Hôpital Sacré-Cœur de Milot (HSCM) Health Care Production Costing Study

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HÔPITAL SACRÉ-CŒUR DE MILOT (HSCM) HEALTH CARE PRODUCTION COSTING STUDY

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ACRONYMS

CRUDEM	Centre Rural pour le Développement de Milot
GOH	Gouvernement d'Haiti
HFG	Health Finance and Governance Project
HSCM	Hôpital Sacré-Cœur de Milot
HTG	Haïtienne Gourde
MASH	Management Accounting System for Hospitals
MSPP	Ministère de la Santé Publique et de la Population (Ministry of Health
USAID	United States Agency for International Development

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EXECUTIVE SUMMARY

By request of the Hôpital Sacré-Cœur de Milot (HSCM), the United States Agency for International Development (USAID) Mission in Haiti asked the Health Finance and Governance (HFG) Project to conduct a costing study of HSCM. The goal of this study is to supply the data and the information necessary for developing a financial viability plan for HSCM.

Background on HSCM

The history of HSCM started with the Brothers of the Sacred Heart of Canada and continued through Doctor Theodore Dubuque, a philanthropist. In 1968, the brothers of the Sacred Heart of Montreal created a foundation called "Rural Center for the Development of Milot" (*Centre Rural pour le Développement de Milot* - CRUDEM), which in 1986, with the support of two Haitian doctors, set up a health center called HSCM.

In 1995 Doctor Theodore Dubuque established the CRUDEM Foundation, a non-profit entity whose mission is, among other things, to improve access to health care services for poor people who are medically underserved. The foundation work with hospitals around the world but its main recipient is HSCM. The CRUDEM Foundation does not provide health care services directly. HSCM is a separate legal entity and does provide health care services. After 25 years, the CRUDEM Foundation has transformed that eight-bed health center into a leading community hospital, serving more than 225,000 inhabitants from several municipalities in the North department.

HSCM offers a great diversity of health services ranging from maternity to pediatrics and surgery to internal medicine with several specialties. The hospital also has state-of-the-art diagnostic services: laboratory and medical imaging with the latest generation equipment.

The hospital requires payment for its services, but the fees are much lower than the prices the private sector in Haiti typically charges. Since the contribution of the donors to health financing has declined significantly while the demand for health care has increased, HSCM must study its cost structure to make more efficient use of resources and to develop an effective long-term financing strategy.

Goals and Rationale of the Study

The primary goal of this analysis is to analyze the cost structure of HSCM to:

- Enable preparation of informed budgets
- Provide data for sound planning
- Strengthen management systems
- Devise a business plan that aligns with HSCM's financing strategy vision and ensures the sustainability of the model of confessional private hospitals

Moreover, as part of its resources mobilization strategy the hospital wants to offer certain health services to a private clientele of patients. For that, HSCM wanted the detailed treatment cost of 10 diseases whose treatment it could offer private clients concurrently with current care offerings.

Methodology

This study uses a tool for costing hospital services called the Management Accounting System for Hospitals (MASH), developed by the USAID *Partners for Health Reformplus* project in 2004. MASH uses a top-down approach for allocating all costs of the hospital according to departments (also called cost centers) that provide "final" services to patients, either as inpatients or outpatients. Therefore, a cost center is the smallest hospital unit that provides a service to which the hospital allocates costs. After discussions with hospital staff and administrators, we defined cost centers so that managers and other final users can see both how the hospital manages departments and stores hospital data. General services include administrative services and infrastructures. Intermediate services include diagnostic services and pharmacy services. The final medical services include outpatient, emergency, and inpatient services. Those medical services serve as "final cost centers" for quantifying the costs of services, which include general overhead costs and costs of intermediate services. This analysis also provides an estimate of the costs associated with a day of hospitalization and the cost of an outpatient visit.

To quantify the costs of individual pathologies whose treatment costs interest, we used an "ingredient" approach. That method multiplies the volume of all resources necessary to treat a given pathology by the unit price of those resources to obtain the aggregate treatment cost.

Results

The analysis estimated operating costs of the HSCM at US$ 5,154,554 (Table ES-1) for calendar 2014. That amount includes the value of all resources the hospital used, not just those included in the budget.

Table ES-1. Total Costs of the Hospital, 2014

Costs	Amount in US$	% of the total
Staff costs	US$ 2,208,822	42.9%
Drugs and medical supplies	US$ 601,867	11.7%
Equipment depreciation	US$ 563,669	10.9%
Direct costs	US$ **3,374,358**	**65.5%**
Indirect costs	US$ **1,780,196**	**34.5%**
Total costs	US$ **5,154,554**	**100%**

Approximately 65% of the expenses of HSCM can be allocated directly to cost centers. That level of direct costs represents a guarantee as to the final figures of the estimate of costs. Indeed with lower indirect costs (35%), less allocation is necessary. Staff accounts for 43% of total costs, drugs and medical supplies account for 12%, and 11% are allocated to equipment depreciation.

Labor Costs

Labor is the major cost driver: salaries represented the largest proportion of the total costs at the time of the study. That reflects the level of care HSCM offered: tertiary health care that requires specialized doctors to treat serious diseases. As a result, measures to control costs or to increase the efficiency of staff-related spending will be important to consider for the future.

Drugs and Medical Supplies

Drugs and medical supplies represent a large proportion of the total costs (12%), which reflects the availability and the use of those supplies in the intermediate care departments: laboratory, radiology, and operating room. The presence of hospital care departments such as surgery, general pediatrics, and maternity also explains the relatively high level of consumption of drugs and medical supplies.

Equipment Depreciation

HSCM has medical equipment that for the most part was the produce of donations rather than hospital purchases. However if the hospital in the future needs to replace that equipment, it would be necessary to provide for annual depreciation expenses of US$ 563,669. Without the total annual depreciation expense, the annual operating cost of HSCM is US$ 4,568,138.

Indirect Costs

Indirect costs of $1,780,196 represent the cost of resources all departments use jointly. The three categories of highest indirect costs were energy production, the staff cafeteria, and maintenance/upkeep of infrastructures. Other cost lines include office supplies, other personnel expenses, transportation, communication, and other operating costs.

Intermediate Cost Centers

The availability and the use of key intermediate medical services are essential to the quality of care that the HSCM aims to provide. Those centers have high costs and most have a variable level of activity. The operating room records US$ 462,787 in costs and performs 1,378 surgical procedures that cost on average $336 per procedure. But the operating room performs a wide variety of procedures. The HSCM laboratory is particularly prolific, with 123,601 tests at approximately $5 a test. But there should be tremendous variation in the real unit cost because of the diversity of the tests. Finally, the radiology department records a cost of $97,935 on a total of 4,166 exams with an average cost of $23 per exam. Here also the unit costs must vary because the types of exams differ.

Final Medical Cost Centers

These results for unit costs require careful interpretation. Their calculation depends heavily on the activity of the hospital, which can change considerably from one year to another. Moreover, although it is tempting to think that the cost data directly correlates with the prices for services, pricing involves far more than costs. It includes other essential variables such as the anticipated, realizable growth in performance of services, demographics of the population/epidemiology, demand for services, political priorities, equity funds, revenue opportunities, etc. That said, the information we present here on total costs, outpatient and inpatient activity, and the unit costs per service provided represents an opportunity that HSCM can mine in the course of implementing its strategic financing plan. For HSCM can reflect any successful effort to control costs in its price structure.

Table ES-2. Unit costs of outpatient visits per final cost center

Final cost center	Total costs (US$)	Number of outpatient visits	Cost per outpatient visit (US$)
Outpatient clinic	676,752	42,428	16
Dental clinic	57,116	2,753	21
Community health	778,263	12,297[1]	63
Emergency	231,987	6,130	38

Table ES-3. Unit costs of hospitalization per final cost centers

Final Cost Centers	Total costs (US$)	Number of patient hospitalization days	Cost per day of hospitalization (US$)	Bed occupancy rate	Average length of stay (days)
Maternity	553,895	8,770	63	102%	4.3
Orthopedics	449,770	4,085	110	47%	10.8
Surgery	989,688	8,052	123	102%	8.5
Pediatrics	608,981	12,165	50	97%	8.4
Internal Medicine	657,562	9924	66	106%	7.8
Intensive Care Unit	150,540	999	151	46%	6.3

[1] The community health department does a lot of educational and treatment in the community and the hospital, hence the high volume of its activity.

Unit Costs of Treatment of Targeted Pathologies

We present the results for the unit costs of the targeted diseases according to the main categories of costs: staff, supplies and drugs, tests and exams, surgical and other procedures, and hospitalization. This presentation makes it possible to see the category that generally constitutes most of the costs, in this case hospitalization. The cost of hospitalization represents the "hotel cost" quantified with the MASH and includes the costs of all hospitalization support services (laundry, maintenance, cleaning, depreciation of equipment in the hospital rooms, etc.). This cost is a function of the volume of activity, and if the demand is high, HSCM can realize economies of scale with respect to this "hotel cost" of one day of hospitalization. The compressible aspect of this cost, compared with the other categories, is an important consideration when using the estimates of the treatment cost as a guide in setting the price of those services.

Table ES-4. Unit costs of treatment for targeted pathologies

Pathology	Cost of medical staff (US$)	Cost of supplies and drugs (US$)	Cost of tests and Exams (US$)	Cost of surgical procedures and other procedures (US$)	Cost of hospitalization (US$)	Total treatment cost (US$)
Severe pre-eclampsia	47.87	77.50	65.19	339.49	202.81	732.86
Cephalo-pelvic disproportion	18.58	44.81	28.76	339.49	121.69	553.34
Materno-fetal infection	31.44	45.12	131.78	NA	237.92	446.26
Severe prematurity	117.95	162.06	106.32	NA	713.75	1,100.08
Cerebrovascular accident (CVA)	55.11	191.55	99.56	NA	282.90	629.11
Cardiac decompensation	56.01	39.04	126.54	NA	323.31	544.90
Femur fracture	42.19	204.60	113.75	430.45	1,193.07	1,984.06
Closed leg fracture	28.13	144.17	96.98	430.45	795.38	1,495.10
Open leg fracture	60.04	234.80	96.98	430.45	1,590.76	2,413.03
Intestinal occlusion	46.71	115.60	117.02	407.99	917.80	1,605.12
Generalized peritonitis	69.57	200.99	133.52	426.56	1,101.35	1,931.99

Discussion

Based on these results, we suggest the following recommendations to support hospital administration efforts to ensure financial viability.

Budgeting

Precise and realistic budgets in line with HSCM's mission and strategic plan are essential.

To what extent is the hospital's current cost structure fully accounted for in its budget planning? Which spending areas are currently off-budget? What spending level does that represent?

HSCM is a hospital that still depends on donations and aid from the CRUDEM Foundation. For example, donors provided most medical equipment at HSCM, and the current cost structure does not take into account depreciation and the future replacement of that equipment. This study and the completed inventory of hardware and equipment associated with it will help the hospital understand the cost structure and plan the budget accordingly. That is critical because the quality of HSCM services depends on the maintenance and replacement of that equipment.

Pharmaceutical and medical supplies are another major cost factor for which full information about volume and unit costs was not available for the study period. The reason is that some of the drugs may be donations, and HSCM did not enter their cost in accounting data. In general, HSCM must distinguish the resources received in the form of donations, enter them in accounting records, and quantify them to capture the precise needs for resources and their use.

Management

Exact measurement and regular monitoring of the indicators of efficiency and the systems for producing those measurements are essential for having reliable management of the resources available to the facility and for proving that operability to financing actors (lenders, investors, the government, and donors).

How does the use of resources change over time? Does the facility take advantage of economies of scale when it increases the level services it provides?

All the average unit costs presented in this analysis are subject to change if HSCM foresees an expansion of services it offers. The modeling of the cost structure in this study will help HSCM carry out that process. This analysis includes the types of measurements that, if HSCM tracks them over time, can provide information about the sectors in which economies of scale are possible. The reason is that at least in the medium term, the unit costs should decrease if the activity volume increases more than the additional resources that may be necessary for expansion.

How does the use of resources compare with that of other hospitals of the same level (considering the available data)?

Currently, the study team does not know whether similar cost data are available for other hospitals of the same kind in Haiti. That makes the comparison of costs difficult. However, as noted above, primary health care services are an important component of HSCM, and that kind of cost data must certainly be available for comparison. Such comparisons would no doubt be informative and helpful for HSCM because they will help explore options for providing more efficient primary health care.

Do the current information systems provide the data necessary for evaluating efficiency?

HSCM has a central system of patient records; consequently, it should not be difficult to make sure that the appropriate data are available to provide estimates of individual unit costs in the future to monitor efficiency. For example, it will be important to compile separately the key indicators of the hospital, such as the number of patients admitted and the number of days of hospitalization, and gather them in a report for all inpatient care departments. Moreover, for now, the financial structure of the hospital includes various entities financing various departments such as community health (Sidale project) and in certain cases, the monitoring of data and the indicators entered are not always consistent across services. All the clinical departments must generate standardized reports on key indicators to facilitate the compilation and use of information for decision-making.

In addition to the clinical departments, HSCM must compile the data on the activities and resources for logistic and administrative cost centers (kitchen, laundry, maintenance, etc.). Those departments play an important role in providing care. As we have seen in the results of this costing analysis, their costs can influence the final costs of medical services. So providing logistic services efficiently will make it possible to promote efficient health care delivery.

Planning

HSCM recognizes the need to progress toward more sustainable financing.

Considering the current cost structure and levels of service, which departments/services are supposed to have unit cost structures that can enable them to subsidize other services without creating obstacles to access to care for the indigent population served?

Revenue-generating opportunities: This analysis has identified some key revenue-generating opportunities available to HSCM, including the use of its laboratory, operating rooms, and radiology equipment for revenue-generating purposes. Considering the cost of the equipment, it will be important for HSCM to open use of these services and equipment to out-patients, if that is not already the case, to increase capacity utilization. Another potential source of revenue is the private offering of treatment for pathologies whose treatment costs HSCM already has estimated. The hospital already has plans to offer such services. However, before setting up such an initiative, it is important for the hospital to conduct a quick market study to evaluate the range of prices it will be able to charge for such services and remain competitive. This will enable HSCM to compare those rates with the costs this study quantified to establish the profitability of a policy of openness to private clients. Moreover, since medical training is part of its current activity, HSCM can plan to offer education services to students from additional universities.

Cross-subsidy opportunities: Although the main mission of HSCM is to treat low-income patients, it receives patients of various socio-economic groups. That is why it is reasonable to provide internal subsidies between those who are able to pay for the services and those who cannot. For example, surgical services' costs are too high for the indigent population, but more affluent patients may wish to profit from the high-quality facilities of HSCM and could pay the cost plus a margin[2] for these services.

Results-based financing (RBF) contracts: The Government of Haiti (GOH) is implementing an RBF scheme to support maternal, infant, and child health care services. If the RBF scheme expands to hospitals in the private tertiary sector, HSCM may be able to participate in the program. Determining the resources necessary to provide the considerable volume of primary health care HSCM produces will

[2] The amount billed will consist of the price of the service plus a profit margin, with the excess over costs used to cover indigent care.

be important for negotiating the contractual prices (in particular, if RBF payments are lower than HSCM's costs).

Private health insurance plans: Although private insurance coverage is low in Haiti (1%[3]), a part of the insured population is looking for care and seeks health care services. Consequently, understanding the cost structure will enable HSCM to enter into contracts with official private insurance plans.

HSCM is an institution offering a quality level of general care comparable to that of much richer countries. It targets a population previously deprived of access to the most elementary care. Ensuring that the facility has the essential resources to continue to deliver quality care constitutes a great responsibility and requires the involvement of many actors. Understanding HSCM's cost structure and discussing its resource needs based on the current situation will enable the HSCM administration to express those needs clearly to the many potential actors in search of profitable investments. That will also enable HSCM to take advantage of opportunities to enter into the complex health-financing contracts the GOH is exploring.

[3] Preliminary data from the LSMS (Living Standards Measurement Survey)

I. CONTEXT

At HSCM's request, USAID Haiti asked the HFG team to conduct a costing study for HSCM.

1.1 Haiti

The Republic of Haiti occupies the western part of the island of Hispaniola in the Caribbean. Its population is approximately 10 million people, of which 44% are younger than 18 years of age. According to the Human Development Index, Haiti is ranked 161st, which makes it[4] the fifth-from-the-last country in that table. That illustrates the weakness of Haiti's economy. Total health spending over the period 2011-2012 came to an estimated 32.4 billion Haitian gourds (HTG), or US$771 million[5]. For that period, the health spending per capita was US$75.9, which is above average for low-income countries. However, foreign aid largely covers the country's health spending. Foreign aid (bilateral and multilateral) accounts for 53% of total health spending over the period 2011-2012. Reliance on foreign aid raises new difficulties at all levels of service provision, especially at the hospital level. For the same period, total hospital expenses were an estimated 8.59 billion HTG (US$200 million). However, direct foreign transfers account for 76% of those expenses, and government spending represents less than 4%.

1.2 HSCM (Hôpital Sacré-Cœur de Milot)

The history of HSCM started with the Brothers of the Sacred Heart of Canada and continued through Doctor Theodore Dubuque, a philanthropist. In 1968, the brothers of the Sacred Heart of Montreal created a foundation called "Rural Center for the Development of Milot" (Centre Rural pour le Développement de Milot - CRUDEM), which in 1986, with the support of two Haitian doctors, set up a health center called HSCM.

During that same period, in 1988, a surgeon from St. Louis, Missouri, Dr. Theodore Dubuque, arrived at HSCM and stayed there for six months, performing approximately 250 surgical procedures. On his return to the United States, he rallied his family and businessmen from his community around his project, and in 1995, he established the CRUDEM Foundation, a non-profit entity. Its mission is, among other things, to improve access to health care services for poor people who are medically underserved. The organization seeks, receives, manages, and disburses contributions, donations, and bequests of funds and other property (movable and real estate) to hospitals around the world to meet the health care needs of the underserved. Its main recipient is HSCM. The CRUDEM Foundation does not provide health care services directly. HSCM is a separate legal entity and does provide health care services.

After 25 years, the CRUDEM Foundation has transformed that eight-bed health center into a leading community hospital, serving more than 225,000 inhabitants from several municipalities in the North department.

[4] 2013 Human Development Report, http://hdr.undp.org/en/2013-report
[5] Haïti National Health Accounting, 2011/12, forthcoming.

HSCM offers a great diversity of health services ranging from maternity to pediatrics and surgery to internal medicine with several specialties. The hospital also has state-of-the-art diagnostic services: laboratory and medical imaging with the latest generation equipment.

The hospital requires payment for its services, but the fees are much lower than the prices the private sector in Haiti typically charges. Since the contribution of the donors to health financing has declined significantly while the demand for health care has increased, HSCM must study its cost structure to make more efficient use of resources and to develop an effective long-term financing strategy.

2. GOALS

2.1 Goals of the Study

The primary goal of the analysis is to evaluate and analyze the hospital's cost structure in order to provide information about the efforts necessary in terms of budget, planning, management and mobilization of resources in the context of the strategic progression toward long-term financing. That strategy must be aligned with the national health financing priorities in order to ensure the long-term sustainability of the religious hospital model in Haiti.

2.2 Rationale of the Study

A cost analysis can provide answers to specific questions in each one of these three fields, in relation to long-term sustainability.

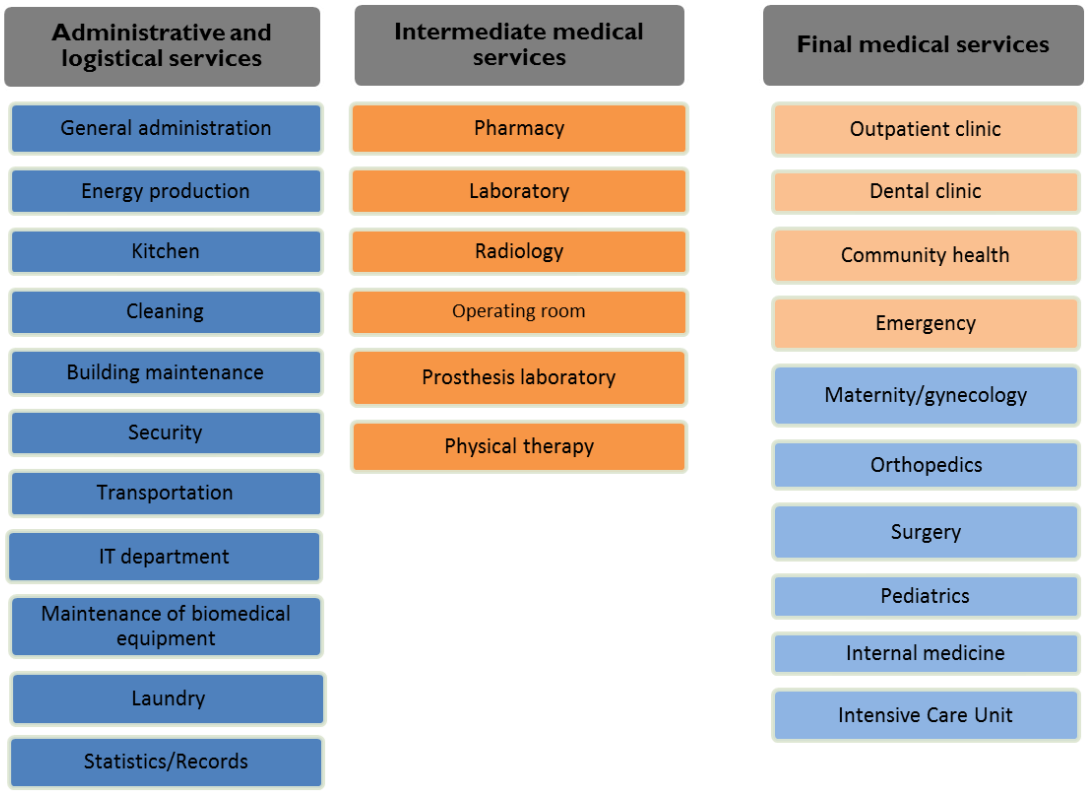
System	Question	Relevance to Sustainability
Budgeting	• To what extent does the hospital's budget planning fully account for its current cost structure? • Which spending areas are currently under-budgeted and what level of expenses does that account for?	Knowing the cost structure data enables HSCM to increase the accuracy of its estimates of future financial needs.
Management	• How does resource use change over time; can the facility realize economies of scale when it increases its volume of service delivery? • Do the current information systems provide the data required to track efficiency?	Having systems in place for accurately measuring and consistently tracking indicators of efficiency is essential for sound management of the facility's resources and to report to donors.
Planning	• Given their cost structure and recent service delivery levels, which departments/services could be part of a revenue-generating strategy without posing access-to-care barriers for the target population, which is primarily poor?	Understanding the cost structure enables HSCM to determine: • revenue-generation opportunities • cross-financing opportunities • which services to offer private clients Understanding how to respond to increasingly sophisticated health financing mechanisms, such as: • Results-based contracting • Health insurance plans

3. METHODOLOGY

This study uses a tool for costing hospital services called the Management Accounting System for Hospitals (MASH), developed by the USAID *Partners for Health Reformplus* project in 2004. MASH uses a top-down approach for allocating all costs of the hospital according to departments (also called cost centers) that provide "final" services to patients, either as inpatients or outpatients. Therefore, a cost center is the smallest hospital unit that provides a service to which the hospital allocates costs. After discussions with hospital staff and administrators, we defined cost centers so that managers and other final users can see both how the hospital manages departments and stores hospital data.

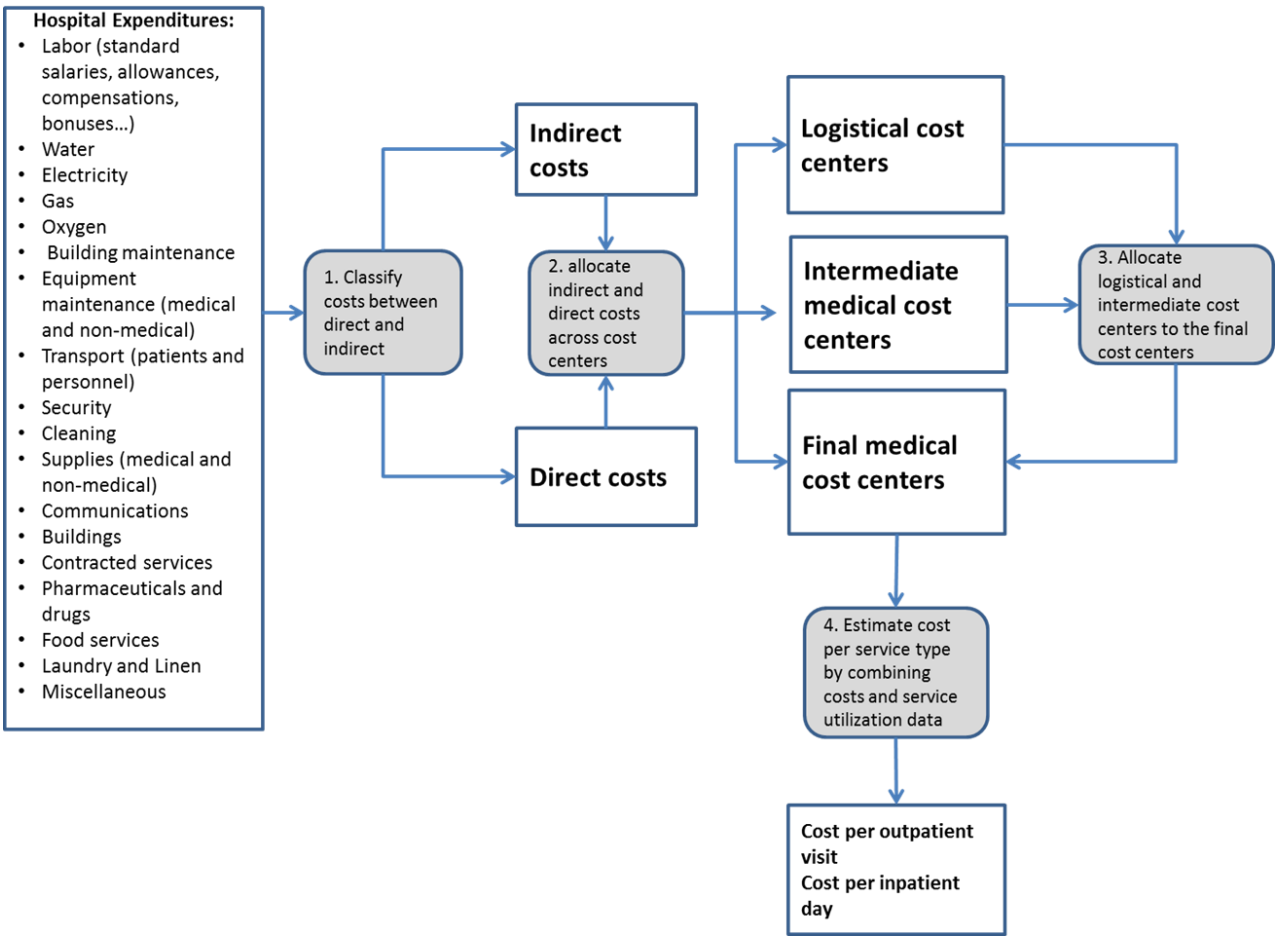
MASH classifies hospital departments into three types: administrative and logistic departments, departments of intermediate medical services, and departments of final medical services.

Exhibit 1: Cost centers used in the MASH organization system for HSCM



The method of allocation of costs follows a top-down process, starting with the administrative and logistic centers then continuing with the intermediate cost centers. A detailed description of this process and relevant assumptions appear in Appendices B and C. Exhibit 2 describes the cost allocation process MASH used. It allocates all costs in four phases.

Exhibit 2: MASH Allocation Diagram



The process includes general services and the building-related services in the total administrative and logistic services. The intermediate services include the services of diagnosis and pharmacy. The final medical services include outpatient care and emergency and inpatient care. The final medical services help quantify the unit costs of the services and provide an appraisal of the daily cost of a bed for inpatient care and the cost of a visit in outpatient care.

The method of calculating the costs of treatment of pathologies by the "ingredient approach" consists of four stages:

- Detailed description of the disease treatment process, in particular resource usage
- Quantification of the resources to treat each disease

- Valuation of those resources
- Adding the value of the various resources to calculate the unit cost of treatment of the disease

For each pathology, we have defined its nature and the treatment protocol from admission to discharge:

- Outpatient treatment or hospitalization
- Average number of days of hospitalization (if applicable)
- Average contact time with medical staff by type
- Average volume of medical supplies used by type
- Average volume of drugs used and prescribed by type
- Laboratory tests, medical imaging exams, surgical interventions, and other procedures needed by type
- Level of resources for each of those tests, exams, interventions, and procedures (staff, supplies, drugs, equipment depreciation, etc.)

We multiplied the volumes defined above by the corresponding unit prices to obtain the treatment cost. We gathered some of the unit prices from the collection of quantitative data within the hospital (unit price of drugs, supplies, etc.) but derived other unit prices from the MASH, in particular the "hotel cost" of a day of hospitalization. The hotel cost by department, which the MASH quantified, includes the costs of all hospitalization support services (laundry, maintenance, cleaning, etc.) and equipment depreciation.

4. RESULTS

We present the results of the MASH analysis in five parts. In the first part, we examine the total costs and the items representing most of those costs: direct costs (labor, drugs, medical supplies, and equipment depreciation) and indirect costs. In the second part, we examine the results of the main intermediate cost centers and their costs, including pharmacy, operating room, laboratory, radiology, etc. In the third part, we examine the cost structure of the final medical cost centers. The fourth part presents the average unit cost according to the activity produced for each final medical service by department of inpatient and outpatient care. In the fifth part, we present the results of the estimations of the treatment cost of targeted pathologies.

The results presented here constitute a summary of the main conclusions of the analysis. More detailed results are in the appendices to this report, along with the intermediate results of the analysis and a complete list of the assumptions we used to allocate costs.

4.1 Total Costs

For the year 2014, the operating costs of HSCM were US$5,154,554. That figure covers the value of all resources used[6], not only those included in the operating expenses indicated by the hospital and CRUDEM Foundation. If we do not consider the depreciation costs[7], the annual operating costs of HSCM fall to US$4,568,138.

Table 1: Total Costs for 2014 in US dollars

All expenses	Value in US Dollars	%
Staff	US$2,208,822	42.9%
Drugs and medical supplies	US$601,867	11.7%
Equipment depreciation	US$563,669	10.9%
Direct costs	US$**3,374,358**	**65.5%**
Indirect costs	US$**1,780,196**	**34.5%**
Total costs	US$**5,154,554**	**100%**

Approximately 66% of HSCM expenses are attributable directly to the cost centers. That level of direct costs enables a more precise cost estimate for all the hospital cost centers than if it were necessary to distribute a higher level of indirect costs.

[6] Includes depreciation of equipment
[7] Total depreciation includes depreciation of medical and non-medical equipment

Exhibit 3: Distribution of Direct Costs

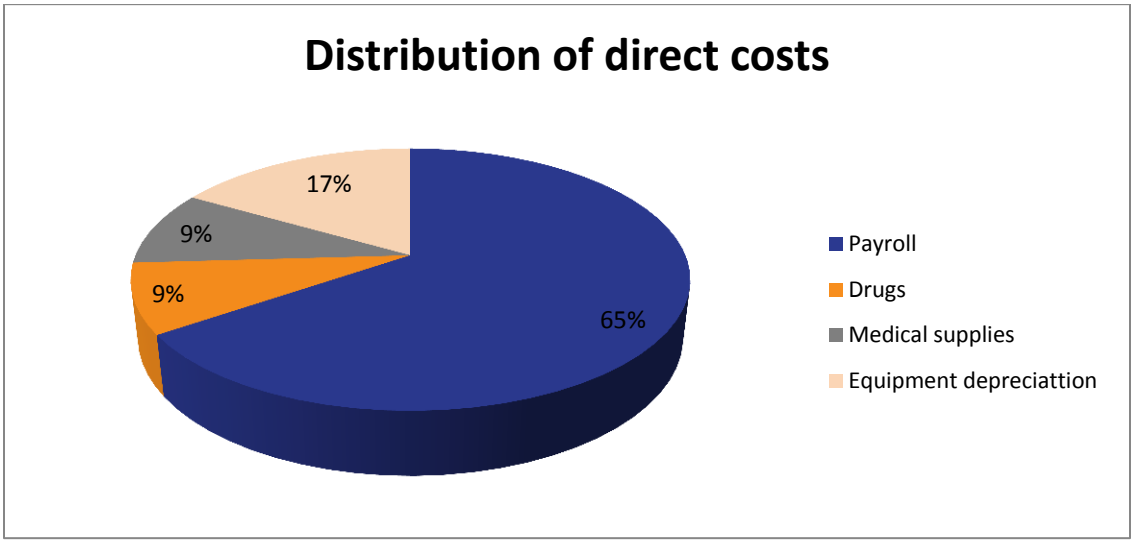


Exhibit 3 shows the distribution of direct costs according to the main categories of cost: staff, drugs and medical supplies, and equipment depreciation. Exhibit 3 indicates that the staff costs account for 65% of the direct costs, drugs and medical supplies for 9% each. The 17% corresponding to depreciation refers to equipment depreciation. We discuss each one of those items later in greater detail.

4.1.1 Staff Costs

The salaries and wages of staff represented the greatest proportion of the direct costs, approximately 65% (US$2,208,822 a year). That reflects the model of distribution of staff for health facilities in the tertiary sector with the presence of many medical specialists to diagnose and treat complex diseases. The dimensions of labor costs will make it important in the future to take into account measures to control the staff costs.

4.1.2 Drugs and Medical Supplies

Medical supplies and drugs represent a cost of US$601,867 a year. Not counting pharmacy, a relatively large proportion of the costs of drugs and medical supplies stem from the main services of inpatient care, such as pediatrics, maternity, and surgery. The use of diagnostic and surgical equipment within HSCM (operating room, laboratory, and radiology) generally requires a relatively large quantity of medical supplies, which also can be a cost factor. Apart from pharmacy, the operating room accounts for 16% of costs, followed by internal medicine and maternity (9% each). Itemized costs of drugs and medical supplies are in Table 2.

Table 2: Costs of drugs and medical supplies by cost center

Cost Center	Medical Supplies	
	Value in US$[8]	*% of total*
Pharmacy	154,651	26%
Operating room	94,992	16%
Internal medicine	53,204	9%
Maternity	52,680	9%
Pediatrics	39,502	7%
Surgery	37,683	6%
All other cost centers	169,155	28%
Total	**601,867**	**100%**

4.1.3 Equipment Depreciation

Equipment costs represent the value of the fixed assets (medical and nonmedical equipment) HSCM uses to provide services. Those costs constitute a major component of hospital costs and require integration into the total cost of providing services. For HSCM, equipment depreciation costs represent approximately 11% of total costs and 17% of direct costs.

The analysis of costs for HSCM includes equipment costs[9]. Because the hospital receives equipment primarily in the form of donations, it does not always keep a record of the purchase price of fixed assets. Therefore the values of current assets are not easy to identify. The attempt at quantifying the cost of the fixed assets proved time-consuming. Indeed, besides the inventory data already available from the administrators of the hospital, that task required involving a member of the HFG team, who had to draw up an inventory of the equipment in each department missing a valuation. Then the study team had to obtain price estimates corresponding to the cost of each piece of equipment. The study team then used the total value of the equipment inventory to calculate an annual depreciation amount. The analysis then added the amount to the other direct costs to arrive at a more exact estimate of the hospital's total operating costs. For calculations of depreciation, we used a service life of five years for equipment.

A more meticulous examination of the results of the inventory in terms of total value of the equipment in Table 3 gives an overview of the cost centers that have the most expensive equipment. Among the medical departments, the laboratory has the largest proportion of the total value of the equipment,

[8] For more information about determining these values, refer to appendixes B and C regarding the cost distribution process.
[9] Without the cost of buildings.

reflecting HSCM's status as one of the top facilities for diagnostic techniques in the region. The operating room also seems well equipped and indicates the level of care that HSCM can offer. The pediatrics and maternity services have a large quantity of equipment, which is normal given the level of care offered.

The depreciation calculation did not take into account the cost of building depreciation. As a result, we did not enter the future costs of replacing the hospital's buildings in the estimates of costs. Additional efforts can consider those costs separately.

Table 3: Total value of equipment by cost center in US dollars

Cost centers	Equipment	
	Value in US dollars	*% of total*
Energy production	818,728	29%
Transportation	788,747	28%
Laboratory	332,390	12%
Operating room	224,030	8%
Pediatrics	72,786	3%
Maternity	71,055	3%
Radiology	67,247	2%
All other cost centers	443,364	16%
Total	2,818,347	100%

4.1.4 Indirect Costs

We calculated US$1,780,196 of indirect costs per year for the cost of the resources all the cost centers jointly use. The largest item is energy production[10] (US$374,659), the staff cafeteria (US$211,210) and hospital maintenance (US$204,871). The other budget items include office supplies, other staff expenses, transportation, communications, and other operating costs (refer to appendix A for more details on cost lines).

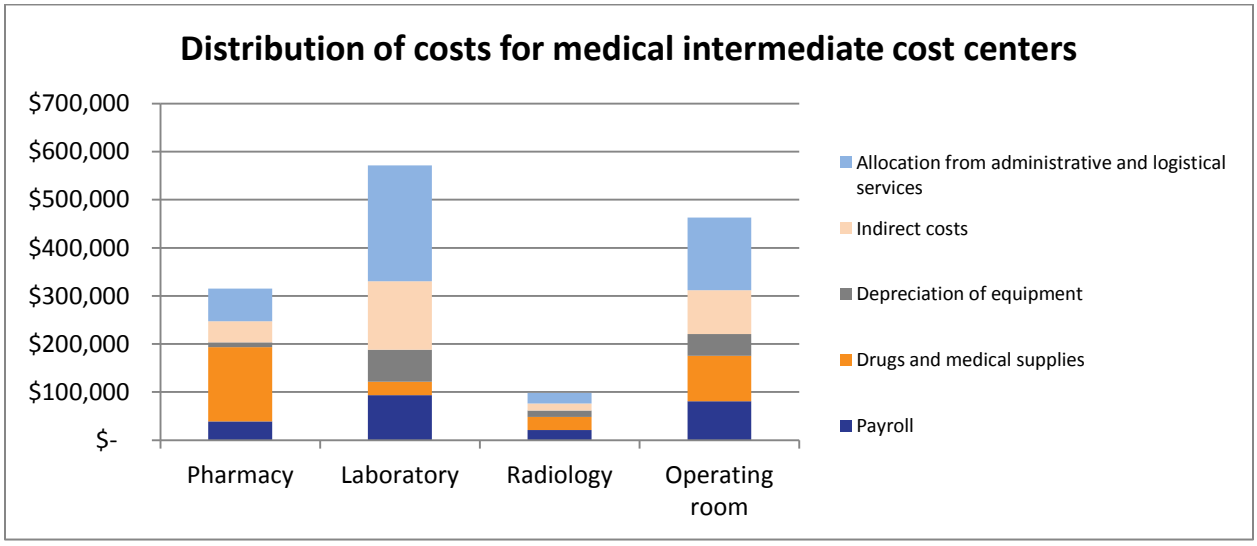
The analysis distributed the costs of administrative and logistic services among the intermediate and final medical cost centers using several allocation criteria. We then distributed the new cost of the intermediate medical services over the final medical cost centers to obtain the final total costs. The results of those allocations are in the following paragraphs. Refer to appendix B for more details on this allocation process and to appendices D and E for the intermediate results.

4.2 Main Intermediate Cost Centers

The top-down allocation of costs in the MASH tool does not directly give an account of the final costs associated with the intermediate cost centers, which may be as important to include for the management of the hospital as the costs associated with the final cost centers. To provide further information on costs, this section will concentrate on the main intermediate cost centers: pharmacy, laboratory, radiology and operating room.

There are three types of costs comprising the total costs of each intermediate center: direct costs, indirect costs, and costs allocated from administrative and logistic cost centers. For the intermediate cost centers, direct costs include staff costs, medical equipment, drugs, and medical supplies. Indirect costs include water, electricity, and all the other common and shared costs (for example, office supplies). The costs also include those allocated from all the logistic and administrative cost centers. Exhibit 4 shows that the distributed costs represent a large portion of the total costs for the intermediate medical cost centers. For the laboratory and the operating room, they account for 42% and 33% of the total costs, respectively, while pharmacy and radiology account for 22% each.

Exhibit 4: Distribution of costs of intermediate cost centers



The management of the hospital may want to analyze the unit costs of the services for the intermediate medical cost centers. The costs the hospital reported for those units are in Table 4. The unit costs require careful interpretation because the services the departments offer are not homogeneous.

The Departments of Laboratory, Radiology, and the Operating Room each produce a series of services, each of which refers to a different level of resource consumption. For example, the laboratory performs various types of tests requiring different equipment, reagents, or types of staff: an HIV test is different from a biopsy. The Radiology Department does simple exams with X-rays and other more sophisticated exams. They differ in terms of costs of the equipment and the supplies used. Likewise, the time devoted to the various procedures doctors perform in the operating room varies, as do the types of staff and the medical supplies used. Thus the unit costs of the laboratory, radiology, and operating room are the average cost of a unit of care in those cost centers and not the exact cost of a service provided.

Table 4: Unit costs of intermediate cost centers

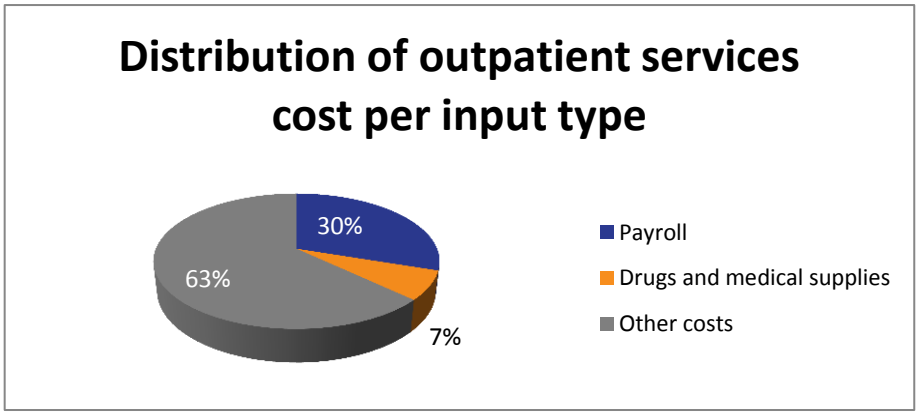
Intermediate medical services	Cost after allocation of costs of services administrative and logistic services	Volume of services	Average unit cost
			Per test
Laboratory	US$571,629	123,601	US$5
			Per exam
Radiology	US$97,935	4,166	US$23
			Per intervention
Operating room	US$462,787	1,378	US$336

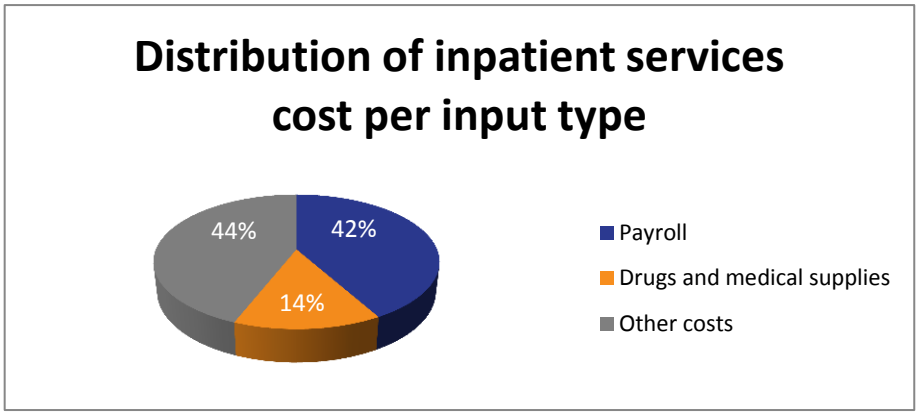
4.3 Cost Structure of Final Medical Services

This section presents the cost structure of the final medical services. For HSCM, we found that outpatient care represents 63% of the total costs of the hospital. Generally for tertiary hospitals that figure is close to one quarter or one fifth. However, this result reflects the mission of HSCM, which includes providing primary health care to the indigent local population.

Exhibit 5 shows the cost of the inpatient and outpatient care distributed according to salaries, drugs, and other inputs. Salaries and drugs make up most of the costs—56%--for hospitalization services, but other costs are greater for outpatient services (63%).

Exhibit 5: Cost structure of inpatient and outpatient care





Tables 5 and 6 (outpatient and inpatient care units) provide a more detailed cost structure.

Table 5: Distribution of costs by input for final medical centers, outpatient care

Final cost centers	Overall cost in US$	Salaries in US$	%	Drugs and supplies in US$	%	Other inputs in US$	%
Outpatient clinic	676,752	328,967	49%	44,993	7%	302,792	45%
Dental clinic	57,116	21,694	38%	12,604	21%	22,819	40%
Community health	778,263	103,887	13%	11,533	1%	662,844	85%
Emergency	231,987	70,365	30%	51,377	22%	110,245	48%
Total	**1,744,118**	**524,913**	**30%**	**120,505**	**7%**	**1,098,700**	**63%**

Among the outpatient care services, the community health service is the largest cost center, followed by the outpatient clinic and the emergency department. The community health service includes HIV testing and treatment and provides care in the community among other things. These tasks can explain the high concentration of costs in that service. The outpatient clinic records the greatest proportion of costs on salaries with 49%, while the emergency department records the greatest proportion of costs on drugs.

Table 6: Distribution of costs by input for final medical centers, inpatient care

Final cost centers	Overall costs in US$	Salaries in US$	%	Drugs and supplies in US$	%	Other inputs in US$	%
Maternity	553,895	229,904	42%	82,506	15%	241,484	44%
Orthopedics	449,770	187,297	42%	71,774	16%	190,700	42%
Surgery	989,688	411,448	42%	121,845	12%	456,395	46%
Pediatrics	608,981	259,399	43%	78,444	13%	271,139	45%
Internal medicine	657,562	300,551	46%	80,117	12%	276,294	42%
Intensive Care Unit	150,540	38,939	26%	46,077	31%	65,524	44%
Total	**3,410,436**	**1,427,538**	**42%**	**481,362**	**14%**	**1,501,536**	**44%**

Surgery and internal medicine are the most significant departments in terms of costs among the inpatient care units. All inpatient care services have a higher proportion of expenditures on salaries compared with drugs except for the intensive care unit (ICU), for which the trend is reversed. That difference is typical of ICUs.

4.4 Unit Costs of Final Medical Services

The last phase of the cost-structure analysis consists of using the cost data in combination with the service volume data to obtain the average costs per service that each department provides. The hospital provided the activity data: number of visits for outpatient care, number of admissions, and number of days of hospitalization for inpatient care. The data about the number of beds come from the equipment inventory data and the documents the hospital provided. The calculation of bed occupancy rates starts with multiplying the total number of beds per service by 360 days for the year to obtain the total possible number of days of hospital care per year. We then divided the number of days of hospitalization reported for each service by the number of possible days of hospital care per year for that same department. The average length of stay per service was the ratio of the number of days of hospital care to the number of admissions.

The following results concerning unit costs require careful interpretation: their calculation is ***very*** *sensitive to the activity of the hospital.* Moreover, for certain cost centers, it is difficult to separate the kinds of care provided. Different kinds of care use different levels of resources. Simply dividing the total cost by the number of units of care produced is not sufficient for obtaining precise figures of unit costs and developing a financially supportable fee list. For example, the number of outpatient consultations includes patients who have come for follow-up visits and those who have come for an initial treatment consultation. Without more detailed data on consumption of resources for each type of service, it is not possible to provide a more exact measurement of the proportion of the total cost of the outpatient clinic department to allocate to the two different types of visits.

Table 7 presents the cost per visit for outpatient care units. For example, the outpatient clinic has the logical structure of primary care service-providers with a high volume of services provided and therefore a reduced unit cost. From a rigorous research standpoint, however, it's necessary to compare that result with the costs of another primary care center in the region to determine whether it is appropriate to characterize the figure of US$16 per visit as low.

Table 7: Unit costs per final cost center, outpatient services

Final cost centers	Total cost (US$)	Number of outpatient visits	Cost per visit (US$)
Outpatient clinic	676,752	42,428	16
Dental clinic	57,116	2,753	21
Community health	778,263	12,297[11]	63
Emergency	231,987	6,130	38

[11] The community health department does a lot of educational and treatment work in the community and at the hospital, hence the high volume of its activity.

Table 8 shows the average costs of a day of hospitalization for inpatient care. Logically, we see that the ICU has the highest cost of a day of hospitalization. The pediatrics service has the lowest cost of a day of hospitalization. We also find that the services of pediatrics, maternity, and internal medicine have a bed occupancy rate higher than 100%. That can be explained by the fact that the data available to HSCM are not yet sufficiently detailed to enable us to distinguish a bed occupied by two different patients on the same day. For example, when a patient is discharged from a bed and that bed is given to another patient the same day, one day of hospitalization is counted for each one of those two patients, which makes two instead of one day.

Table 8: Unit costs by final cost center, inpatient services

Final cost centers	Total cost (US$)	Number of days of hospitalization	Cost per day of hospitalization (US$)	Bed-occupancy rate	Average length of stay (days)
Maternity	553,895	8,770	63	102%	4.3
Orthopedics	449,770	4,085	110	47%	10.8
Surgery	989,688	8,052	123	102%	8.5
Pediatrics	608,981	12,165	50	97%	8.4
Internal medicine	657,562	9924	66	106%	7.8
Intensive Care Unit	150,540	999	151	46%	6.3

4.5 Unit Costs of Targeted Pathologies

The results show that, in general, hospitalization constitutes the largest category of cost and that cost increases with the number of days spent in the hospital. Diseases treated with a surgical procedure are generally more expensive. Fractures of the leg and the femur, intestinal occlusion, and generalized peritonitis are the most expensive pathologies to treat.

Table 9: Unit costs of targeted pathologies

Pathologies	Cost of medical staff (US$)	Cost of medical supplies and drugs (US$)	Cost of laboratory tests[12] (US$)	Cost of medical imaging exams (US$)	Cost of surgical procedures (US$)	Average number of days of hospitalization	Cost of hospitalization (US$)	Total cost of treatment (US$)
Severe pre-eclampsia	47.87	77.50	65.19	NA	339.49	5	202.81	732
Cephalo-pelvic disproportion	18.58	44.81	28.76	NA	339.49	3	121.69	553
Materno-fetal infection	31.44	45.12	98.24	33.55	NA	7	237.92	446
Severe prematurity	117.95	162.06	72.77	33.55	NA	21	713.75	1.100
Cerebrovascular accident (CVA)	55.11	191.55	30.61	68.96	NA	7	282.90	629
Cardiac decompensation	56.01	39.04	60.05	66.49	NA	8	323.31	544
Femur fracture	42.19	204.60	28.02	85.73	430.45	15	1,193.07	1.984
Closed leg fracture	28.13	144.17	28.02	68.96	430.45	10	795.38	1.495
Open leg fracture	60.04	234.80	28.02	68.96	430.45	20	1,590.76	2.413
Intestinal occlusion	46.71	115.60	62.73	54.30	407.99	10	917.80	1.605
Generalized peritonitis	69.57	200.99	99.98	33.55	426.56	12	1,101.35	1.931

Note: maternity has its own ultrasound machine so the cost of ultrasounds done as part of treatment is included in the cost of hospitalization.

[12] Cost of surgical procedures, exams and tests done in the hospital's laboratory

5. DISCUSSION

This part of the report considers the cost structure described in the results. We use the data to provide answers and recommendations for the subjects considered and the goal of the study: supporting hospital management's efforts to ensure financial sustainability.

Budgeting

Precise and realistic budgets in line with HSCM's mission and strategic plan are essential.

To what extent does budget planning fully account for the hospital's current cost structure? What spending areas are currently off-budget? What spending level does that represent?

HSCM is a hospital that still depends on donations and aid from the CRUDEM Foundation. For example, donors financed most medical equipment at HSCM, and the current cost structure does not take into account the depreciation and future replacement of that equipment. This study and the completed inventory of hardware and equipment associated with it will help the hospital understand the cost structure and plan the budget accordingly. That is critical because service quality depends on the maintenance and replacement of that equipment.

Pharmaceutical and medical supplies are another major cost factor for which full information about volume and unit costs was not available for the study period. Some of the drugs may be donations, and HSCM did not enter cost in accounting records. In general, HSCM must distinguish the resources received in the form of donations. HSCM must enter all resources regardless of source in accounting records and quantify them to capture the precise needs for resources and their use.

Management

Exact measurement and regular monitoring of efficiency indicators and the systems for producing those measurements are essential for reliable management of resources available to the facility and for proving that reliability and efficiency to financing actors.

How does the use of resources change over time? Does the facility take advantage of economies of scale when it increases the level of services it provides?

All the average unit costs presented in this analysis are subject to change if HSCM foresees an expansion of the services it offers. The modeling of the cost structure contained in this study will help HSCM carry out that process. This analysis includes the types of measurements that, if HSCM tracks them over time, can provide information about the sectors in which economies of scale can accrue. At least in the medium term, the unit costs should decrease if the activity volume increases more than the additional resources that may be necessary for the expansion.

How does the use of resources compare with that of other hospitals of the same level (considering the available data)?

Currently, the study team does not know whether similar cost data are available for other hospitals of the same kind in Haiti. That makes the comparison of costs difficult. However, as noted above, primary health care services are an important component of HSCM. That kind of cost data must certainly be

available for comparison. Such comparisons would no doubt be fruitful for HSCM they will help explore various options for providing more efficient primary health care.

Do the current information systems provide the data necessary for evaluating efficiency?

HSCM has a central system of patient records; consequently, it should not be difficult to make sure that the appropriate data are available to provide estimates of individual unit costs in the future to monitor efficiency. For example, it will be important to compile separately the key indicators of the hospital, such as the number of patients admitted and the number of days of hospitalization, and gather them in a report for all inpatient care departments. Moreover, for now, the financial structure of the hospital includes various entities financing various departments such as community health (Sidale project) and in certain cases, the monitoring of data and the indicators entered are not always consistent across services. All the clinical departments must generate standardized reports on key indicators to facilitate the compilation and use of information for decision-making.

In addition to the clinical departments, HSCM must compile the data on the activities and resources for logistic and administrative cost centers (kitchen, laundry, maintenance, etc.). Those departments play an important role in providing care. As we have seen in the results of this costing analysis, their costs can influence the final costs of medical services. So providing logistic services efficiently will make it possible to promote efficient health care delivery.

Planning

HSCM recognizes the need to progress toward more sustainable financing.

Considering the current cost structure and levels of service, which departments/services are supposed to have unit cost structures that can enable them to subsidize other services without creating obstacles to access to care for the indigent population served?

Revenue-generating opportunities: This analysis has identified some key revenue-generating opportunities available to HSCM, including the use of its laboratory, operating rooms, and radiology equipment for revenue-generating purposes. Considering the cost of the equipment, it will be important for HSCM to open use of these services and equipment to out-patients, if that is not already the case, to increase capacity utilization. Another potential source of revenue is the private offering of treatment for pathologies whose treatment costs HSCM already has estimated. The hospital already has plans to offer such services. However, before setting up such an initiative, it is important for the hospital to conduct a quick market study to evaluate the range of prices it will be able to charge for such services and remain competitive. This will enable HSCM to compare those rates with the costs this study quantified to establish the profitability of a policy of openness to private clients. Moreover, since medical training is part of its current activity, HSCM can plan to offer education services to students from additional universities.

Cross-subsidy opportunities: Although the main mission of HSCM is to treat low-income patients, it receives patients of various socio-economic groups. That is why it is reasonable to provide internal subsidies between those who are able to pay for the services and those who cannot. For example, surgical services' costs are too high for the indigent population, but more affluent patients may wish to profit from the high-quality facilities of HSCM and could pay the cost plus a margin[13] for these services.

[13] The amount billed will consist of the price of the service plus a profit margin, with the excess over costs used to cover indigent care.

Results-based financing (RBF) contracts: The Government of Haiti (GOH) is implementing an RBF scheme to support maternal, infant, and child health care services. If the RBF scheme expands to hospitals in the private tertiary sector, HSCM may be able to participate in the program. Determining the resources necessary to provide the considerable volume of primary health care HSCM produces will be important for negotiating the contractual prices (in particular, if RBF payments are lower than HSCM's costs).

Private health insurance plans: Although private insurance coverage is low in Haiti (1%[14]), a part of the insured population is looking for care and seeks health care services. Consequently, understanding the cost structure will enable HSCM to enter into contracts with official private insurance plans.

HSCM is an institution offering a quality level of general care comparable to that of much richer countries. It targets a population previously deprived of access to the most elementary care. Ensuring that the facility has the essential resources to continue to deliver quality care constitutes a great responsibility and requires the involvement of many actors. Understanding HSCM's cost structure and discussing its resource needs based on the current situation will enable the HSCM administration to express those needs clearly to the many potential actors in search of profitable investments. That will also enable HSCM to take advantage of opportunities to enter into the complex health-financing contracts the GOH is exploring.

[14] Preliminary data from the LSMS (Living Standards Measurement Survey)

APPENDIX A: TOTAL SPENDING BY TYPE

Data Types and Sources

After determining the cost centers, we gathered the necessary data about activity and costs. Those data include the volumes of services, quantities of drugs and medical supplies, total staffing, data about direct expenses, and other data such as the distribution of the space in the building, the inventories of equipment and vehicles, and costs relating to investments and fixed assets.

We collected data about expenses at the hospital. The financial department and pharmacy provided data about drugs and medical supplies, including the volume of drugs and medical supplies. The collection of data on the volume of services includes the number of beds, admissions for inpatient care, number of days of hospitalization, outpatient consultations, and the number of procedures per department. In general, we collected data at the hospital's records department about the volume of services for all outpatient consultations, all inpatient care services, the emergency department, the laboratory, radiology and the operating room. The hospital's administrative department provided data for logistic services (energy production, transportation, etc.). The data collected about drugs and medical supplies include the quantity of drugs and supplies each medical cost center uses and certain unit costs of specific drugs. The administrative department provided data on the number of staff members, salaries/wages, additional compensation, and the distribution of hours certain staff members spent in different cost centers. The financial department provided data about expenditures, which included indirect costs (supplies, fuel, maintenance, etc.). We drew up inventories of equipment and the space various services occupied.

Payroll Data

Staff costs (expenditures on human resources): these concerned the expenditures on human resources incurred for service provision by production unit. In this study, those expenses include the base salaries, the expenses of contributing to the National Elderly Assistance Office (*Office National Assistance Vieillesse)* payable by the facility, job-related bonuses employees received, and their classification.

The work programs that the hospital's administrative department supplied provided the basis of estimates for the distribution of human resources work hours among the cost centers. They are expressed as %.

Depreciation Assumptions

The depreciation periods used for costing in the model are variable and depend on the type of equipment (heavy equipment, light equipment, rolling stock, etc.). The manufacturer generally supplies that information. Within HSCM, donors provided most of that equipment. Therefore, it has been difficult to trace the exact value and the probable service life of those goods. Through centralized purchasing websites, we conducted a search to find out the theoretical cost of acquisition of the equipment. Based on the most common approach in the "costing" literature, we considered an average service life of five years for the equipment available in each of the defined cost centers.

The depreciation calculation did not include costs of depreciation of the buildings. So the future costs of replacing the hospital's buildings are not in the cost estimates of this study.

Data about Drugs and Medical Supplies

The pharmacy supplied data on the volume of drugs and medical supplies for each medical department. The pharmacy supplied the data for the outpatient clinics and the hospitalization departments. However, the volume data about drugs and medical supplies for the entire year studied were not complete, and we used financial data as a supplement for certain services. That lack of accurate, complete information on medical supplies and drugs is the result of the lack of a monitoring system for tracking all the drugs and supplies each unit or department uses.

Data about Expenditures

Although budget information is available, the HFG team followed the standard procedure of using actual spending data for 2014. The actual data about expenditures constitute financial resources used that are more precise than the budgets because they are likely to vary from the initial budget. Table 10 shows the costs we used in this analysis. In general, we estimated all direct costs based on actual consumption. The team estimated the equipment depreciation costs directly from the inventory. We based the staff expenses estimates on the payroll data HSCM provided.

Table 10: Total costs provided for 2014 in US$

Items	Amount in US$	% of total
Salary expenses	2,208,822	43%
Drugs	291,088	6%
Medical supplies	310,779	6%
Equipment depreciation[15]	563,669	11%
Hospital Maintenance and CRUDEM	204,871	4%
Linen and Cleaning	40,666	1%
Electricity production	374,659	7%
Other energy expenses	46,608	1%
Vehicles and Transportation	107,868	2%
Cafeteria Expenses	211,210	4%
Bonus and other payments	142,956	3%
Freight, mail, customs, legal and bank	163,034	3%
Secretarial, Printing and office supplies	46,087	1%
Data processing and communication	63,349	1%
Social security expenses	36,620	1%
Depreciation of small equipment	22,747	0.4%
Other patient-related spending	154,473	3%
Other expenses	165,048	3%
Total	**5,154,554**	**100%**

[15] Depreciation does not constitute an actual flow of money.

APPENDIX B: COST ALLOCATION PROCESS

Allocation of Costs

The process of analysis of final cost includes allocating the direct costs to the appropriate cost centers, determining the rules of allocation of indirect costs, finalizing the sequence by stages, and performing the calculations of final costs.

The main hospital resources that contribute to providing care are: staff, equipment, drugs, and medical supplies. Most of the time, we can track and directly allocate those costs to a specific cost center. That is why we defined them as direct costs: payroll, equipment depreciation, consumption of drugs, and medical supplies specific to each cost center. We then define the fixed direct costs (payroll and equipment depreciation) and the variable direct costs (drugs and medical supplies). This involves distinguishing between the direct costs that vary immediately with the volume of patients (variable) and those that do not depend immediately on the volume of medical activity (fixed).

Departments share some hospital resources so it is impossible or very cumbersome to measure directly what quantity of a resource an individual cost center uses. These are indirect costs. For the costs of administration, communication and transportation, we used a process of indirect allocation to distribute them among the cost centers. We based the allocation of the indirect costs on identified cost factors, or allocation criteria exerting the most influence on the incurred costs. For each cost center, such allocation criteria could be the floor space occupied, the number of staff, the number of patients, etc. The direct, fixed, and variable costs, defined above, also can be criteria for the allocation of indirect costs.

In the top-down sequence, we allocate the cost centers to various "levels." The cost centers at the top "supply" to the cost centers on the next lower level, which in turn supply to the cost centers on the level below them. The assumption is that a cost center is either a supplier or a customer of another cost center. For example, in this analysis, we assumed that the administrative department serves the cleaning unit while recognizing that the cleaning unit can offer cleaning services for the offices of the administrative department. In that case (and in many others), services are not necessarily performed in just one direction. But to conclude the process of top-down allocation of costs, we had to make a decision about the hierarchical organization based on the value of the services offered. In certain cases, the difference in value between services is small enough that the hierarchy of the levels does not significantly affect the final costs.

APPENDIX C: ASSUMPTIONS FOR TOP-DOWN ALLOCATION

To do the top-down allocation, each cost center received a basis of allocation/criterion for allocating the total of those costs toward all the cost centers on lower levels. Table 11 shows a list of the bases of allocation for each cost center and the assumptions or calculations we used to determine the amount of the basic unit to apply to each of the lower cost centers.

Table 11: Assumptions for top-down allocation

Cost center	Basis of allocation	Assumptions
Administrative and logistic services		
Maintenance/Cleaning	Floor space	• We measured and reported the space in each building in square meters based on the blueprints of the hospital and actual measurements we took during the inventory. The larger the space used, the larger the quantity of resources for cleaning.
General administration	Distribution of staff members	• Based on the payroll data, we distributed staff over various cost centers according to the time spent at the cost centers. The greater the number of employees, the higher the management services are.
Transportation	Direct costs	• We calculated the direct costs by summing the consumption of drugs/medical supplies, payroll, and equipment depreciation assigned to a cost center. The higher the value is, the more important the cost center is in terms of resources directly used for transportation.
Laundry	Direct costs of hospitalization services	• We calculated the direct costs by summing the consumption of drugs/medical supplies, payroll, and equipment depreciation assigned to a cost center. The higher the value is, the more important the cost center is in terms of laundry room resource usage.
Maintenance	Floor space	• We measured and reported the space in each building in square meters based on the blueprints of the hospital and actual measurements we took during the inventory. The larger the space used, the larger the quantity of maintenance resources.
Kitchen/Cafeteria	Distribution of staff members	• Based on the payroll data, we distributed staff over various cost centers according to the time spent at the cost centers. The greater the number of employees, the higher the cafeteria services would be. The kitchen serves meals only to the staff, not to patients.
Maintenance of biomedical equipment	Value of medical equipment	• We compiled the value of the equipment in each service/department based on the inventory data. The greater the value of the equipment, the more important it is to maintain it, and the greater the maintenance resource consumption.

Cost center	Basis of allocation	Assumptions
Medical records	Direct costs of medical services	• We calculated the direct costs by summing the consumption of drugs/medical supplies, the payroll, and the equipment depreciation assignable to a cost center. The greater the value, the more important the cost center is in terms of time that the records service devotes to that department. The records service follows only the activity of the medical departments.
Security	Floor space	• We measured and reported the space in each building in square meters based on the blueprints of the hospital and the actual measurements we took during the inventory. The larger the space used, the larger the quantity of resources for security.
IT	Direct costs	• We calculated the direct costs by summing the consumption of drugs/medical supplies, the payroll, and the equipment depreciation assigned to a cost center. The greater the value, the more important the cost center is in terms of its use of IT resources.
Energy production	Direct costs	• We calculated the direct costs by summing the consumption of drugs/medical supplies, the payroll, and the equipment depreciation assigned to a cost center. The greater the value is, the more important the cost center is in terms of energy consumption.
Intermediate medical departments		
Pharmacy	Estimates expressed as %	• Based on the value of the drugs purchased from the financial report and distributed over each cost center according to the level of activity by type (outpatient/inpatient)
Laboratory	Volume of tests	• Distributed over each cost center using the volume of services the department offers according to the level of activity by type (outpatient/inpatient)
Radiology	Volume of exams	• Distributed over each cost center using the volume of services the department offers according to the level of activity by type (outpatient/inpatient)
Operating room	Volume of surgical procedures	• Distributed over each cost center using the volume of services the department according to the level of activity by type (outpatient/inpatient)

APPENDIX D: TOP-DOWN ALLOCATION RESULTS

Stage 1: Classify costs as direct and indirect costs

We classified all expenses corresponding to the budget items indicated in Table 10 as direct and indirect according to the following criteria:

- Direct costs: costs that we can directly track and allocate to a specific cost center (salaries, drugs, etc.)
- Indirect costs: costs many cost centers share (utilities, maintenance, etc.)

Stage 2: Allocate direct and indirect costs to cost centers

In this cost analysis, we divided the cost centers into administrative and logistic services, intermediate medical services, and final medical services. The goal of this first phase of the hospital costing consists of defining a total cost for each administrative/logistic, intermediate medical, and final medical cost center. We accumulate the direct costs[16] of each cost center and then allocate the indirect costs[17] using appropriate allocation statistics. The cost by service center represents information necessary for budget management and planning at the hospital level. The cost structure of HSCM is in Table 12, Table 13, and Table 14.

The final medical services are the most expensive from an operational standpoint, with approximately 50% of total costs, followed by logistic services (30%) and intermediate medical departments (20%).

[16] In this report, the term "direct costs" designates costs associated with the main resources of health care delivery, which are easily assignable to a specific cost center: staff, equipment, drugs, and medical supplies.
[17] Indirect costs refer to all other hospital costs.

Table 12: Allocation of administrative and logistic costs

Cost centers	Direct costs (US$)	%	Indirect costs (US$)	%	Total costs (US$)	%
Administrative and logistic services						
General administration	306,076	9.1%	207,306	11.6%	513,382	10.0%
Energy production	178,372	5.3%	52,442	2.9%	230,814	4.5%
Kitchen	29,372	0.9%	68,137	3.8%	97,509	1.9%
Cleaning	76,195	2.3%	80,679	4.5%	156,874	3.0%
Building maintenance	64,638	1.9%	69,884	3.9%	134,522	2.6%
Security	68,876	2.0%	49,063	2.8%	117,939	2.3%
Transportation	170,346	5.0%	40,425	2.3%	210,772	4.1%
IT department	12,862	0.4%	8,459	0.5%	21,321	0.4%
Maintenance of biomedical equipment	4,332	0.1%	6,649	0.4%	10,981	0.2%
Laundry	15,227	0.5%	26,031	1.5%	41,258	0.8%
Statistics/Records	26,250	0.8%	24,824	1.4%	51,075	1.0%
Total	**952,548**	**28.2%**	**633,898**	**35.6%**	**1, 586,447**	**30.8%**

Table 13: Allocation of costs of intermediate medical departments

Cost centers	Direct costs (US$)	%	Indirect costs (US$)	%	Total costs (US$)	%
Intermediate medical departments						
Pharmacy	203,659	6.0%	43,413	2.4%	247,072	4.8%
Laboratory	187,965	5.6%	142,265	8.0%	330,230	6.4%
Radiology	61,937	1.8%	14,452	0.8%	76,389	1.5%
Operating room	220,437	6.5%	91,655	5.1%	312,092	6.1%
Prosthesis laboratory	16,433	0.5%	11,224	0.6%	27,657	0.5%
Physical therapy	5,419	0.2%	13,683	0.8%	19,102	0.4%
Total	**695,850**	**20.6%**	**316,692**	**17.8%**	**1,012,542**	**19.6%**

Table 14: Allocation of costs of final medical services

Cost centers	Direct costs (US$)	%	Indirect costs (US$)	%	Total costs (US$)	%
Final medical services						
Outpatient clinic	232,365	6.9%	83,810	4.7%	316,175	6.1%
Dental clinic	23,364	0.7%	9,327	0.5%	32,691	0.6%
Community health	297,987	8.8%	269,514	15.1%	567,501	11.0%
Emergency	51,935	1.5%	30,576	1.7%	82,511	1.6%
Maternity/gynecology	212,370	6.3%	82,254	4.6%	294,624	5.7%
Orthopedics	125,424	3.7%	43,782	2.5%	169,206	3.3%
Surgery	255,259	7.6%	113,395	6.4%	368,655	7.2%
Pediatrics	210,071	6.2%	76,681	4.3%	286,753	5.6%
Internal medicine	263,233	7.8%	101,192	5.7%	364,425	7.1%
Intensive Care Unit	53,951	1.6%	19,074	1.1%	73,025	1.4%
Total	**1,725,960**	**51.1%**	**829,605**	**46.6%**	**2,555,565**	**49.6%**

Table 15: Allocation of total direct and indirect costs

Cost centers	Direct costs (US$)	%	Indirect costs (US$)	%	Total costs (US$)	%
Administrative/logistic services	952,548	28.2%	633,898	35.6%	1,586,447	30.8%
Intermediate medical departments	695,850	20.6%	316,692	17.8%	1,012,542	19.6%
Final medical services	1,725,960	51.1%	829,605	46.6%	2,555,565	49.6%
Total	3,374,358	100%	1,780,196	100%	5,154,554	100%

Stage 3: Allocate administrative/logistic costs to intermediate and final cost centers

Phase 3 of the allocation process includes allocating the costs of administrative and logistic cost centers to the intermediate and final cost centers. The criteria of allocation of costs of all cost centers (described in Appendix B) reflects the use of the services of a given cost center by the others and can include the space occupied, the number of staff or the number of patients. At the end of phase 3, the costs appear as indicated in Table 16. After allocation, the intermediate cost centers now represent approximately 30% of the total costs of the hospital, and the final cost centers represent the remaining 70%.

Table 16: Allocation of administrative and logistic costs to intermediate and final cost centers

Cost centers	Total costs before allocation (US$)	Administrative and logistic costs allocated		Total costs after allocation (US$)	New % of total costs
		Value in US dollars	*% of total*		
Intermediate medical departments	**1,012,542**	**525,313**	**33%**	**1,537,856**	**30%**
Pharmacy	247,072	68,419	4.3%	315,491	6%
Laboratory	330,230	241,399	15.2%	571,629	11%
Radiology	76,389	21,546	1.4%	97,935	2%
Operating room	312,092	150,695	9.5%	462,787	9%
Prosthesis laboratory	27,657	18,623	1.2%	46,279	1%
Physical therapy	19,102	24,631	1.6%	43,733	1%
Final medical services	**2,555,565**	**1,061,134**	**67%**	**3,616,699**	**70%**
Outpatient clinic	316,175	112,242	7.1%	428,417	8%
Dental clinic	32,691	14,467	0.9%	47,158	1%
Community health	567,501	155,907	9.8%	723,408	14%
Emergency	82,511	54,505	3.4%	137,016	3%
Maternity/gynecology	294,624	137,914	8.7%	432,537	8%
Orthopedics	169,206	70,689	4.5%	239,895	5%
Surgery	368,655	188,755	11.9%	557,409	11%
Pediatrics	286,753	126,113	7.9%	412,866	8%
Internal medicine	364,425	166,533	10.5%	530,958	10%
Intensive Care Unit	73,025	34,010	2.1%	107,035	2%
Total	**3,568,108**	**1,586,447**	**100%**	**5,154,554**	**100%**

Note: the total at the bottom of the column "Administrative and logistic costs allocated" is equal to the sub-total of Table 12, and it is added to the column of Total Costs (on its left) to calculate the new totals of each intermediate and final cost center. We allocated the administrative cost centers according to the criteria defined in Table 10.

Stage 4: Allocation of costs of intermediate centers to all final medical services

Phase four consists of allocating the costs of the centers of intermediate medical services to the final cost centers. That is done based on usage of the services of those intermediate cost centers by the final cost centers. The result is the "total costs by final medical cost center," as indicated in Table 17.

We allocated the intermediate cost centers according to consumption for the pharmacy, the number of tests for the laboratory, the number of exams for radiology, and the number of surgical procedures for the operating room. More details about those bases of allocation and assumptions appear in Table 10.

Table 17: Total costs by final medical cost center

Cost centers	Cost before allocation (US$)	Intermediate medical costs allocated		Total costs after allocation (US$)	New % of total costs
		Value in US dollars	*% of total*		
Outpatient clinic	428,417	248,335	16.1%	676,752	13%
Dental clinic	47,158	9,958	0.6%	57,116	1%
Community health	723,408	54,855	3.6%	778,263	15%
Emergency	137,016	94,971	6.2%	231,987	5%
Maternity/gynecology	432,537	121,357	7.9%	553,895	11%
Orthopedics	239,895	209,875	13.6%	449,770	9%
Surgery	557,409	432,279	28.1%	989,688	19%
Pediatrics	412,866	196,115	12.8%	608,981	12%
Internal medicine	530,958	126,604	8.2%	657,562	13%
Intensive Care Unit	107,035	43,505	2.8%	150,540	3%
Total	**3,616,699**	**1,537,856**	**100%**	**5,154,554**	**100%**

The cost centers of inpatient care represent approximately 34% of the costs, while outpatient services represent approximately 66%. Surgery is the most significant cost center (19%), followed by community health (15%), the outpatient clinic and internal medicine (13% each) and pediatrics (12%).

APPENDIX E: LIST AND COSTS OF TESTS, EXAMS, INTERVENTIONS AND PROCEDURES FOR EACH PATHOLOGY

The following table shows a list of tests, exams, interventions, and procedures for each pathology as collected in interviews with medical staff for each department. Note that in addition to these laboratory tests, all patients at HSCM undergo a rapid diagnostic test for syphilis and HIV. Other facilities perform some tests unavailable at the hospital, and in certain cases the patient pays for those tests. However, the hospital performs most tests for the targeted diseases, and those are the tests we considered in the costing.

Table 18: List of tests, exams, interventions, and procedures by pathology

Pathologies	**Laboratory tests** (number of tests necessary in parentheses)	**Medical imaging exams** (number of exams necessary in parentheses)	**Surgical procedures and other procedures**	**Average length of hospitalization**
Severe pre-eclampsia	complete blood count (2) blood group (1) BT-CT (1) hepatic assessment (2) renal assessment (2) proteinuria (2)	ultrasound	Cesarean	5
Cephalo-pelvic disproportion	complete blood count (2) blood group (1) BT-CT (1)	ultrasound	Cesarean	3
Materno-fetal infection	complete blood count (2) CRP (2) Cytological, Bacteriological and Chemical Exam (1) glycemia (1) bilirubinemia (4) blood group (1) Ionogram (2) renal assessment (1) hepatic assessment (2)	X-ray chest (1), X-ray abdomen (1)	NA	7
Severe prematurity	complete blood count (3) CRP (3) Cytological, Bacteriological and Chemical Exam (1) glycemia (1) bilirubinemia (3) blood group (1)	X-ray chest (1), X-ray abdomen (1)	NA	21
Cerebrovascular accident (CVA)	complete blood count (1) urine test (1) renal Assessment (2) Ionogram (1)	X-ray lung (1) EKG (2)	NA	7
Cardiac decompensation	complete blood count (2) urine test (1) renal assessment (1) cardiac enzymes (1), Ionogram (1), cholesterol (1) blood group (1) sedimentation rate (1) lipid assessment (1)	X-ray lung (1) EKG (1) Echocardiography (1)	NA	8

Femur fracture	complete blood count (2) glycemia (1) BT-CT (1)	EKG (2) X-ray thigh (2)	Nailing	15
Closed leg fracture	complete blood count (2) BT-CT (1) glycemia (1)	EKG (2) X-ray chest (1)	Nailing	10
Open leg fracture	complete blood count (2) BT-CT (1) glycemia (1)	EKG (2) X-ray chest (1)	Nailing	20
Intestinal occlusion	complete blood count (3) renal assessment (3) lonogram (3) sedimentation rate (1) BT-CT (1) PT-INR (1)	X-ray chest (1), X-ray abdomen (1), ultrasound scans abdomen (1)	colostomy	10
Generalized peritonitis	complete blood count (4) renal assessment (3) lonogram (3) BT-CT (1) capillary glycemia (4) plasma glycemia (1), blood group (1)	X-ray chest (1), X-ray abdomen (1)	laparotomy	12

The table of costs shows the itemized cost of tests, exams, and procedures. We divided the costs into:

- cost of medical supplies (everything that is for single use or for a single patient during the treatment: gloves, syringes, probes, etc.)
- cost of staff: valuation of time that medical staff spends conducting a test, an exam, or a surgical procedure; various types of staff (doctors, nurses, etc.) may be involved, and we valued each type of time based on the corresponding salary
- cost of chemical products and drugs (every product necessary to conduct tests and the drugs used in interventions)
- structural cost: estimated based on the MASH and representing the ratio of the operating cost of each department of intermediate medical services (including equipment depreciation and costs allocated from the logistic and administrative services) to the volume of activity of that department in 2014; the structural cost reflects the fixed part of the production cost of a test, exam, etc., compared with the variable part, which consists of supplies and products used; the structural cost thus defined could benefit from possible economies of scale by increasing its denominator and therefore increasing the activity of the services concerned

Table 19: Total costs per test, exam, intervention or procedure

Cost centers	Cost of medical supplies (US$)	Cost of chemical products and drugs (US$)	Structural cost (US$)	Cost of staff (US$)	Total cost (US$)
Laboratory tests					
Complete blood count	0.654	1.409	3.350	0.310	5.723
Ionogram	0.654	2.191	3.350	0.310	6.506
Renal assessment	0.654	1.302	3.350	0.465	5.772
Cytological, Bacteriological and Chemical Exam	1.676	1.098	3.350	0.775	6.898
CRP (proteinuria)	0.654	1.314	3.350	0.465	5.783
Cardiac enzymes	0.654	1.147	3.350	0.930	6.081
Sedimentation rate	0.704	0.000	3.350	0.310	4.364
Urine test	0.553	0.149	3.350	0.155	4.207
Lipid assessment	0.654	3.787	3.350	0.930	8.721
Blood group	0.654	0.239	3.350	0.310	4.554
Cholesterol	0.654	1.596	3.350	0.465	6.065
Capillary glycemia	0.308	0.000	3.350	0.155	3.813
Hepatic assessment	0.654	1.726	3.350	0.930	6.660
Plasma glycemia	0.654	3.217	3.350	0.465	7.686
BT/CT- PT/INR	0.704	0.000	3.350	0.310	4.364
Test kit, Syphilis	0.410	0.000	3.350	0.155	3.915
HIV test kit	0.980	0.000	3.350	0.155	4.485
Bilirubinemia	0.654	0.550	3.350	0.310	4.864
Medical imaging exams					
X-rays	4.893	0.000	10.540	1.340	16.773
Ultrasound	8.200	0.000	10.540	2.010	20.750

ECG	14.212	0.000	10.540	1.340	26.092
Echocardiography	9.587	0.000	10.540	1.490	21.617
Surgical procedures and other procedures					
Laparotomy	66.576	134.064	190.190	35.730	426.559
Colostomy	65.901	119.734	190.190	32.160	407.985
Cesarean	91.833	29.989	190.190	27.480	339.493
Nailing	73.654	126.404	190.190	40.200	430.449

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