26		30	
Heat source : Stove				12 000
<b>Communication</b>				
1 announcement at radio		150 000		
1 announcement in TV		300 000		

Table of useful life years for capital equipment

Capital item type	Capital item	Useful life years
Vehicles (and spare parts)	Pick-up	5
	Motorcycle (Yamaha)	5
	Motorcycle (Sinili)	3
	Tyre	2
	Patin	2
Cold chain equipment	Refrigerator	8
	Cold box	5
	Vaccine carrier	3
Waste management equipment	Incinerator	5

## Annex 6. Variation of cold chain storage needs

Table A 6. Increase of demand for the cold chain storage capacity due to the introduction of PCV 13

Characteristics of vaccines selected for use								Vaccine wastage			Target Group	Immunization schedule	
Vaccine	Presentation (dose/vial)	Packed volume national data		Average packed volume from data base		Recommended	Price of vaccine (\$/US/dose)	National vaccine wastage figures	WHO/GAVI indicative wastage rates	Wastage factor		Current schedule	Current schedule with PCV13
choose from dropdown list	choose from dropdown list	Vaccines (cm <sup>3</sup> /dose)	Diluents (cm <sup>3</sup> /dose)	Vaccines (cm <sup>3</sup> /dose)	Diluents (cm <sup>3</sup> /dose)	+2°C to +8°C or -25°C to -15°C					Enter as % of total population		
BCG	20			1,2	1,1	+5°C		50	50	2,00		1,0	1,0
Measles	10			2,1	3,0	+5°C		45	40	1,82		1,0	1,0
OPV	20			1,0		-20°C		15	25	1,18		4,0	4,0
TT	10			3,1		+5°C		15	25	1,18		2,0	2,0
YF	10			2,6	4,9	+5°C		45	40	1,82		1,0	1,0
DTP-HepB-Hib	10			2,6		+5°C		10	25	1,11		3,0	3,0
PCV-13	1	13,7		13,8		+5°C		5	5	1,05			3,0
Net volume of OPV at -20°C in higher level stores, per FIC												4,7	4,7
Net volume of lyophilized vaccines to be stored at -20°C in higher level stores, per FIC												0,0	0,0
Net volume of vaccines w/o lyo & OPV stored at +5°C in higher level stores, per FIC												27,0	70,3
Net volume of vaccines w/o OPV stored at +5°C in higher level stores, per FIC												27,0	70,3
Net volume of all vaccines stored at +5°C in lower level stores, per FIC												31,7	75,0
Net volume of all vaccines & diluents, stored at +5°C at service delivery, per FIC												48,3	91,6
No. of vaccine doses per FIC												12,0	15,0
Percent increase of the net vaccine volume compared to Schedule-A in store for -20°C													0%
% increase of the net vaccine volume compared to Schedule-A in higher stores @+5°C													
% increase of the net vaccine volume compared to Schedule-A in lower store @+5°C													161%
% increase of the net vaccine volume compared to Schedule-A in lower store @+5°C													161%
% increase of the net vaccine volume compared to Schedule-A at service delivery													137%
% increase of the net vaccine volume compared to Schedule-A at service delivery													90%

Source: WHO Logistics Planning Tool (2013) with Benin's data.

**Annex 7: Financing agents to health-care financing mechanisms****Financing agents to health care financing mechanisms in 2010**

	BZ		BZ		BZ/PRK		BZ/SABA		DDS A/L		DDS B/A		DDS O/P		DDS Z/C		ANV		Total
	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	
Central government schemes					3 374		840		16 765		27 160		18 482		37 562		3172476		3 405 864
Community level financing					2 928				364		2 776		1 125		2 173				76 225
Non-profit institutions financing schemes (NPISH)																		200 000	200 000
Rest of the world		54 000		194 491			490							2 700				6 027 436	6 284 180
Sampling weight					8		4		16.50%		25%		36.70%		21.90%				
<b>Total</b>																			<b>9 966 270</b>

**Financing agents (FA) to health care financing mechanism (HF) in 2011**

	BZ		BZ		BZ/PRK		BZ/SABA		DDD O/P		DDS	
	F	D	F	D	F	D	F	D	F	D	F	D
Central government schemes					4 854		840					
Community level financing					3 391							
Non-profit institutions financing schemes (NPISH)												
Rest of the world	163 406		69 000				1 406		25 664		45 234	
<b>Total</b>	<b>163 406</b>		<b>69 000</b>		<b>8 245</b>		<b>2 246</b>		<b>25 664</b>		<b>45 234</b>	
	DDS A/L		DDS B/A		DDS O/P		DDS Z/C		ANV		Total	
	D	F	D	F	D	F	D	F	D	F		
Central government schemes	16 959		20 100		21 865		27 083		1625548			1 875 765
Community level financing	1 800		5 103				3 237					90 553
Non-profit institutions financing schemes (NPISH)										300 000		300 000
Rest of the world						2 000			1344248	7 814 341		9 465 299
<b>Total</b>		<b>18 759</b>		<b>25 203</b>		<b>23 865</b>		<b>30 320</b>		<b>9 458 589</b>		<b>11 731 617</b>

**Annex 8: Financing agents to health-care functions****Financing agents to health-care functions in 2010**

F. Sources	Cold chain maintenance	EPI Surveillance	Facility-based routine immunization service delivery	Immunization programmes	Not disaggregated	Other routine immunization programme activity	Outreach routine immunization service delivery	Program management	Record-Keeping & HMIS	Social mobilization, advocacy	Supervision	Surveillance	Training	Vaccine collection, storage and distribution	Total
<b>Transfers from domestic revenue</b>															
FS.1.1.1. Internal transfers within central government	64 637	87 841	1 738 297		77 368	12 568	291 301	136 254	455 375	115 288	128 291		83 724	85 715	<b>3 276 659</b>
FS.6.2. Other revenues from communities n.e.c					4 949	3 292						1 125			<b>9 366</b>
FS.1.4. Other transfers							490								<b>490</b>
<b>Transfers distributed by Government from foreign origin</b>															
FS. 2.1.3 GAVI				3 632 954											<b>3 632 954</b>
FS. 2.1.2.1. UNICEF	600			2 161 834	28 918					14 500		2 100	14 874		<b>2 222 826</b>
FS. 2.1.2.2. WHO		33 158					266 095	33 520		8 480	28 460	29 920			<b>399 633</b>
FS.2.1.4.3. Rotary club int.										200 000					<b>200 000</b>
FS.RI.1.5. AMP											21 700		1 514		<b>23 214</b>
<b>Total</b>	<b>65 237</b>	<b>120 999</b>	<b>1 738 297</b>	<b>5 794 788</b>	<b>111 235</b>	<b>15 860</b>	<b>557 886</b>	<b>169 774</b>	<b>455 375</b>	<b>338 268</b>	<b>178 451</b>	<b>33 145</b>	<b>100 112</b>	<b>85 715</b>	<b>9 765 142</b>

## Financing agents to health-care functions in 2011

F. Sources	Cold chain maintenance	EPI Surveillance	Facility-based routine immunization service delivery	Immunization programmes	Not disaggregated	Other routine immunization programme activity	Outreach routine immunization service delivery	Program management	Record-Keeping & HMIS	Social mobilization, advocacy	Supervision	Surveillance	Training	Vaccine collection, storage and distribution	Total
<b>Transfers from domestic revenue</b>															
FS.1.1.1. Internal transfers within central government	94 003	87 841	1 521 997		65 019	12 568	179 699	122 715	455 375	115 288	172 341		81 958	152 693	<b>3 061 497</b>
FS.6.2. Other revenues from communities n.e.c					8 340	5 191									<b>13 531</b>
FS.1.4. Other transfers						3 613	1 526				49				<b>5 188</b>
<b>Transfers distributed by Government from foreign origin</b>															
FS. 2.1.3 GAVI					5 712 374										<b>5 712 374</b>
FS. 2.1.2.1. UNICEF				1 674 309		118 180	96 016	45 234		19 254	93 522	6 464	12 906	69 000	<b>2 134 885</b>
FS. 2.1.2.2. WHO						2 000						154 016			<b>156 016</b>
FS.2.1.4.3. Rotary club int.										300 000					<b>300 000</b>
FS.RI.1.5. AMP											19 713		96 657		<b>116 370</b>
<b>Total</b>	<b>94 003</b>	<b>87 841</b>	<b>1 521 997</b>	<b>1 674 309</b>	<b>5 785 733</b>	<b>141 552</b>	<b>277 241</b>	<b>167 949</b>	<b>455 375</b>	<b>434 542</b>	<b>285 625</b>	<b>160 480</b>	<b>191 521</b>	<b>221 693</b>	<b>11 499 861</b>

## Annex 9 - Coding for financial flow analysis

Table A 7. Funding sources

FS. CODE	FS. Description
<b>FS.1</b>	<b>Transfers from government domestic revenue</b>
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
<b>FS.2</b>	<b>Transfers distributed by government from foreign origin</b>
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.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
FS.2.2.1.1	- 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

<b>FS. CODE</b>	<b>FS. Description</b>
<i>FS.2.2.4</i>	<i>- from other sources</i>
<i>FS.2.2.4.1</i>	<i>- from BMGF commodity transfers</i>
<i>FS.2.2.4.2</i>	<i>- from CHAI commodity transfers</i>
<i>FS.2.2.4.3</i>	<i>- from other external/NGO source commodity transfers (Specify)</i>
<b>FS.3</b>	<b>Social insurance contributions</b>
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
<b>FS.4</b>	<b>Compulsory prepayment</b>
FS.4.1	Compulsory prepayment from households/individuals
FS.4.2	Compulsory prepayment from employers
FS.4.3	Other
<b>FS.5</b>	<b>Voluntary prepayment</b>
FS.5.1	Voluntary prepayment from households/individuals
FS.5.2	Voluntary prepayment from employers
FS.5.3	Other
<b>FS.6</b>	<b>Other domestic revenues not elsewhere classified (n.e.c)</b>
FS.6.1	Other revenues from households n.e.c
<i>FS.6.2</i>	<i>Other revenues from communities n.e.c</i>
<b>FS.7</b>	<b>Direct foreign transfers</b>
<b>FS.7.1</b>	<b>Direct foreign financial transfers</b>
FS.7.1.1	Direct bilateral transfers
FS.7.1.2	Direct multilateral transfers
FS.7.1.3	Other direct foreign transfers
<b>FS.7.2</b>	<b>Direct foreign aid in kind</b>
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)
<i>FS.7.2.2.1</i>	<i>Direct bilateral foreign aid in kind</i>
<i>FS.7.2.2.1.1</i>	<i>- from USG bilateral aid in kind</i>
<i>FS.7.2.2.1.2</i>	<i>- from DfID bilateral aid in kind</i>
<i>FS.7.2.2.1.3</i>	<i>- from JICA bilateral aid in kind</i>
<i>FS.7.2.2.1.4</i>	<i>- from NORAD bilateral aid in kind</i>
<i>FS.7.2.2.1.5</i>	<i>- from other bilateral aid in kind (Specify)</i>
<i>FS.7.2.2.2</i>	<i>Direct multilateral foreign aid in kind</i>
<i>FS.7.2.2.2.1</i>	<i>- from UNICEF aid in kind</i>
<i>FS.7.2.2.2.2</i>	<i>- from WHO aid in kind</i>
<i>FS.7.2.2.2.3</i>	<i>- from PAHO aid in kind</i>
<i>FS.7.2.2.2.4</i>	<i>- from other multilateral aid in kind GAVI Alliance</i>

FS. CODE	FS. Description
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
<b>FS.7.9</b>	<b>Any other source not elsewhere classified (n.e.c)</b>
<b>FSR.1</b>	<b>Loans</b>
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-concessional loans
FSR.1.1.1.3	HIPC/Debt relief
FSR.1.1.2	Other loans taken by government
<b>FS.RI.1</b>	<b>Institutional units providing revenues to financing schemes</b>
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
<b>FS.RI.2</b>	<b>Total foreign revenues (FS.2 + FS.7)</b>

Table A 8. Financing Agents

FA.CODE	FA.Description
<b>FA.1</b>	<b>General Government</b>
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.CODE	FA.Description
FA.1.9	All other general government unit
<b>FA.2</b>	<b>Insurance Corporations</b>
<b>FA.3</b>	<b>Other Corporations /Business (other than insurance)</b>
<b>FA.4</b>	<b>Non-Profit Institutions Serving Households</b>
<b>FA.5</b>	<b>Households</b>
FA.5.1	Community organizations/groups
<b>FA.6</b>	<b>Rest of the World</b>
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.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
<b>FA.9</b>	<b>Any other agents not else where classified</b>

Table A 9. Health financing mechanism

HF.CODE	HF.Description
<b>HF.1</b>	<b>Government schemes and compulsory contributory health care financing schemes</b>
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
<b>HF.2</b>	<b>Voluntary health care payment schemes (other than OOP)</b>
HF.2.1	Voluntary health insurance schemes
HF.2.2	Non-profit institutions financing schemes (NPISH)

HF.CODE	HF.Description
<b>HF.3</b>	<b>Household out-of-pocket payment</b>
<i>HF.3.1</i>	<i>Community level financing</i>
<b>HF.4</b>	<b>Rest of the world</b>
<b>HF.99</b>	<b>Not disaggregated</b>

**Table A 10. Health Providers**

HP.CODE	HP.Description
<b>HP.1</b>	<b>Hospitals</b>
HP.1.1	General hospitals
HP.1.1.1	General hospitals - public
<i>HP.1.1.1.1</i>	<i>National general hospitals</i>
<i>HP.1.1.1.2</i>	<i>Provincial or regional general hospitals</i>
<i>HP.1.1.1.3</i>	<i>District hospitals</i>
HP.1.1.2	General hospitals - social security
HP.1.1.3	General hospitals - NGO/private non-profit
<b>HP.3</b>	<b>Providers of ambulatory health care</b>
HP.3.1	Medical practices
HP.3.4	Ambulatory health care centres
HP.3.4.9	All other ambulatory centres
<i>HP.3.4.9.1</i>	<i>Government facilities</i>
<i>HP.3.4.9.3.1</i>	<i>PHC Type 1 (Health Centre)</i>
<i>HP.3.4.9.3.2</i>	<i>PHC Type 2 (CHPS)</i>
<i>HP.3.4.9.3.3</i>	<i>PHC Type 3 ()</i>
<i>HP.3.4.9.3.4</i>	<i>PHC Type 4 (Specify)</i>
<i>HP.3.4.9.2</i>	<i>Social security facilities</i>
<i>HP.3.4.9.3</i>	<i>NGO facilities</i>
<b>HP.4</b>	<b>Providers of ancillary services</b>
HP.4.2	Medical and diagnostic laboratories
<b>HP.6</b>	<b>Providers of preventive care</b>
<i>HP.6.1</i>	<i>Country Specific Preventative providers</i>
<i>HP.6.2</i>	<i>Research Providers</i>
<i>HP.6.2.1</i>	<i>Public research institutions</i>
<i>HP.6.2.2</i>	<i>Para-statal (quazi-public) research institutions</i>
<i>HP.6.2.3</i>	<i>Private research institutions</i>
<b>HP.7</b>	<b>Providers of health care system administration and financing</b>
HP.7.1	Government health administrative agencies
<i>HP.7.1.1</i>	<i>National MOH</i>
<i>HP.7.1.2</i>	<i>Provincial MOH</i>
<i>HP.7.1.3</i>	<i>District MOH</i>
HP.7.2	Social health insurance agencies
HP.7.3	Private health insurance administrative agencies
HP.7.9	Other administrative agencies
<b>HP.8</b>	<b>Rest of the economy</b>

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HP.CODE	HP.Description
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

**Table A 11. Health Care Functions**

HC.CODE	HC.Description
<b>HC.1</b>	<b>Curative care</b>
<b>HC.6</b>	<b>Preventive care</b>
HC.6.1	Information, education and counseling programmes
HC.6.1.1	<i>Social mobilization, advocacy</i>
HC.6.2	Immunization programmes
HC.6.2.1	<i>Facility-based routine immunization service delivery</i>
HC.6.2.2	<i>Outreach routine immunization service delivery</i>
HC.6.2.3	<i>Training</i>
HC.6.2.4	<i>Vaccine collection, storage and distribution</i>
HC.6.2.5	<i>Cold chain maintenance</i>
HC.6.2.6	<i>Supervision</i>
HC.6.2.7	<i>Program management</i>
HC.6.2.8	<i>Other routine immunization programme activity</i>
HC.6.5	Surveillance
HC.6.5.1	<i>EPI Surveillance</i>
HC.6.6	Record-keeping and HMIS
HC.7	<i>Governance and health system financing and administration</i>
<b>HC.99</b>	<b>Not disaggregated</b>
<b>HC.RI.3</b>	<b>Prevention and public health services</b>
HC.RI.3.3	Prevention of communicable diseases