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GRENADA GENERAL HOSPITAL COSTING 2012

December 2013

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GRENADA GENERAL HOSPITAL COSTING 2012

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

A&E	Accident and emergency
CCU	Critical care unit
CI	Confidence interval
CMS	Central Medical Stores
CVD	Cardiovascular disease
EC$	Eastern Caribbean Dollar
FTE	Full time equivalent
GoG	Government of Grenada
HIV	Human immunodeficiency virus
ICD	International Classification of Diseases
ICU	Intensive care unit
MASH	Management Accounting System for Hospitals
MoF	Ministry of Finance
MoH	Ministry of Health
NCDs	Non-communicable diseases
NHI	National Health Insurance
NIDCU	National Infectious Disease Control Unit
OT	Operating theaters
PAHO	Pan American Health Organization
SE	Standard error
USAID	United States Agency for International Development
UWI-HEU	University of the West Indies – Health Economics Unit
WHO	World Health Organization

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EXECUTIVE SUMMARY

Grenada is currently considering developing a National Health Insurance (NHI) scheme to provide sustainable health sector financing and reduce reliance on out-of-pocket spending. An NHI "pre-feasibility" assessment prepared by the HEU, Centre for Health Economics of the University of the West Indies identified key areas for research in preparation for developing NHI. One recommendation was a study to estimate of the current cost of health services at the country's General Hospital, a 212-bed referral hospital in St. George's. Such as study would be a critical research input when designing and modeling the financial sustainability of an NHI system and also essential for HIV/AIDS program financial sustainability planning. The Ministry of Health (MoH) requested that the USAID-funded Health Systems 20/20 Caribbean project assist in conducting this costing study.

The 2008 Grenada Country Poverty Assessment highlighted overutilization of secondary care facilities for primary care, with less than five percent of cases at hospitals due to emergencies (Kairi Consultants Ltd. 2008). During the 2011 *Grenada Health Systems and Private Sector Assessment*, hospital administrators reported that the General Hospital suffers from overcrowding and long waiting times, especially for outpatient care (Hatt et al 2012). The *Health Systems Assessment* also noted, "Stock-outs and wastage in public sector facilities are common. Public sector stock-outs are primarily due to lack of funds." HIV treatment and care and support services remain centralized, with one treatment site at the General Hospital and six care and support sites throughout the country.

OBJECTIVES

The objective of this activity was to assess the cost of services at the General Hospital in 2012, specifically:

- To understand how much services cost to deliver at the current volume of service
- To provide hospital management with data to assess efficiency
- To provide the MoH with data to make evidence-based arguments to the Ministry of Finance for resources
- To help assess current user fee structures
- To help inform discussions for National Health Insurance.

In addition to cost estimates for health services being provided currently, Grenadian leaders are concerned about future general financial constraints facing the country and the health sector as a whole. The growing burden of non-communicable diseases (NCDs) in an aging population, as well as concerns about funding for infectious diseases such as HIV, contributes to this shift in focus. To address these concerns, in-depth assessment of the inpatient costs to treat five disease conditions – cancer, cardio-vascular disease (CVD), diabetes, hypertension, and HIV – was included in this analysis. Thus, secondary objectives of this report are:

- To estimate the cost per admission for these five selected diseases.
- To estimate the potential changes in demand for services for five priority diseases over time due changes in Grenada's demographic profile.

A final objective for the costing was to demonstrate how results from a general costing study could be used to inform disease-specific planning and management. For this purpose, we assess the costs of HIV and infectious disease control within the General Hospital.

The methodology employs a "step-down" allocation of all costs to a set of clearly defined medical units. Data were collected from June 2013 to October 2013, with a validation workshop and training held in Grenada in October 2013. Patients' medical records were sampled and their data were combined with the results of the step-down allocation to calculate the costs per admission for the five selected diseases.

RESULTS

For the calendar year 2012, operating costs at the General Hospital were EC$34,054,926. This includes all the value of all resources used, not just those included in the budget. Table ES1 provides a summary of the cost by type of input.

TABLE ES1: GENERAL HOSPITAL TOTAL COSTS FOR 2012

Expenditure	EC$	% of total
Salaries and wages	24,872,134	73.0%
Pharmaceuticals, reagents, medical supplies	4,164,644	12.2%
Vehicle depreciation	115,828	0.3%
Fuel and petrol	177,307	0.5%
Rental - equipment etc.	4,577	0.0%
Utilities	1,346,501	4.0%
Heavy equipment rental	456,690	1.3%
Contracted security services	531,333	1.6%
Transport services	24,376	0.1%
Building maintenance	94,048	0.3%
Equipment maintenance	11,294	0.0%
Oxygen	537,714	1.6%
Food services	1,291,472	3.8%
Laundry	107,295	0.3%
Stationery and postage	52,913	0.2%
Other costs	266,800	0.8%
TOTAL	**34,054,926**	**100.0%**

Capital costs for buildings and equipment were not available for this analysis.

For this cost analysis, we divided cost centers into "administrative services and logistics," "intermediate medical services," and "final medical services." The final goal of the hospital costing is to allocate all of the hospital's administrative and intermediate costs to the final medical services cost centers, but each level of service incurs costs directly. When looking at these direct costs, outpatient clinics including the Outpatient General, Accident and Emergency, NIDCU, and the Eye Clinic cost centers made up 14.3 percent of the direct costs. Overall, the cost centers that fall under administrative services and logistics

accounted for a total of 14.2 percent of total direct costs. The largest cost centers include the operating theater at 10.6 percent, accident and emergency at 8.1 percent, the laboratory at 8.5 percent, and Inpatient Obstetrics and Neonatal Unit at 7.7 percent. The male and female medical and surgical cost centers accounted for a total of 18.2 percent of the direct costs.

Table ES2 portrays service volumes and unit costs for the final cost centers.

TABLE ES2: UNIT COSTS BY FINAL COST CENTERS

Final Cost Center	Patient volume (OP Visits; Patient days)	Bed Occupancy Rate	Average Length of Stay (days)	Per Outpatient visit (EC$)	Per Patient Admission (EC$)	Per Patient Day (EC$)	Per Hospital Bed (EC$)
Outpatient General	15,684	-	-	165	-	-	-
Accident & Emergency (Outpatient)	31,469	-	-	128	-	-	-
NIDCU	1,318	-	-	440	-	-	-
Eye Clinic	6,861	-	-	43	-	-	-
Inpatient Obstetrics and Neonatal	7,245	71%	3.6	-	2,432	625	161,610
Male Medical	6,567	69%	5.3	-	2,163	408	103,058
Female Medical	5,965	63%	5	-	2,051	410	94,104
Male Surgical	6,926	59%	5.2	-	3,154	606	131,269
Female Surgical	5,338	61%	6.8	-	4,083	600	133,543
Gynaecology	3,716	42%	4	-	3,030	758	117,294
Eye Ward	846	18%	5.6	-	11,289	2,016	133,702
Paediatrics	5,313	58%	4.6	-	3,118	678	144,047
Private Ward	979	26%	5.5	-	7,678	1,396	130,169

Among the outpatient cost centers, the NIDCU had the most expensive cost per visit (EC$440). However, the majority (53 percent) of these costs are for pharmaceutical and medical supplies. The Eye Clinic had a very low cost per visit (EC$43). The A&E cost center reported about twice as many outpatient visits as the Outpatient General clinic, which again may be due to the practice of admitting many inpatients through the A&E.

Across the inpatient cost centers, Obstetrics and Neonatal had the highest patient volume (7,245 patient days) and the highest occupancy rate (71 percent), but its cost per patient day was at the median compared to other cost centers (EC$625). The Female Medical ward had the lowest cost per patient admission at EC$2,051, and the Eye Ward was the most expensive at EC$11,289.

Pharmacy drugs and supplies were out-of-stock for almost 94 days per year (95 percent CI: 77.7 to 110.5); this is more than three months and represents unavailability for over 26 percent of the year. Laboratory supply or reagent products were out of stock for an average of 38 days per year (95 percent CI: 23.7 – 61.9).

The average cost per admission for the General Hospital as a whole was about EC$ 2,978. The average cost per admission was estimated here to be almost EC$ 1,000 more for four of the five diseases assessed, with the cost per admission for hypertension, at EC$ 3,387, only slightly above the average for the whole hospital. An admission with a cancer diagnosis cost just under EC$ 5,000 on average, compared to just under EC$ 4,200 for diabetes and about EC$ 3,600 for hypertension. It should also be noted that the average cost per admission for cancer patients was only EC$ 1,614 (95 percent CI: 1,110 to 2,119) for patients admitted for one day, while for patients admitted for more than one day the average cost per admission was EC$ 5,942 (95 percent CI: 4,738 to 7,145). Ward costs constitute the majority of costs, ranging from 58 percent to 80 percent of the cost per admission.

This analysis shows that admissions for three diseases – hypertension, cancer, and diabetes – will likely increase over the coming years. Even by 2025, admissions could increase by over 50 percent. These findings are based on two observations: (1) Older people have higher rates of admittances for these diseases, and (2) the population structure in Grenada is likely to shift to older age groups in the coming years.

We estimate that about 93 percent of the NIDCU drug costs, or over EC$ 284,000, come from anti-retroviral drugs, which are currently paid for by the Global Fund. The cost for anti-retroviral drugs alone was also more than the cost of drugs for the outpatient clinic in general, and about EC$ 10,000 less than the entire cost of the eye clinic. Dividing the costs for antiretroviral drugs by the number of patients suggests that these drugs cost about EC$ 3,156 per patient per year, although this may underestimate the costs since some of the patients were not on treatment the entire year.

RECOMMENDATIONS

1. Strengthen accounting systems to comprehensively capture costs

Costing studies such as this one are a valuable tool to provide hospital managers with ad hoc information on hospital performance. However, such studies cannot substitute for routine financial management information systems which should produce performance data on a regular basis to assist managers to monitor performance.

The hospital accounting system operates on the cash basis of accounting, rather than the more accurate and more business-oriented accruals basis. The accrual basis recognizes expenditures as soon as the obligation to pay is established, and not just when cash is actually paid out. The international public service accounting standards recommend that governments consider moving to an accruals basis for the sake of accuracy and better capturing of the costs of providing services.

The hospital did not have an available inventory providing total capital assets and costs associated with them. A current and accurate inventory of all capital items is important for costing and management.

2. Improve the use of hospital service data

Once data are available from the financial information system and/or the HMIS, management should make every effort to analyze them on a regular basis and use them to monitor hospital performance. Some analyses that could easily be performed include: comparing patient load with staff numbers in each department/cost center to assess productivity; reviewing the cost structure of the hospital to determine how the available financial resources are allocated across different expenditure items.

3. Standardize and track pharmaceutical usage data

Pharmaceuticals, including medical supplies and reagents, accounted for about 12 percent of the hospital's total costs in 2012. Expenditure on laboratory supplies was an item of concern as this one item accounted for 42 percent of all expenditure on pharmaceuticals.

4. As part of cost monitoring and management, track changes in utilization and case-mix over time.

Our demographic analysis suggested that the number of admissions for diabetes, cancer, and hypertension will increase in the future, suggesting that the total cost of operating the General Hospital may increase in the future. Tracking these changes over time can inform planning for hospital capacity as well as costs.

5. Use cost information to inform disease-specific programs

The costing of the General Hospital can help inform the planning for disease-specific programs. In the analyses presented here, HIV/AIDS was studied in depth. We found that the NIDCU represented 1.7 percent of the total costs of the hospital, with drugs representing 53 percent of the total costs at the NIDCU. We estimate that about 93 percent of the NIDCU drug costs, or over EC$ 284,000, are for anti-retroviral drugs, which are currently paid for by the Global Fund. As the Global Fund and other partners start to withdraw financial support for ARVs, this means that funds on the order of what was spent by the outpatient eye clinic will need to be found to continue the anti-retroviral treatment program (assuming that the number of patients does not increase over time).

1. INTRODUCTION

1.1 GRENADA: CONTEXT AND HEALTH SYSTEM OVERVIEW

Grenada is an upper-middle-income country in the Eastern Caribbean, with a population of approximately 105,500, of which 30 percent live below the poverty line. Total fertility has fallen to 2.19 births per woman (World Bank 2012), but about 43 percent of the population is under the age of 25 (United States Census Bureau 2013). Public sector health services are delivered through four hospitals, six health centers, and 30 medical stations. There are also three small private hospitals and more than 30 private physician practices in Grenada. Although 61 percent of the population lives in non-urban areas (WHO 2013), there is good geographic coverage of public health services. Citizens of Grenada may obtain care at public facilities for a small consultation fee and receive drugs at public pharmacies at subsidized prices. To promote access to services for vulnerable population groups, children under 17 and adults over 60 are exempted from all user fees, as are individuals considered "indigent"[1] (Tayag 2013). Basic reported heath indicators, such as births attended by a skilled health care worker and immunization coverage, are higher than in other countries in the region. Chronic and non-communicable diseases (NCDs) now account for the majority of reported health problems in Grenada, with diseases of the circulatory system among the leading causes of morbidity and mortality in adults.

With regard to HIV and AIDS, Grenada recorded its first case of HIV in 1984 and had a cumulative total of 464 reported cases as at the end of 2011. The cumulative number of AIDS cases for the same period is 303 (65.3 percent of the HIV cases). The cumulative total of AIDS cases related deaths is 220 (72.6 percent of AIDS cases) (UNAIDS 2012). In recent years, there have been significant improvements in treatment, care, and support services for people living with HIV. However, stigma and discrimination issues persist, and evidence suggests that some people living with HIV in Grenada do not access care and treatment services until HIV is at an advanced stage (Hatt et al 2012).

1.2 HEALTH SECTOR FINANCING IN GRENADA

The latest available estimates from 2011 indicate that total health expenditures were approximately 6 percent of the Gross Domestic Product, which is a slight decrease from 7.4 percent in 2009. Government spending is an estimated 50 percent of total health expenditure, while out-of-pocket payments constitute an estimated 49 percent implying limited financial protection for health for many consumers and the risk that families could be impoverished by catastrophic costs. In 2011, external resources only accounted for 3 percent of the total expenditure on health, down from 6 percent in 2010 (World Bank 2012).

The government's share of health spending is primarily generated from general tax revenues. The WHO estimates that the government of Grenada allocated 11 percent of its total government budget to health in 2011 (WHO 2013). The proportion is comparable to budgetary allocations in 2011 to health in St. Vincent and the Grenadines (9.5 percent), St. Lucia (11.8 percent), Antigua and Barbuda (11.0 percent), or Barbados (10.8 percent) (Hatt et al 2012). Grenada's Ministry of Health (MoH) uses historical

[1] Indigents are identified at health care facilities by a social worker who administers a standardized series of questions. If a patient is considered "indigent" by the social worker, that individual is given a card that certifies this for a limited time period (usually a year) and allows the individual to be eligible to receive government subsidy.

budgeting, rather than planning based on the population's health needs and estimates of resources required to meet those needs. According to Ministry of Finance (MoF) representatives interviewed during the 2011 *Grenada Health Systems and Private Sector Assessment* (Hatt et al. 2012), there is no "scientific" method used to determine the budget allocation to the MOH. Previous spending levels, especially on staff, are the primary determinant of future spending levels.

Some public sector revenue is collected directly from health care consumers in the form of small user fees charged at health centers, hospitals, labs, and pharmacies. Fees are charged for minor and major surgeries, laboratory tests, x-rays, and prescription drugs. The General Hospital in St. Georges also collects user fees from patients electing to utilize its private ward. The government 2012 Actual Provisional budget indicates that revenue generated by hospital fee collection was 0.67 percent of total health expenditures, totaling EC$361,912. Hospital fees plus laboratory and x-ray fees was equal to 4.7 percent of total government health expenditure in 2012 (Government of Grenada 2013).

Grenada has a mandatory social security scheme, known as the National Insurance Scheme, which provides old-age pensions, stipends for those unable to work due to disability or sickness, funeral and survivors' benefits, and employment injury compensation, but there currently is no national health insurance (NHI) scheme in Grenada (authors' interview with members of the National Health Insurance Advisory Committee, 15 October 2013). However, there is interest in establishing such a scheme in the future. In preparation for the development of NHI, the Government of Grenada commissioned a Pre-Feasibility Health Financing Assessment (Theodore et al 2012). Selected findings include:

- Grenada, like the other countries of the Organization of the Eastern Caribbean States, has limited fiscal space, indicating limited ability to increase Government spending on health or other functions;
- The function of the NHI will be mainly one of reallocating resources already being expended;
- The country's income base as a whole—government, employers and employees—suggests that initial affordability will not be the primary issue when establishing an NHI scheme. The most pressing issue will be sustainability, given the expectations of the population and the normal tendency of health care costs to rise;
- The expectation of an improved quality of care and the widening of the range of effective access to care will certainly put a strain on the NHI;
- Prior to NHI design, it is necessary that additional precursor investigations take place, including macroeconomic analysis, health insurance industry analysis, health services costing, and information technology infrastructure assessment, among others.

1.3 HEALTH SERVICE DELIVERY IN GRENADA

Public sector primary health care in Grenada is delivered through a network of 30 Medical Stations and six Health Centers. There are six health districts in Grenada, each of which is managed by a District Medical Officer. Three district hospitals provide secondary care, and the 212-bed General Hospital in St. George's is the main referral hospital[2].

During the 2011 *Health Systems Assessment*, administrators reported that the General Hospital suffers from overcrowding and long waiting times, especially for outpatient care (Hatt et al 2012). The 2008

[2] Note that the number of beds changed during 2012 due to structural damage in the male medical ward. The 212 figure represents an estimated number of beds in use on average throughout 2012.

Country Poverty Assessment also highlighted overutilization of secondary care facilities for primary care, with less than five percent of cases at hospitals due to emergencies (Kairi Consultants Ltd. 2008). There are currently few disincentives to discourage this phenomenon, as non-emergency patients are neither turned away nor encouraged to visit a community-level facility; the Accident and Emergency (A&E) Department is open 24 hours a day, and doctors are always available at the hospital. The *Health Systems Assessment* also noted, "Stock-outs and wastage in public sector facilities are common. Public sector stock-outs are primarily due to lack of funds" (Hatt et al 2012).

HIV treatment and care and support services remain centralized, with one treatment site at the General Hospital and six care and support sites throughout the country. All blood draws must be sent to the central laboratory at the General Hospital and it can take from one to two weeks to receive a result; confirmation of positive results used to be done by the Caribbean Epidemiology Centre in Trinidad but now is done in country (Hatt et al 2012).

The Medical Records Unit at the General Hospital compiles monthly inpatient statistics on admissions, discharges, and bed occupancy rates for the different wards, based on individual patient discharge records. Mortality rates disaggregated by diagnosis (using ICD-10 codes), as well as sex and age groups, are also compiled. The clerk in charge of compiling these statistics uses Excel to enter the data on an ongoing basis. The General Hospital submits the monthly inpatient utilization reports to the Epidemiology and Information Unit. Retrieving a patient's file in the General Hospital is a multi-step process that involves locating the patient's file number using an index-card system, and then retrieving the file from a room of files, often in another building.

1.4 OBJECTIVES

Grenada's level of out-of-pocket spending on health was estimated to be among the highest in the Caribbean region in 2011 (Global Health Observatory). In addition, external donor funding for HIV/AIDS-related programs is likely to further decrease in the coming years. As noted above, the country is currently considering development of an NHI to provide sustainable health sector financing and reduce reliance on out-of-pocket spending. The NHI "pre-feasibility" assessment prepared by the Centre for Health Economics of the University of the West Indies identified key areas for research in preparation for developing NHI. One recommendation was a study to estimate of the current cost of health services at the General Hospital, a critical input when designing and modeling the financial sustainability of an NHI system and also essential for HIV/AIDS program financial sustainability planning. The MoH requested that the Health Systems 20/20 Caribbean project assist in conducting this costing study.

The objective of this activity was to assess the cost of services at the General Hospital in 2012, specifically:

- To understand how much services cost to deliver at the current volume of service
- To provide hospital management with data to assess efficiency
- To provide the MoH with data to make evidence-based arguments to the Ministry of Finance for resources
- To help assess current user fee structures
- To help inform discussions for National Health Insurance.

In addition to cost estimates for health services being provided currently, Grenadian leaders are concerned about future general financial constraints facing the country and the health sector as a whole.

The growing burden of non-communicable diseases (NCDs) in an aging population, in addition to concerns about funding for infectious diseases such as HIV, contributes to this shift in focus. To address these concerns, in-depth assessment of the inpatient costs to treat five disease conditions – cancer, cardio-vascular disease (CVD), diabetes, hypertension, and HIV – was included in this analysis. Estimated unit costs for treating patients with NCD conditions can be combined with epidemiological and/or actuarial projections to estimate the future costs of providing care under the NHI scheme. Thus, secondary objectives of this report are:

- To estimate the cost per admission for these five selected diseases.
- To estimate the potential changes in demand for services for five priority diseases over time due changes in Grenada's demographic profile.

A final objective for the costing was to demonstrate how results from a general costing study could be used to inform disease-specific planning and management. For this purpose, we assess the costs of HIV and infectious disease control within the General Hospital.

2. METHODOLOGY

2.1 TOP-DOWN GENERAL HOSPITAL COSTING STUDY

2.1.1 OVERVIEW

The HS 20/20 Caribbean team proposed that the MoH set up a Costing Working Group to assist the team in data collection and promote sustainable capacity building. This Working Group consisted of representatives of the MoH and the General Hospital., and the data collection team worked closely with them throughout the process to build their capacity to collect cost data and use the costing templates.

The costing team used a hospital services costing tool called the Management Accounting System for Hospitals (MASH) as the basis for this analysis (Partners for Health Reform*plus* 2004). MASH is a framework for tracking and analyzing a health facility's services, resources, and costs. It provides the means for both routine management control and the initiation and management of change, and is a useful tool for examining costs in connection with productive efficiency. MASH helps make management of resources and services transparent and comprehensible for all parties involved.

This methodology employs a "step-down" allocation of all costs to a set of clearly defined medical units. Services provided by the General Hospital were classified into three types: overhead, intermediate services, and final medical services. Overhead services include all administrative services and physical building costs. Intermediate services include diagnostic services as well as food and laundry services. The final medical services include outpatient, emergency and inpatient services by ward. These medical services served as "cost centers" for purposes of estimating unit costs that include the distributed overhead and intermediate services costs. In addition, this analysis provided an estimate of the cost of an inpatient bed-day and the cost of an outpatient visit.

2.1.2 DEFINITION OF COST CENTERS

The first step in the MASH process is to define cost centers. A cost center is the smallest hospital unit that provides one kind of service, where costs are accumulated or assigned. Through discussions with the hospital staff and administrators, cost centers were defined in a way that was useful to managers and other final users and reflected both how departments are currently organized as well as how hospital data is stored. For the full list of cost centers for this costing exercise see Annex A, Table A.1.

2.1.3 DATA COLLECTION

After determining the cost centers, the next step was to gather the necessary output and cost data. This includes service volumes, quantities of drug and medical supplies, total staff numbers, direct expenditure data, and other data such as building space allocations, equipment and vehicle inventories, and other capital and fixed asset costs. The HS 20/20 data collection team visited the General Hospital from June 10 – 21, 2013 and collected data referring to the 2012 calendar year (January 1 – December 31, 2012). A consultant located in Grenada continued to collect data through November 2013.

The team collected expenditure data from the Accounts offices of the General Hospital and the MoH, as well as procurement and invoice data from the Central Medical Store (CMS) for individual departments, such as Pharmacy, Laboratory, Medical-Surgical, Domestics, and Radiology. Service volume data

collection included bed numbers, inpatient admissions and discharges, number of patient days and average length of stay, occupancy rates, outpatient visits, and number of procedures or units per department. In total, service volume data were collected from the outpatient clinic, all inpatient wards, the A&E department, the National Infectious Disease Control Unit (NIDCU), the nutritionist office, the kitchen, the physiotherapy department, the laboratory, the pharmacy, digital imaging, the operating theater (OT), the ICU/CCU, and laundry. Data concerning drugs and medical supplies included total expenditure on drugs as well as unit costs of specific drugs (provided by the CMS), quantity of drugs and supplies used by each cost center (provided by the pharmacy at the General Hospital), and information on any donated drugs or supplies. Staff positions, numbers of staff, salaries/wages and any additional compensation or allowances, work hours (full time equivalent, or FTE), and where possible, allocation of staff time spent in different cost centers. Staff numbers, time, and allocation to departments were collected from the Head Matron's office (for nursing staff) and the Medical Director's office (for doctors). Expenditure data were collected from the Accounts Departments and included both direct and indirect costs (covering utilities, equipment, fuel, maintenance, laundry, pharmaceutical and medical supplies, food), as well as donated goods or volunteer labor. Capital and equipment inventories were collected, as well as square footage of space occupied by the different wards.

2.1.4 COST ALLOCATION AND STEP-DOWN SEQUENCE

The final cost analysis process includes assigning direct costs to the relevant cost centers, determining the rules for allocating indirect costs, finalizing the "step-down" sequence, and performing final cost calculations.

Some hospital resources are shared in a way that makes it impossible or impractical to measure directly how much of the resource is used in a particular cost center. For administration, communication and transportation costs, an indirect allocation process was used to distribute them across the cost centers. Indirect cost allocation is based on identified "cost drivers", or indicators that most directly influence the cost being incurred. These could be floor space utilized, number of staff, number of patients, etc.

In the step-down sequence, cost centers are assigned to different "levels." Centers at the top "supply" the centers below them with some kind of service, and they in turn do the same for the centers below them. The assumption is that a cost center is either a supplier or a customer to another cost center. For example, in this analysis we assumed that the maintenance unit 'serves' the domestic department. While we acknowledge that the domestic department may offer cleaning services to the maintenance unit, the maintenance unit also will do upkeep to the domestic department offices. In this case (and others) the direction of services in not necessarily one directional, but, in order to conclude the step-down process, a decision was made as to which order is either larger (in terms of the value of services offered) or that the value of services is small enough that the hierarchy of levels will not affect final costs in a substantive way.

2.1.5 ALLOCATION ASSUMPTIONS

Detailed allocation bases and assumptions used for the step-down process are included in Annex B, along with additional assumptions made for general calculations in the top-down costing, including staffing, drug consumption, and eye ward versus eye clinic assumptions.

The value of vehicle depreciation was estimated using the assumption that the sum insured is the current total value of each vehicle. The sum insured on each vehicle was provided by the Chief Engineer based on the insured value of each vehicle. Property cost and expenditures associated with office rental were allocated directly to Administration for the step-down process. In the above table they are included in 'Rental – equipment etc.' category. Utilities were calculated based on the 2010 Estimated

Outturn in the Estimates of Revenue and Expenditure for the year 2012. This was calculated by taking the total utilities cost in the Ministry of Finances' (MOF) budget estimating the MOH's portion based on the percentage of total government budget to the MOH and then taking the percentage of the MOH's budget that is allocated to the General Hospital in 2010.

2.1.6 ANALYSIS OF PHARMACY AND LABORATORY SUPPLY STOCK-OUTS

In addition to the use of the MASH tool for the General Hospital costing, the team sampled stock cards in the pharmacy and laboratory in order to determine the level of stock-outs and the costs associated with them. The General Hospital used physical stock cards to capture drug and supply usage, so the following samples were analyzed: one out of every four cards in the pharmacy and one out of every three cards in the laboratory, with the exception of including all HIV drugs. From the cards sampled, the total usage of the items in calendar year 2012 was recorded, including the number of days when items were out of stock.

Using this information, the team determined the average usage per day when items were in stock, multiplied by total days when the product was out of stock to calculate the 'missed usage.' Using the average procurement unit price per product (as recorded by CMS) allowed for estimation of the value of 'missed usage' per item. Once these variables were determined, the team calculated the average number of days items were out of stock and the average value of the 'missed usage' for the sample, and calculated 95 percent confidence intervals[3].

This method provides a "best estimate" of the costs that would be incurred if the product were in stock the entire year, but is subject to several caveats:

1. Substitution is possible – if a supply or reagent is out of stock, in some cases another supply or reagent could be used in its place. Generally, this replacement will be more expensive than the original out-of-stock item, indicating that if the supply or reagent had been in stock the entire year, some savings may have been accrued due to decreased use of another entity. However, we may also have over-estimated usage if a particular drug, reagent, or supply is used as a substitute for another product (and then later becomes out of stock) – the estimated daily usage would then reflect higher usage during the stock out of the other product, which would impact our calculations.

2. Rationing can occur – if laboratory staff are aware that a supply or reagent is running low, they may ask medical staff to limit their use of the supply or reagent to necessary or emergency cases. In this case, the estimated daily usage when the supply or reagent was in stock may underestimate *usage* under non-stock out circumstances. Thus, we may under-estimate the cost of 'missed usage'.

3. The price of products included here is the average procurement price through the Central Medical Stores, and may, for some drugs, include the higher prices charged for emergency procurement. While emergency procurements would be less frequent if items were procured early and in sufficient quantities, emergency procurement may also be necessary in some cases to address unforeseen high volume use of a product. It is not clear how this may affect costs.

[3] Bias-corrected and accelerated bootstrapping was used to account for the large proportion of supplies or reagents that were NOT out of stock (and thus have zero values), to prevent confidence intervals from accruing a negative lower bound, and due to the fact that some reagents or supplies are very expensive, and the data therefore have a right skew.

Finally, it should be noted that pharmacy stock-outs may slightly over-estimate *hospital-wide* stock-outs, since the pharmacy may send its last units of a product to a ward or clinic and then be 'out-of-stock' while the drug remains available in other areas. As a sensitivity analysis, we excluded periods when drugs or medical supplies were out of stock for 7 days or less. This is intended to reflect more closely 'stock-outs for medical services' rather than 'stock-outs in the pharmacy'.

2.2 DISEASE-SPECIFIC COSTING STUDY

As noted in the introduction, five disease areas were prioritized for more extensive analysis of inpatient care costs. These included cancer, cardiovascular disease (CVD), diabetes mellitus, hypertensive diseases, and HIV. The team consulted with the Ministry of Health to identify the specific ICD-10 diagnostic codes used by the General Hospital in 2012 for each of the five diseases. The following definitions were used:

1. Cancer: Diagnostic codes C00 through D48, including in-situ neoplasms, benign neoplasms, and neoplasms of uncertain or unknown behavior. Thus, investigations and treatments of all neoplasms of whatever stage or behavior were included.

2. CVD: Diagnostic codes I70 to I79, including diseases of the arteries, arterioles, and capillaries. Other heart diseases, diseases of the veins, and other diseases of the circulatory system were not included.

3. Diabetes Mellitus: Diagnostic codes E10 to E16, including diabetes mellitus and other diseases of glucose regulation and pancreatic internal secretion.

4. Hypertensive diseases: Diagnostic codes I10 to I15, including all hypertensive diseases.

5. HIV: Diagnostic codes B20 to B24 for human immunodeficiency virus disease.

In order to analyze the costs of treating these 5 conditions in the broader context of demographic changes in Grenada, two separate but related analyses were done. First, demographic projections of the age structure of Grenada's population were used to estimate the potential number of admissions in future years, and then the costs of treating each of the five diseases were estimated through a detailed review of patient medical records.

The protocol for this study was reviewed by Abt Associates, Inc. Institutional Review Board. It was exempted from the need for ethical review. However, considerations related to security and privacy were accounted for in this study, as described below.

2.2.1 PATIENT DATA SAMPLING AND ESTIMATION OF COST PER DISEASE

In order to estimate the cost of treating patients for these five diseases, we undertook four steps. First, we selected a sample of admissions. Second, we reviewed the patient records for the sampled admissions in order to document the quantity of resources used for a particular admission. Third, we determined the unit costs of all of the resources used to treat the patients. Finally, we multiplied the quantities and the unit costs to determine the full cost of a particular admission. These were then averaged across all patients sampled, by disease.

In 2012, there were 2,388 unique admissions with a diagnoses from at least one of the five diseases considered, representing 27% of all admissions to the General Hospital.[4] For CVD and HIV, there were 31 and 19 admission in 2012, respectively, and all these admissions were included in the sample. For the other three diseases, we aimed to sample 10% of the admissions. Table 2.1 specifies details for the sampling framework and final sample.

The General Hospital does not employ a system that uses 'primary diagnosis' or 'reason for admittance'. Thus, multiple diagnoses need to be considered, since it is not clear for which diagnosis a patient was primarily admitted.

Fifty-five percent of these admissions had at least two diagnoses from among the five diseases. This indicates that there were 3,017 admissions eligible for sampling, but that some admissions were included more than once under different diseases. We therefore separated the sampling framework into two strata: one for admissions with no co-diagnosis from among the five diseases being considered (although they might have had other co-diagnoses) and one for admissions which did have at least one co-diagnosis from among the five diseases considered (who may have had other co-diagnoses as well). The sample was then selected to reflect the proportion of patients in the two strata. Once the sample size was determined for each strata/disease group, we then randomly sampled admissions from all admissions within the strata/disease group.

TABLE 2.1: SAMPLE SIZE FOR DISEASE SPECIFIC COSTING ANALYSES

Condition	Number of Admissions 2012	% with no co-diagnosis within 5 diseases	% with co-diagnosis from the 5 diseases	Sample with no co-diagnosis within 5 diseases	Sample with co-diagnosis from the 5 diseases or total	Total Sample size
Hypertension	1287	40%	60%	52	78	130
HIV	19	89%	11%		19	19
Diabetes	982	31%	69%	31	68	99
CVD	31	16%	84%		31	31
Cancer	698	74%	26%	52	19	71
Subtotal	**3017**	**45%**	**55%**			**350**

Admissions were identified by their patient identification number. We pulled patient files based on this number, and identified the appropriate admission based on the date of admission. If a particular patient file was not available, we attempted to replace the file with another randomly sampled admission.

For each admission, data regarding resource usage (quantities) were then extracted from patient records. This included age, sex, ward, length of stay (admission and discharge dates), diagnoses, laboratory tests performed, the quantity, formulation, and type of drugs administered to the patient, as well as information on whether the patient was admitted through the A&E department, whether they were admitted to the ICU during their stay, and whether they had surgery. (See Figure 2.1 for a sample data extraction form).

[4] Data were supplied to the costing team by the Medical Records Department at the General Hospital.

The costing team extracted data from patient records in a secured office at the General Hospital in June 2013. No names, addresses, dates of birth or other data that could potentially be used to identify patients were recorded or extracted. Data were recorded (single entry) directly into a Microsoft Excel Template, which was saved on password-protected computers. No paper forms were used for the data extraction.

FIGURE 2.1: PATIENT RECORD DATA COLLECTION TEMPLATE

Patient No & Information				Name of diagnosis		Name of drug (Medication)	Dose	Route	Frequency	# of days given	Total # of doses given
Record no.	1		Diagnosis 1		Drug 1						
Age			Diagnosis 2		Drug 2						
			Diagnosis 3		Drug 3						
	DD	MM	Diagnosis 4		Drug 4						
Admit :			Diagnosis 5		Drug 5						
Dis :			Diagnosis 6		Drug 6						
			Diagnosis 7		Drug 7						
Sex: M / F			Diagnosis 8		Drug 8						
A&E: Y / N			Diagnosis 9		Drug 9						
ICU: Y / N			Diagnosis 10		Drug 10						
Surgery: Y / N			Diagnosis 11		Drug 11						
Sample domain:			Diagnosis 12		Drug 12						
			Diagnosis 13		Drug 13						
	Name :	# times	Name :	# times	Drug 14						
Lab 1					Drug 15						
Lab 2					Drug 16						
Lab 3					Drug 17						
Lab 4					Drug 18						
Lab 5					Drug 19						
Lab 6					Drug 20						

Unit costs for drugs, by formulation and dosage, were derived from CMS purchase prices. We used the average purchase price for the year 2012. In a few cases, some drugs were not purchased in 2012; in these cases we used 2011 purchase prices. Some drugs utilized by patients were not purchased via the CMS. These drugs were either donated to the hospital or were bought by patients at private pharmacies and brought to the General Hospital by patients. To approximate the unit costs for these drugs, we surveyed Gittens Pharmacy in St. George's to determine the retail price of these drugs. These prices reflect prices at the Gittens Pharmacy in 2013, and may reflect some changes in prices since 2012.

The unit costs for other intermediate services (physiotherapy visit, ICU stay, surgery, digital imaging, and laboratory tests) were derived from the step-down costing described above. For a physiotherapy visit, we took the total costs for this unit and divided by the total number of physiotherapy visits for the year to determine an average cost per visit. Similarly, we determined the average cost of an ICU stay by dividing the total cost of the ICU by the number of admissions; however, we subtracted the costs of other intermediate cost centers (e.g., pharmacy, laboratory, and digital imaging) from the total cost of the ICU before calculating the average costs, since these other costs were itemized in the data extraction.

For surgery, digital imaging and laboratory services, we took a weighted average of services to determine the average cost of a service. We used the price charged to patients for these services as best proxy for the weights. For example, we took the number of major surgeries, multiplied by the price charged for a major surgery, then added the number of intermediate surgeries multiplied by the price charged for an intermediate surgery, etc. until all types of surgeries were added in. We then divided the total cost of the operating theater (less any other intermediate cost centers accounted for elsewhere in the costs, as we did for ICU) and divided by the total of surgeries multiplied per price. This results in the cost per EC dollar charged. To determine the cost of major surgery, we then multiply the cost per EC dollar charged by the price charged for major surgery to estimate the average cost per major

surgery. For laboratory, because the full year of lab tests by type were not available, we took a sample of data from months available and multiplied upward to estimate the total weighted number of tests done for the year.

The costing team worked with nurses at the General Hospital to classify diagnostic codes for procedures into major, intermediate, and minor surgery.

Some digital imaging was done offsite at the Spice Island Imaging Centre; we used the listed price by service type to approximate the unit costs of these services. When calculating the final cost of services, we tracked both this and the pharmaceuticals to estimate what amount of the costs was paid for by patients.

Ward costs, including staff time, supplies, laundry, kitchen costs, etc., and A&E costs were also taken from the top-down costing. Again, the intermediate cost centers discussed above were taken out of these centers when determining the total costs. For the pharmacy, for example, the cost of the drugs themselves were not included in the unit costs for an inpatient bed-day or a visit to the accident and emergency department. However, the other costs of the pharmacy, such as staff or drug wastage costs, were included. We estimated the costs for medical supplies, such as gloves, gauze, etc., based on their total value as a percentage of the total of all pharmaceutical procurement through CMS, and retained this percentage of costs in the unit costs for services. On the other hand, the entire cost of the operating theater was excluded since this was included already in the average cost per surgery.

The unit costs and quantities of inputs were analyzed using Stata 12.0. The analysis looks at the average cost per patient for each of the five disease categories. Note that because of multiple diagnoses, some patients were diagnosed with more than one of the five diseases. We analyzed patients based on the disease for which they were sampled; for example if a patient was sampled because of a hypertension diagnosis but was also diagnosed with diabetes, this patient was included only in the hypertension analysis. As a sub-analysis, we look at the cost per admission for patients with multiple diagnoses. To determine 95% confidence intervals that account for the right skew in the average cost per admission, we use the bootstrapped standard error based on 1,000 draws[5].

The main outcomes for this analysis include the cost per admission and the cost per admission by cost center. We also included analyses on the number of co-diagnoses, length of stay, and cost by major age group.

2.2.2 DEMOGRAPHIC PROJECTIONS

The purpose of this sub-analysis was to analyze how demand for services for the 5 diseases is associated with age, and to construct projections of potential future demand for services for these 5 diseases.

The team determined the total admission rate in 2012 for each of the five diseases by major age groups. The admission rate is defined as the number of admittances by people in a particular age group with a diagnosis for a particular disease, divided by the total population in a particular age group. United States Census Bureau estimates and projections for Grenada were used to determine the total population by age group (United States Census Bureau 2013). The age groups used were: ages 0 to 14, 15 to 24, 25 to 54, 55 to 64, and 65 and over.

[5] Note that for CVD and HIV, the mean calculated is the mean cost of treatment for the year 2012 since all relevant admissions were included in the sample; the 95% confidence interval applies to costs for other years.

The admission rates from 2012 were then multiplied by the projected total population per age group in 2025 and 2050 to project the number of admissions in each of those years.

2.3 VALIDATION OF RESULTS AND CAPACITY BUILDING

Finally, in collaboration with the MoH, the analysis team prepared a Hospital Costing Training and Dissemination Workshop, which was held October 16th and 17th, 2013. An overview of health economics concepts, types of costing studies, training with the MASH costing tool, and preliminary results were presented to participants, who included staff from the MoH and the General Hospital. Since many of the participants were staff at the hospital and had contributed to the data collection process, the team was able to input some missing data and finalize allocation assumptions during this workshop.

In addition, the preliminary results of the General Hospital costing were compiled and presented more formally to the representatives of the MoH, including the Minister of Health and the Permanent Secretary on October 18th. Discussion points included the need for developing local expertise to use the data and results, and the importance of informing hospital management, health care workers, and the public about health sector costs, especially since costs are likely to increase due to demographic trends.

The Minister provided two recommendations for action:

1. The Ministry of Health needs to look at the final data and made recommendations for cost control activities at the General Hospital. A 'champion' is needed to promote key messages from the analysis and move reforms forward.

2. The Ministry of Health and the General Hospital need to build capacity to perform cost analyses and use cost data for management. It was proposed that a small team be set up in the Ministry of Health to estimate the costs of community health services. This likely could be done by Ministry staff with guidance from experts.

3. FINDINGS: GENERAL HOSPITAL COSTING ANALYSIS

3.1 TOTAL COSTS

3.1.1 TOTAL EXPENDITURES

For the calendar year 2012, operating costs at the General Hospital were EC$34,054,926 (Table 3.1). This includes all the value of all resources used, not just those included in the budget. Capital cost for building and equipment are not included in these costs. Operating costs were provided by the General Hospital Accounts Report, but are also supplemented with additional expenses such as donations and costs captured under the Ministry of Health budget. It is important to note that the annual budget for the General Hospital includes additional items unrelated to the Hospital operations, such as the full cost of the off-site laundry facility, which serves other institutes beyond the General Hospital.[6]

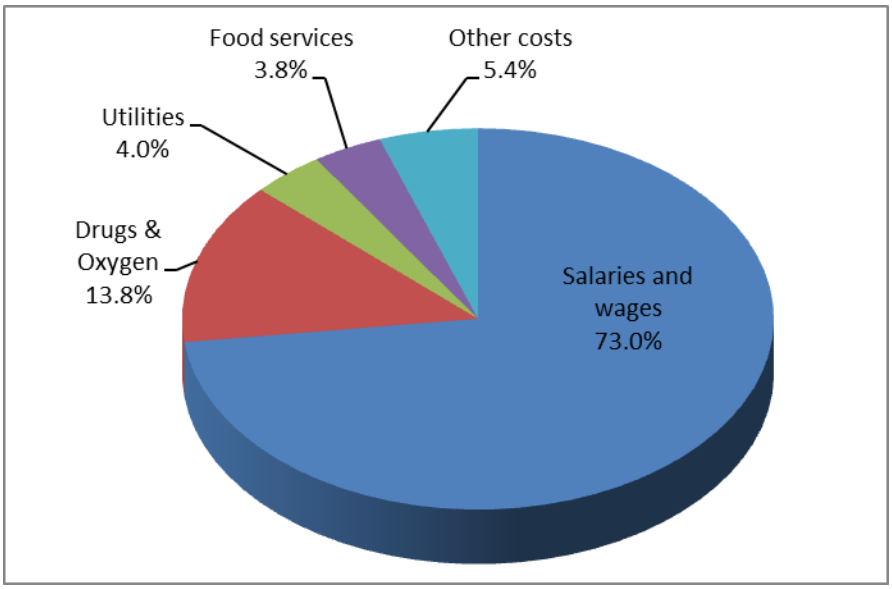
TABLE 3.1: GENERAL HOSPITAL TOTAL COSTS FOR 2012

Expenditure	EC$	% of total
Salaries and wages	24,872,134	73.0%
Pharmaceuticals, reagents, medical supplies	4,164,644	12.2%
Vehicle depreciation	115,828	0.3%
Fuel and petrol	177,307	0.5%
Rental - equipment etc.	4,577	0.0%
Utilities	1,346,501	4.0%
Heavy equipment rental	456,690	1.3%
Contracted security services	531,333	1.6%
Transport services	24,376	0.1%
Building maintenance	94,048	0.3%
Equipment maintenance	11,294	0.0%
Oxygen	537,714	1.6%
Food services	1,291,472	3.8%
Laundry	107,295	0.3%
Stationery and postage	52,913	0.2%
Other costs	266,800	0.8%

[6] No revenue data for patient payments for drugs, laboratory, digital imaging, or the private ward are included. These data reside at the Ministry of Finance and were not made available to the costing team. It should be noted that patient payments return to the consolidated budget for the Government of Grenada, and are not retained or earmarked for use by the General Hospital.

TOTAL	**34,054,926**	**100.0%**

FIGURE 3.1: BREAKDOWN OF TOTAL COSTS, 2012



Personnel wages and salaries were the largest proportion of the total costs at about 73 percent. Of this, physicians made up 17 percent of the costs, nurses made up 73 percent, and non-medical personnel, including administrators, lab technicians, and pharmacists, made up 10 percent of the labor costs. See Annex D for further breakdown of salaries. Cost controls targeted at personnel costs could yield substantial savings. However, the hospital management is limited in its ability to influence personnel costs, and as reported in the 2013 Estimates of Expenditure (GoG 2013), 116 established posts are still vacant, including posts for a surgeon and other specialists. As noted in the Methodology section, some of these needs are fulfilled through Medical Missions (the cost of which was included in this analysis).

Pharmaceuticals, oxygen and other medical supplies made up the second largest category of costs at 13.8 percent. As shown in Table 3.2, the Laboratory accounted for 42 percent of the pharmaceutical and medical supply expenditures (excluding costs for oxygen), followed by the Operating Theater at about 13 percent. For a breakdown of pharmaceutical and supply expenditures by product, please refer to Section 3.6.2.

TABLE 3.2: PHARMACEUTICAL AND MEDICAL SUPPLY COSTS BY COST CENTER

Cost center	Drug and Supply Expenditures	Percent of Total
Laboratory	1,752,621	42.1%
Operating Theater	521,085	12.5%
Accident & Emergency (Outpatient)	233,632	5.6%
NIDCU	314,614	7.6%
Other Cost Centers	1,342,691	32.2%
Total	**4,164,644**	**100.0%**

3.1.2 CAPITAL COSTS

Capital costs represent the value of fixed assets used in the delivery of services. These are an important component of hospital costing, particularly when the full cost of delivering services is required, for example, for pricing purposes to set user fees or to contract with insurance companies for the care of their members.

The analysis of GH does not include capital costs because it was not possible to obtain the value of fixed assets in time for the analysis. The hospital does not maintain a register of all fixed assets nor are the values of the assets currently in use easily retrievable. An attempt to estimate the cost of fixed assets proved too time-consuming as it involved collecting data from each department from their inventory lists (displayed in each office) and then obtaining estimates of the costs of those items in order to calculate a depreciation amount for the year that would be added to the other costs in 3.1.1 above, to arrive at a more accurate estimate of the total costs of running the hospital.

Studies in other countries can give an indication of the magnitude of capital costs in hospitals. In 2012, a costing study of the Mount St. John's Medical Center (MSJMC) in Antigua and Barbuda showed capital costs at 8.9% of total costs (Routh 2013). A similar study in 2009 in the Philippines, estimated capital costs for five tertiary hospitals (116 to 455 beds) at an average of 12.6% (range 8% to 16%; median 13%) (Tsilaajau 2009). If the GoG wanted to include an estimate for capital costs, the unit costs provided in this report could be marked up by a factor of anything from 10 to 20% and this would give some assurance that the total unit costs are not significantly understated.

3.2 ALLOCATIONS OF COSTS TO ALL COST CENTERS

As noted in the methods section, this cost analysis divided cost centers into "administrative services and logistics," "intermediate medical services," and "final medical services." The final goal of the hospital costing is to allocate all of the hospital's administrative and intermediate costs to the final medical services cost centers. Accumulating the direct costs[7] of each cost center is the first step of the "step-down" allocation method. The cost structure for the General Hospital is presented in Table 3.3 below.

Outpatient clinics include the Outpatient General, Accident and Emergency, NIDCU, and the Eye Clinic cost centers, which made up 14.3 percent of the direct costs. Overall, the cost centers that fall under administrative services and logistics accounted for a total of 14.2 percent of total direct costs. The largest cost centers include the Operating Theater at 10.6 percent, the Accident and Emergency at 8.1 percent, the Laboratory at 8.5 percent, and Inpatient Obstetrics and Neonatal Unit at 7.7 percent. The male and female medical and surgical cost centers accounted for a total of 18.2 percent of the direct costs.

[7] In this report, the term direct cost means costs prior to any allocation rules being applied.

TABLE 3.3: DIRECT COSTS BY COST CENTER

Cost centers	Direct costs (EC$)	% of direct costs
Administrative Services and Logistics		
Building Maintenance/ Bioengineer/ Transport/ Security/ Switchboard	2,162,906	6.4%
Domestics	1,338,890	3.9%
General Administration/ Finance	1,010,534	3.0%
Medical Records	339,965	1.0%
Subtotal Administrative cost centers	*4,852,295*	*14.2%*
Intermediate Medical Services		
Laundry	222,233	0.7%
Nutritionist	61,545	0.2%
Kitchen	1,725,567	5.1%
Pharmacy	212,791	0.6%
Laboratory	2,882,011	8.5%
Digital Imaging	634,391	1.9%
Operating Theater	3,620,238	10.6%
ICU/CCU	1,062,309	3.1%
Physiotherapy	145,679	0.4%
Subtotal Intermediate cost centers	*10,566,764*	*31.0%*
Final Medical Services		
Outpatient General	1,459,589	4.3%
Accident & Emergency (Outpatient)	2,755,183	8.1%
NIDCU	464,619	1.4%
Eye Clinic	206,914	0.6%
Inpatient Obstetrics and Neonatal	2,619,677	7.7%
Male Medical	1,385,757	4.1%
Female Medical	1,247,072	3.7%
Male Surgical	1,918,245	5.6%
Female Surgical	1,645,807	4.8%
Gynaecology	1,218,226	3.6%
Eye Ward	1,037,261	3.0%
Paediatrics	1,937,333	5.3%
Private Ward	878,653	2.6%
Subtotal Final cost centers	*18,635,867*	*54.7%*
Total	**34,020,690**	**100%**

Note: ICU = Intensive care Unit; CCU = Critical Care Unit; NIDCU = National Infectious Disease Control Unit

3.3 STEP-DOWN ALLOCATION OF ADMINISTRATIVE COSTS

Step two in the allocation process takes the administrative and logistics cost center costs and allocates them to the intermediate and final cost centers, in the order in which they appear in Table 3.3 (i.e., beginning with Building Maintenance, followed by Domestics, General Administration, and Medical Records). The criteria used for allocating any cost center's costs reflects the use of that cost center's services by the others and may include space utilized, number of staff, or number of patients. At the end of step two, the costs appear as shown in Table 3.4.

TABLE 3.4: ADMINISTRATIVE COST ALLOCATIONS TO INTERMEDIATE AND FINAL COST CENTERS

Cost Centers	Direct Costs Before Allocation (EC$)	Administrative Costs Allocated (EC$)	Costs After Administrative Allocation (EC$)
Intermediate Medical Services			
Laundry	222,233	22,409	244,642
Nutritionist	61,545	40,969	102,513
Kitchen	1,725,567	232,894	1,958,461
Pharmacy	212,791	71,012	283,802
Laboratory	2,882,011	297,787	3,179,799
Digital Imaging	634,391	170,625	805,015
Operating Theater	3,620,238	521,064	4,141,302
ICU/CCU	1,062,309	157,775	1,220,084
Physiotherapy	145,679	54,624	200,303
Subtotal Intermediate Cost Centers	*10,532,527*	*1,569,157*	*12,135,921*
Final Medical Services			
Outpatient General	1,568,586	182,640	1,642,229
Accident & Emergency (Outpatient)	2,919,852	438,110	3,193,293
NIDCU	511,290	82,165	546,784
Eye Clinic	218,483	24,042	230,955
Inpatient Obstetrics and Neonatal	2,760,303	516,093	3,135,769
Male Medical	1,420,067	254,461	1,640,219
Female Medical	1,227,658	244,469	1,491,541
Male Surgical	1,965,691	333,341	2,251,586
Female Surgical	1,712,885	315,563	1,961,370
Gynaecology	1,324,976	290,824	1,509,050
Eye Ward	1,096,731	89,692	1,126,952
Paediatrics	1,937,333	282,894	2,081,758
Private Ward	924,506	228,846	1,107,499
Subtotal Final Cost Centers	*18,635,867*	*3,283,138*	*21,919,005*
TOTAL	**34,020,690**	**4,852,295**	**34,054,926**

Note that the total under column "Administrative Costs Allocated" equals the subtotal under Table 3.3, and is added to the Direct Costs column to the left to calculate the new totals for each intermediate

and final cost center. Administrative cost centers were allocated by square feet for Building Maintenance and Domestics, by FTE staff for General Administration, and Medical Records was allocated by staff salaries for the intermediate and outpatient cost centers, and by staff salaries plus patient days for the inpatient cost centers. Further details on allocation assumptions can be found in Annex B. Intermediate cost centers now account for about 36 percent of the total cost, and final cost centers for the remaining 64 percent.

3.4 STEP-DOWN ALLOCATION OF INTERMEDIATE COST CENTERS TO FINAL MEDICAL COST CENTERS

The third step is to allocate the costs of the intermediate medical service cost centers to the final cost centers. This is done on the basis of the usage of these intermediate cost center services by the final cost centers. The result is the "total costs by final medical cost center," as shown in Table 3.5.

Intermediate cost centers were allocated by estimated percent usage for Laundry, actual visits for Nutritionist, inpatient bed days for Kitchen, direct consumption for Pharmacy, actual tests for Laboratory, number of tests for Digital Imaging, actual surgeries for Operating Theater, inpatient bed days for ICU/CCU, and actual treatments for Physiotherapy. Further detail regarding these allocation bases and assumptions are included in Annex B.

TABLE 3.5: TOTAL COSTS BY FINAL MEDICAL COST CENTER

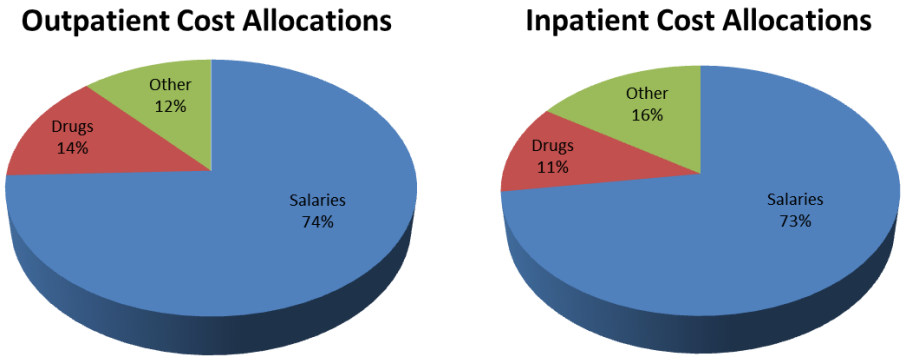
Final Medical Services Cost Centers	Final Allocation (EC$)	% of Final Allocation
Outpatient General	2,589,104	7.6%
Accident & Emergency (Outpatient)	4,043,173	11.9%
NIDCU	580,233	1.7%
Eye Clinic	297,784	0.9%
Subtotal Outpatient	7,510,295	*22.1%*
Inpatient Obstetrics and Neonatal	4,525,072	13.3%
Male Medical	2,679,502	7.9%
Female Medical	2,446,703	7.2%
Male Surgical	4,200,612	12.3%
Female Surgical	3,205,036	9.4%
Gynaecology	2,815,064	8.3%
Eye Ward	1,704,702	5.0%
Paediatrics	3,601,169	10.6%
Private Ward	1,366,770	4.0%
Subtotal Inpatient	*26,544,631*	*77.9%*
Total	**34,054,926**	**100%**

Inpatient cost centers accounted for about 78 percent of costs, while outpatient services accounted for about 22 percent. A&E was the largest cost center for outpatient services. Staff interviews suggest that a large majority of hospital inpatients are admitted through the A&E, which could be causing an inflated cost that does not reflect true patient needs, but data to support this claim were unavailable. If true, the Hospital could benefit from determining a more efficient way to admit patients not in need of A&E care.

Obstetrics and Neonatal care made up the largest inpatient cost center, and also had the highest bed occupancy rate of the inpatient wards.

For both outpatient and inpatient cost centers, salaries make up the majority of allocated costs at 75 and 72 percent, respectively, as shown below in Figure 3.2.

FIGURE 3.2: COST ALLOCATIONS BY INPUT FOR OUTPATIENT AND INPATIENT SERVICES



Salaries made up the largest proportion of most inpatient and outpatient costs, as shown in Table 3.6, with the Eye Ward reporting the highest proportion spent on salaries. The NIDCU is an anomaly as the only cost center with a minority of costs incurred by salaries (37 percent); 53 percent of costs were pharmaceuticals and medical supplies. The three other outpatient cost centers, Outpatient General, A&E, and the Eye Clinic, all have among the highest portions of cost due to salaries. Drugs & Supplies and Other Costs made up similar proportions of total costs, mostly reflecting costs allocated down from the administrative and intermediate cost centers.

TABLE 3.6: COST ALLOCATIONS BY INPUT FOR FINAL MEDICAL COST CENTERS

Cost Centers	Total Cost (EC$)	Salaries (EC$)	% *Salaries*	Drugs & Supplies (EC$)	% *Drugs*	Other Costs (EC$)	% *Other*
Outpatient General	2,589,104	2,025,078	*78%*	279,915	*11%*	284,110	*11%*
Accident & Emergency (Outpatient)	4,043,173	3,113,775	*77%*	419,339	*10%*	510,060	*13%*
NIDCU	580,233	212,655	*37%*	306,366	*53%*	61,212	*11%*
Eye Clinic	297,784	236,039	*79%*	34,390	*12%*	27,356	*9%*
Inpatient Obstetrics and Neonatal	4,525,072	3,250,433	*72%*	577,994	*13%*	696,645	*15%*
Male Medical	2,679,502	1,839,729	*69%*	373,244	*14%*	466,529	*17%*
Female Medical	2,446,703	1,631,710	*67%*	371,108	*15%*	443,885	*18%*
Male Surgical	4,200,612	3,002,934	*71%*	529,657	*13%*	668,022	*16%*
Female Surgical	3,205,036	2,333,821	*73%*	317,068	*10%*	554,147	*17%*
Gynaecology	2,815,064	2,048,941	*73%*	328,864	*12%*	437,259	*16%*
Eye Ward	1,704,702	1,408,249	*83%*	168,980	*10%*	127,473	*7%*
Paediatrics	3,601,169	2,767,909	*77%*	293,423	*8%*	539,837	*15%*
Private Ward	1,366,770	1,000,860	*73%*	120,529	*9%*	245,381	*18%*
Total EC$	**34,054,926**	**24,872,134**	***73%***	**4,120,876**	***12%***	**5,061,916**	***15%***

3.5 EFFICIENCY INDICATORS

Unit costs, or the cost per some unit of service provided (such as outpatient visits or inpatient bed-days), can be used to demonstrate hospital efficiencies or areas for improvement. Unit costs can be reduced either through increasing the volume of services (such as outpatient visits or inpatient admissions) or by reducing fixed or variable costs attributed to that department. However, factors other than efficiency can influence costs, so it is important to do further research into the staff performance, service quality, and occupancy rates before enacting drastic changes. For example, if occupancy rates are high in a specific ward, it may not be possible to increase admissions; or, if occupancy is low, but only a small number of staff are available to work in that department, the hospital may determine to allocate less patient beds and space (to decrease costs) to a ward rather than increase admissions, in order to maintain an acceptable level of service quality. Salaries for specialists in some departments may also drive up the total costs for a department.

3.5.1 UNIT COSTS FOR INPATIENT AND OUTPATIENT SERVICES

Table 3.7 portrays service volumes and unit costs for the final cost centers.[8]

TABLE 3.7: UNIT COSTS BY FINAL COST CENTERS

Final Cost Center	Patient volume (OP Visits; Patient days)	Bed Occupancy Rate	Average Length of Stay (days)	Per Outpatient visit (EC$)	Per Patient Admission (EC$)	Per Patient Day (EC$)	Per Hospital Bed (EC$)
Outpatient General	15,684	-	-	165	-	-	-
Accident & Emergency (Outpatient)	31,469	-	-	128	-	-	-
NIDCU	1,318	-	-	440	-	-	-
Eye Clinic	6,861	-	-	43	-	-	-
Inpatient Obstetrics and Neonatal	7,245	71%	3.6	-	2,432	625	161,610
Male Medical	6,567	69%	5.3	-	2,163	408	103,058
Female Medical	5,965	63%	5	-	2,051	410	94,104
Male Surgical	6,926	59%	5.2	-	3,154	606	131,269
Female Surgical	5,338	61%	6.8	-	4,083	600	133,543
Gynaecology	3,716	42%	4	-	3,030	758	117,294
Eye Ward	846	18%	5.6	-	11,289	2,016	133,702
Paediatrics	5,313	58%	4.6	-	3,118	678	144,047
Private Ward	979	26%	5.5	-	7,678	1,396	130,169

[8] It is important to note that care should be taken when comparing costs between departments. Unit costs per patient visit, admission, or patient day do not fall entirely within the hospital's control. To compare costs across departments, the unit cost per hospital bed is a more accurate comparison. For example, the Eye Ward, which has the lowest occupancy rate at 18 percent, also has the highest cost per patient admission and per patient day, about 34 and 33 percent more expensive than the next unit cost. However, the cost per hospital bed is the third most expensive and about 15 percent more expensive than the average.

The total number of patient days was calculated by multiplying the total number of patient admissions per ward by the estimated average length of stay for each patient. The average length of stay per ward was reported by the nursing department, and led to a total of 47,669 patient days, slightly more than the number reported by the Medical Records department (47,652 patient days)[9]. Total outpatient visits were reported by the nursing department.

Among the outpatient cost centers, the NIDCU had the most expensive cost per visit (EC$440). However, Table 3.6 demonstrated that the majority (53 percent) of these costs are for pharmaceutical and medical supplies. The Eye Clinic had a very low cost per visit (EC$43).[10] The A&E cost center reported about twice as many outpatient visits as the Outpatient General clinic, which again may be due to the practice of admitting many inpatients through the A&E.

Across the inpatient cost centers, Obstetrics and Neonatal had the highest patient volume (7,245 patient days) and the highest occupancy rate (71 percent), but its cost per patient day was at the median compared to other cost centers (EC$625). The Female Medical ward had the lowest cost per patient admission at EC$2,051, and the Eye Ward was the most expensive at EC$11,289.[11]

Table 3.8 breaks down the unit cost (either per patient visit for outpatient or per patient day for inpatient cost centers) by its inputs: drugs and supplies, salaries, and other (largely costs allocated from administrative services and logistics and intermediate medical centers).

TABLE 3.8: BREAKDOWN OF UNIT COSTS BY INPUT

Final Medical Service Cost Centers	Outpatient Visits/ Patient Days	Bed Occupancy Rate	Cost per Unit; EC$ (Visit or Patient Day)			
			Drugs	Salaries	Other	Total
Outpatient General	15,684	-	18	129	18	165
Accident & Emergency (Outpatient)	31,469	-	13	99	16	128
NIDCU	1,318	-	232	161	46	440
Eye Clinic	6,861	-	5	34	4	43
Inpatient Obstetrics and Neonatal	7,245	71%	80	449	96	625
Male Medical	6,567	69%	57	280	71	408
Female Medical	5,965	63%	62	274	74	410
Male Surgical	6,926	59%	76	434	96	606
Female Surgical	5,338	61%	59	437	104	600
Gynaecology	3,716	42%	88	551	118	758
Eye Ward	846	18%	200	1,665	151	2,016
Paediatrics	5,313	58%	55	521	102	678
Private Ward	979	26%	123	1,022	251	1,396

[9] This discrepancy (17 patient days) is very small compared to the total number of patient days and is unlikely to influence the results presented.

[10] This may be explained in part by the allocation assumptions made in separating costs between the outpatient Eye Clinic and inpatient Eye Ward (detailed in the Methodology section), such as drug consumption allocated to the eye clinic was based on the ratio of Outpatient General drug consumption compared to the Male and Female Surgical wards.

[11] Note that the Eye Ward and Male Medical Wards were combined in September 2012, causing the potential for inaccuracy of allocation costs. Costs were allocated based on the number of beds and the number of nurses/orderlies for the first nine months of the year. For the last three months, costs are allocated by number of beds assigned to each ward.

The Hospital's inpatient cost centers had an overall occupancy rate of 55 percent (59 percent with the exclusion of the eye ward and private ward, which had very low occupancy rates). This is in contrast to results reported in the 2011 *Health Systems and Private Sector Assessment*, in which key stakeholders reported that occupancy rates across the hospital approached 100 percent in 2010 (Hatt et al 2012). Occupancy rates were calculated by multiplying the total number of patient beds per ward by 366 days in the year 2012 to get the total possible patient days; then the number of reported patient days was divided by the number of possible patient days.

3.5.2 COMPARISON WITH OTHER EASTER CARIBBEAN HOSPITALS

In comparison with another costing study that was recently done in St Lucia, the two hospitals are quite similar in size and patient volumes. Total hospital costs for Grenada General Hospital (GH) are 5% higher than Victoria Hospital's (VH). The only substantial difference in unit costs appears to be in the cost per outpatient visit which is higher in VH than in GH despite the fact that VH has higher volume of patients. This comparison is merely intended to give an indication of how GH compares with a similar hospital in the region. Although a similar study was carried out in Antigua, this has not been included in the above comparison due to some differences in the calculation of the final unit costs resulting from an absence of data to allocate diagnostic costs across the final cost centers.

TABLE 3.9: COMPARISON OF COSTS WITH ST. LUCIA VICTORIA HOSPITAL

Overall unit costs and volume statistics	Grenada General Hospital EC$	St. Lucia Victoria Hospital EC$
Per outpatient visit	136	201
Per patient day	618	597
Per admission	2,974	2,177
Per bed	124,911	123,954
Number of beds	212	164
Number of admissions	8,915	9,339
Number of inpatient days	42,895	34,032
Average length of stay	4.8	3.6
Number of outpatient visits (incl. A&E)	55,332	58,562
Total hospital cost	33,976,929	32,421,801

3.6 STOCK-OUTS OF PHARMACEUTICAL AND LABORATORY SUPPLIES

Staff in both the pharmacy and the laboratory reported to the costing team that stock-outs of supplies led to either rationing or unavailability of services. This section reports on the findings of the assessment of stock-outs in these two departments.

3.6.1 LABORATORY SUPPLIES AND REAGENTS

Table 3.9 shows the results for the reagent and supply stock-outs for the laboratory[12].

TABLE 3.10: RESULTS FOR THE ANALYSIS OF STOCK OUTS IN THE LABORATORY

Variable	Mean	95% Confidence Interval		Number of reagents and supplies analyzed
		Low	High	
Number of days a supply or reagent is out of stock	38.2 days	23.7	61.9	40
Value of the actually used supply or reagent (average) (EC$)	2,817	2,092	4,328	32
Value of 'missed usage' (average) (EC$)	523	230	1,563	32
Value of 'missed usage' as a percentage of the total value actually used	19%	N/A	N/A	32

The data in Table 3.10 show:

1. Laboratory supply or reagent products were out of stock for an average of 38 days per year (95 percent CI: 23.7 – 61.9); this is more than one month and represents unavailability for over 10 percent of the year.

2. Ensuring that all reagents/supplies were in stock throughout the year would increase expenditures for reagents/supplies by about 19 percent. However, this does not account for potential savings due to less need for substitution of other reagents/supplies to replace the out of stock item. It also does not reflect full usage of reagents/supplies, since our calculations cannot account for rationing of reagents/supplies when their stock level is low.

Running low or out of supplies may constrain the quality of care provided in some cases. The costs presented in this report reflect the quality of care as implemented in 2012. During planning and budgeting, improvements in access to necessary supplies and reagents should also be considered together with the costs presented in this report.

[12] Unit prices for eight out of 40 of the reagents or supply stock cards sampled were not available; the analysis of the 'value of missed usage' could only be done for items for which these data were available.

3.6.2 PHARMACEUTICAL DRUGS AND SUPPLIES

In 2012, the CMS procured 289 different types of drugs, supplies, or commodities. Table 3.11 lists the ten most expensive drugs, in terms of total the total value for the drugs, as well as their value as a percentage of all items ordered for the pharmacy via CMS. Ten percent of the 289 products procured accounted for over 72 percent of the total costs to the pharmacy.

TABLE 3.11: TEN DRUGS WITH MOST TOTAL COST (ORDERED THROUGH CMS) FOR 2012

Rank	Drug name	Value (EC$)	% Total CMS procurement	Notes
1	Lopinavir/ritonavir (200MG/50MG)*	271,416	13.5%	Out of stock in pharmacy 4 days
2	Enoxaparin	126,209	6.3%	20mg/inj/vial included in sample; out of stock 108 days
3	Surgical Gloves	110,823	5.5%	3 types included in sample: - surgical glove powder free size 6.5 (in stock all year); - surgical glove powder size 6.5 (out of stock 41 days) -gloves surgical powder size 8.5 (out of stock 181 days)
4	Examination Gloves	82,902	4.1%	One type included in sample, in stock all year
5	Sodium Chloride (Saline; any formulation)	77,596	3.9%	2 types included in sample: -0.9%/250ml out of stock 155 days -0.9%/infusion/ 500ml out of stock 12 days
6	Dextrose (any formulation)	76,567	3.8%	5%/infusion/liter formulation was not out of stock
7	Blood Glucose Strip (diagnostic)	63,921	3.2%	Not in sample
8	Co-Amoxiclav	53,371	2.7%	2 types included in sample: -312-5mg/susp/bott out of stock 151 days -457mg/5ml/susp/ bot out of stock 25 days
9	Syringes	47,151	2.3%	2 types included in sample: -syringe 5cc with needle out of stock 113 days -syringe 20cc without needle out of stock 6 days
10	Erythromycin	43,284	2.2%	2 types included in sample: -40mg/ml/susp/bot out of stock 33 days -0.5%/oint out of stock 200 days
	Total value of drugs and supplies procured via CMS	**2,007,479**	**47.5%**	
	*All ARVs	333,561	16.6%	Nevirapine tablets out of stock 48 days; didanosine tablets 16 days; no other ARV out of stock for more than 5 days

The ten drugs / supplies listed in Table 3.11 accounted for almost 50 percent of all CMS procurement for the pharmacy.

The items listed in Table 3.11 have been grouped together based on the type of drug; therefore, different formulations or dosages of the same drug are counted together. Lopinavir/ritonavir accounted for 13.5 percent of the total CMS procurement in 2012, and the various dosages and formulations of Enoxaparin accounted for 6.3 percent of total CMS procurement. Our sample of drugs records included one form of Enoxaparin (20mg injection, EC$11.50 per vial), which was out of stock for 108 days (see last column of Table 3.10). Enoxaparin also comes in 40mg and 60mg injection vials. Thus, it is not clear from this analysis if Enoxaparin was completely out of stock at any point in the year. However, use of a 40mg (EC$ 14.67 per vial) or 60mg vial (EC$ 22.57 per vial) when only 20mg is needed may create unnecessary waste.

TABLE 3.12: RESULTS FOR THE ANALYSIS OF STOCK-OUTS IN THE PHARMACY*

Variable	Mean	95% Confidence Interval		Number of drugs/ supplies analyzed
		Low	High	
Number of days a drug or pharmacy supply is out of stock	93.8 days	77.7	110.5	141
Value of the actually used drug or pharmacy supply (average) (EC$)	2,643	1,872	4,001	141
Value of 'missed usage' (average) ($EC)	1,360	777	3,777	141
Potential 'missed usage' as a percentage of the total value actually used	51%	N/A	N/A	141

*Excludes ARVs, which were sampled with certainty and therefore would be over-weighted if included in this analysis

The number of days out of stock varied by the form of the drug. Injectable and intravenous drugs were out of stock on average 106 days, drugs in suspension or syrup were out of stock on average 53 days, drugs in tablet, capsule, or pill form were out of stock 78 days on average, drugs in other forms (topical, eye/ear drops, etc.) were out of stock 131 days on average, and supplies were out of stock 99 days on average.

The data in Table 3.12 show:

1. Pharmacy drugs and supplies were out-of-stock for almost 94 days per year (95 percent CI: 77.7 to 110.5); this is more than three months and represents unavailability for over 26 percent of the year. This figure decreases to 91.7 days if stock-outs of 7 days or less are excluded from the analysis.

2. The value of the absent stock, if used at the same rates as when it was in stock, would represent about 51 percent of the value of pharmacy products included in the sample that were used during the year. However, this does not account for potential savings due to substitution of other drugs/supplies to replace the out of stock item. It also does not reflect full usage of drugs/supplies, since our calculations cannot account for rationing of drugs/supplies when their stock level is low.

Running low or out of drugs/supplies likely constrains the quality of care provided. The costs presented in this report reflect the quality of care as implemented in 2012. During planning and budgeting,

improvements in access to necessary supplies and reagents should also be considered together with the costs presented in this report.

Table 3.13 shows the analysis for all ARVs currently listed in the pharmacy. For ARVs, drugs stock-outs were less of a problem than they were for other drugs, with only Nevirapine and didanosine tablets out of stock in the pharmacy for more than seven days. Lopinavir/ritonavir (Kaletra) accounted for 83.8 percent of total ARV costs. If stock-outs of less than seven days are removed from the analysis, then ARV drugs were out of stock for 4.3 days, on average, and the potential 'missed usage' as a percentage of the total value actually used is 0.2%.

TABLE 3.13: RESULTS FOR THE ANALYSIS OF STOCK OUTS FOR ANTI-RETROVIRAL DRUGS (ARVS)

Variable	N	Mean	Range	
			Low	High
Number of days a drug or pharmacy supply is out of stock	15	5.1	0	48*
Value of the actually used drug or pharmacy supply (average)	15	18,949	300	238,048**
Value of 'missed usage' (average)	15	212	0	2,360***
Potential 'missed usage' as a percentage of the total value actually used	15	1.1%	N/A	N/A

*Nevirapine tablets (200mg)

**Reflects the amount actually used for Lopinavir/ritonavir; the number in Table 3.10 represents the amount procured.

*** Lopinavir/ritonavir, which was out of stock four days.

4. FINDINGS: DISEASE-SPECIFIC COSTING ANALYSIS

4.1 INPATIENT COSTS PER ADMISSION FOR FIVE FOCAL DISEASES

4.1.1 SAMPLE SIZE, CHARACTERISTICS, AND CO-DIAGNOSES

In total, patient files for 348 admissions were included in the sample; two files were unavailable at the time of data extraction, both for admissions with a CVD diagnosis. Table 4.1 describes the characteristics of the patients from the admissions sampled, by disease category. For all diseases, more than half of admissions sampled were male; for cancer 75 percent of admissions sampled were for men. Cancer and hypertension had the shortest length of stay, on average, with both under 7 days, while CVD, diabetes, and HIV all had average lengths of stay over 8 days. The overall average length of stay for the entire hospital was about 4.8 days in 2012. The average age at admission was over 60 for CVD, diabetes, and hypertension, 54 years old for cancer, and just over 38 years old for HIV.

TABLE 4.1: CHARACTERISTICS OF ADMISSIONS, BY DISEASE

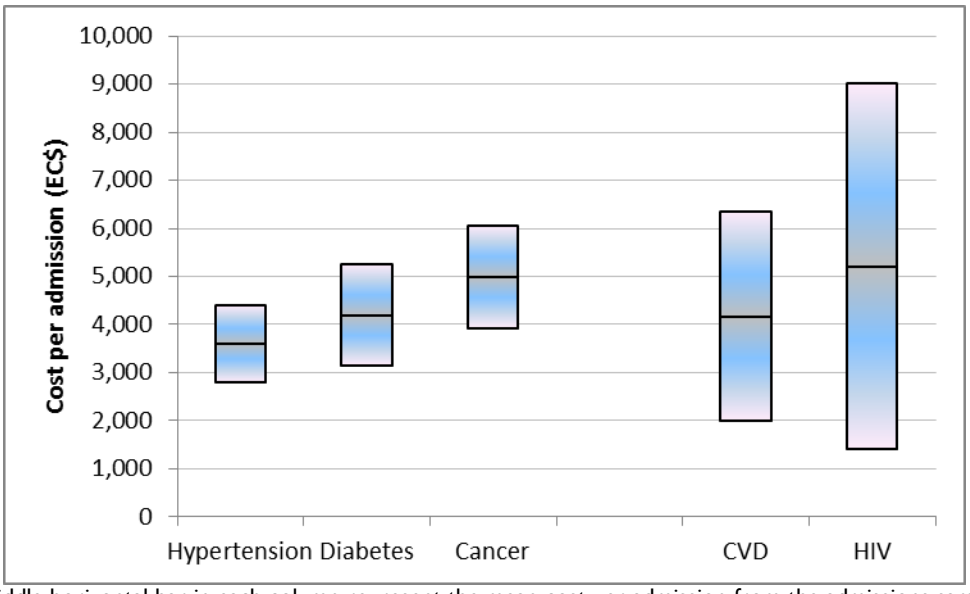
Disease	Number of records sampled	Percentage female	Average number of co-diagnoses (in addition to disease for which sampled)	Average length of stay in days (standard error)	Average age at admission (standard error)
Cancer	72	25%	1.9	6.9 (0.9)	54.0 (2.1)
CVD	29	45%	2.7	8.4 (2.3)	72.5 (2.8)
Diabetes	100	43%	2.5	8.9 (1.2)	62.7 (1.5)
HIV	19	47%	1.9	10.6 (4.5)	38.3 (4.7)
Hypertension	130	42%	2.6	6.2 (0.8)	63.0 (1.4)

Multiple diagnoses were common; in addition to the disease for which an admittance was sampled, patients admitted for CVD, diabetes, and hypertension had 2.5 or more other diseases diagnosed, on average, while those admitted for cancer and HIV had just under two additional disease diagnoses (note that co-diagnoses excludes procedures and investigations which may have been listed under diagnoses in the patient record). Co-diagnoses among the five diseases were also common. Of admissions sampled, there were 227 records with hypertension or diabetes, and 140 had both. For sixty-three percent of admittances sampled for hypertension, the patient also had diabetes, and for 60 percent of admittances sampled for diabetes, the patient also had hypertension. Eighty-seven percent of patients sampled for CVD also had hypertension. Twenty percent of patients sampled for cancer also had hypertension and 15 percent had diabetes.

4.1.2 AVERAGE COST PER ADMISSION

Figure 4.1 shows the average cost per admission for the five diseases, along with their 95 percent confidence intervals.[13] An admission for HIV was the most expensive, on average, with a cost of EC$ 5,203 (95 percent CI: EC$1,393 to 9,013) per admission.

FIGURE 4.1: AVERAGE COST PER ADMISSION, BY DISEASE



Notes: The middle horizontal bar in each column represent the mean cost per admission from the admissions sampled, with the upper and lower horizontal bar representing the 95% confidence interval.

Table 4.2 lists the average cost per admission for hypertension, diabetes, and cancer, and for admissions with more than one diagnoses from among these three diseases. As stated previously, an admission with a cancer diagnosis was the most expensive of these three at just under EC$ 5,000 per admission on average, compared to just under EC$ 4,200 for diabetes and about EC$ 3,600 for hypertension. Diabetes had the longest length of stay, on average, while patients admitted with a cancer diagnoses were the youngest, on average, at 54 years of age.

TABLE 4.2: AVERAGE COST PER ADMISSION FOR HYPERTENSION, DIABETES, AND CANCER, AND FOR ADMISSIONS WITH MULTIPLE DIAGNOSES AMONG THE THREE DISEASES

Category of diagnoses	Number of admittances	Cost per admittance (EC$)	95% confidence interval	Average age	Average length of stay (days)
Patients sampled for Hypertension	127	3,587	2,787 to 4,387	63.0	6.2
Patients sampled for Diabetes Mellitus	100	4,190	3,147 to 5,233	62.7	8.9
Patients sampled for Cancer	72	4,980	3,908 to 6,052	54.0	6.9

[13] In pairwise comparisons, an admission for cancer was more expensive than an admission for hypertension at the 5 percent significance level.

Category of diagnoses	Number of admittances	Cost per admittance (EC$)	95% confidence interval	Average age	Average length of stay (days)
Patients with Hypertension and Diabetes	140	3,747	3,115 to 4,379	66.5	7.0
Patients with Hypertension and Cancer	28	5,924	3,040 to 8,808	60.7	11.0
Patients with Diabetes and Cancer	24	6,257	2,991 to 9,524	65.7	12.3
Patients with Hypertension and Diabetes and Cancer*	16	5,355	2,625 to 8,086	64.3	10.4

Patients with both a hypertension and diabetes diagnosis fell in between patients sampled for one or the other disease both in terms of cost (about EC$ 3,750 per admission) and length of stay (7.0 days on average), but did tend to be older (66.5 years of age at admission).[14]

Patients admitted with a cancer diagnosis as well as at least one of hypertension or diabetes seem to have higher costs than other patients, averaging over EC$ 5,000 per admission. However, the limited sample of these patients indicates that these results are not statistically significant different from other admittance types, and thus firm conclusions cannot be drawn. These higher costs may, in part, be explained by longer lengths of stay. It should also be noted that the average cost per admission for cancer patients was only EC$ 1,614 (95 percent CI: 1,110 to 2,119) for patients admitted for one day, while for patients admitted for more than one day the average cost per admission was EC$ 5,942 (95 percent CI: 4,738 to 7,145). The latter cost is relatively similar to the costs for admissions with multiple diagnoses including cancer. This may indicate that the higher cost observed here is simply because these admissions represent cancer admissions with more than one day admissions and has not relation with the presence of multiple diagnoses.

Annex F Table F.1 through Table F.4 present the cost per admission by major age category (age breakdowns for HIV are excluded to preserve anonymity of the patients). There appears to be little association between age and the average cost per admission.

4.1.3 COMPONENTS OF COST

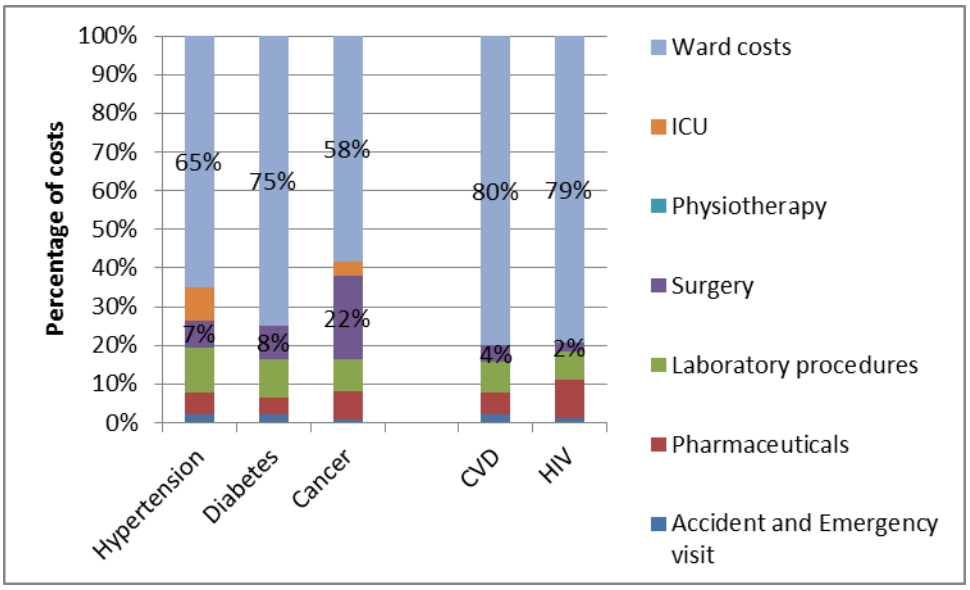
Figure 4.2 presents the percentage of the costs borne by each final and intermediate cost center, by disease. For all diseases, the ward costs (which do not include the costs of the relevant intermediate cost centers) constituted over 50 percent of all costs. When considering the projected increase in admissions for these categories, the capacity of wards to handle more patients needs to be considered; if the wards currently can handle more patients, then the costs associated with treatment may increase at a lower proportional rate than the increase in the number of new admissions. However, if wards need to be expanded or new staff hired to handle an increase in admissions, then costs may rise sharply.

Surgeries constituted 22 percent of costs for patients admitted with a cancer diagnosis, while laboratory procedures constituted just over 10 percent of costs for admissions sampled for hypertension and diabetes. Pharmaceuticals constituted 10 percent of costs for HIV admissions. All other cost components were less than 10 percent of the total costs.

[14] Note that the 140 admissions with both hypertension and diabetes are included in the analyses based on the disease for which an admission was sampled (i.e., it is a subset of the patients, not a separate category).

Note that costs for digital imaging are included in the laboratory costs, due to the way digital imaging is recorded on the patient records.

FIGURE 4.2: COST OF ADMISSION BY COST CENTER AND DISEASE



Annex E Table E.5 presents the results shown in Figure 4.2 in tabular form.

Table 4.3 shows the percentage of admissions that received a particular service, by disease category. The high proportion of costs attributed to surgery for cancer (relative to other diseases) is reflected by the fact that 42 percent of admissions sampled for cancer had surgery, compared with 20 percent or less for other diseases. Cancer patients were also less likely to be admitted through the accident and emergency department, likely because they are receiving scheduled treatments. Relatively few patients were admitted to the ICU or had physiotherapy.

TABLE 4.3: PERCENTAGE OF PATIENTS RECEIVING A SERVICE, BY DISEASE CATEGORY

Disease	Percentage of patients admitted via the accident and emergency department	Percentage of patients with a stay in the ICU	Percentage of patients with a surgery	Percentage of patients with physiotherapy
Cancer	47%	1%	42%	4%
CVD	93%	0%	14%	7%
Diabetes	90%	0%	20%	7%
HIV	68%	0%	11%	0%
Hypertension	86%	2%	12%	6%

Among the diabetes admissions, 9 percent of sampled admittances (95 percent CI: 3.2 to 14.7percent) had an amputation procedure during their stay at the hospital, constituting just under half of all surgeries for admissions sampled for diabetes; data from medical records indicates that 5.6 percent of all admittances to the hospital with a diagnosis of diabetes had a procedural code consistent with amputation.

4.1.4 COSTS PAID BY PATIENTS

Two types of costs were included in this analysis that were partly or fully borne by the patients. Note that these costs are not reflected in the top-down costing of the General Hospital. First, patients may have bought and brought drugs with them, or had family members do this for them, during their stay at the hospital. However, some of the drugs recorded on the charts that did not come through CMS may also have been donated drugs; thus, the figures presented here may over-represent what patients paid, but should reflect the full value of bought or donated drugs. Second, patients may have sought laboratory or imaging services in St. George (notably for troponin tests, CAT scans, or magnetic resonance imaging).

The amount, both relative and absolute, of these costs is shown in Table 4.4. For cancer, patients paid, on average, EC$ 52 for drugs (14 percent of all drug costs) and EC$ 209 for laboratory procedures (52 percent of all laboratory and imaging costs), for a total of EC$ 262 per admission. In both absolute and relative terms, both of these costs to patients were highest for cancer admissions. For cancer admissions, patient-borne costs represent 5.3 percent of the overall cost per admission, on average. Patient paid costs for drugs were otherwise under EC$ 40, and under EC$10 for CVD and diabetes admissions. Patient-borne costs for laboratory or imaging procedures were higher than patient-borne costs for drugs; this is likely due to the high prices charged for these services; only about 1.6 percent of laboratory or imaging procedures were done off-site.

TABLE 4.4: COST FOR PHARMACEUTICALS AND LABORATORY TESTS, AND THE PERCENTAGE OF COSTS ESTIMATED TO BE PAID BY PATIENTS

Disease	Average cost of pharmaceuticals per admission (% of total costs)	Average cost of pharmaceuticals paid by patients per admission (% of pharmaceutical costs)	Average cost of laboratory procedures per admission (% of total costs)	Average cost of laboratory procedures paid by patients per admission (% of laboratory costs)	Percentage of costs paid by patients for pharmaceuticals and laboratory
Cancer	363 (7%)	52 (14%)	404 (8%)	209 (52%)	5.3%
CVD	228 (5%)	6 (3%)	337 (8%)	97 (29%)	2.5%
Diabetes	179 (4%)	4 (2%)	422 (10%)	151 (36%)	3.7%
HIV	518 (10%)	36 (7%)	372 (7%)	148 (40%)	3.5%
Hypertension	194 (5%)	16 (8%)	421 (12%)	149 (36%)	4.6%

4.1.5 DRUG COSTS

Pharmaceuticals represent 5 to 10 percent of the total cost per admission, but a few drugs constitute the majority of the pharmaceutical costs. For example, the five most costly drugs prescribed to patients sampled for cancer constitute 62 percent of drug costs, for CVD the top five represent 69 percent of drug costs, for diabetes they represent 56 percent of costs, and for hypertension they represent 51 percent of costs. For HIV, the five most expensive drugs represent 50 percent of the total drug costs (see Table 4.5). Note that this analysis excludes drugs bought by patients or donated. Enoxaparin, the second most costly drug in terms of procurement costs in 2012, was the most expensive drug for CVD (40 percent of all drug costs), hypertension (27 percent of all drug costs), and diabetes (27 percent of drug costs). Insulin (Novolin R) was the second most expensive drug among diabetes admissions, while Paclitaxol was the most expensive drug for cancer (35 percent of all drug costs). Lopinavir/Ritonavir was the most expensive drug for HIV admissions, representing 12 percent of all drug costs. However, some patients may have brought this drug with them from their routine supply and self-administered the drug, and the nurses may not have recorded on the patient chart.

TABLE 4.5: TOP FIVE DRUGS IN TERMS OF COSTS, BY DISEASE

Drug rank	Cancer	CVD	Diabetes	HIV	Hypertension
	Name (% of drug cost)	*Name (% of drug cost)*	*Name (% of drug cost)*	*Name (% of drug cost)*	*Name (% of drug cost)*
1	Paclitaxol (35%)	Enoxaparin (40%)	Enoxaparin (27%)	Lopinavir 200mg/Ritonavir 50mg (12%)	Enoxaparin (27%)
2	5% Dextrose (8%)	Erythromycin (10%)	Novolin R (11%)	Nystatin (11%)	Metronidazole (7%)
3	Enoxaparin (7%)	Cefuroxime (8%)	Cefuroxime (6%)	Co-Amoxiclav (10%)	Erythromycin (6%)
4	Metronidazole (6%)	Ceftriaxone (6%)	Metronidazole (6%)	Ranitidine (9%)	Ranitidine (6%)
5	Erythromycin (6%)	Heparin Sodium (5%)	Heparin Sodium (6%)	Cefuroxime (8%)	Paclitaxol (5%)

4.1.6 CONCLUSIONS

The average cost per admission for the General Hospital as a whole was about EC$ 2,978. The average cost per admission was estimated here to be almost EC$ 1,000 more for four of the five diseases assessed, with the cost per admission for hypertension, at EC$ 3,387, only slightly above the average for the whole hospital. The demographic analysis suggested admissions for these diseases will increase in the coming years; likely, then, costs will also increase as the disease mix of patients at the hospital changes to reflect an older population, as well as in relation to an increase in the number of admissions. The amount of increase cannot be determined, however, from this analysis because the relationship between increases in admissions and ward capacity is not clear, and a more thorough assessment of the current case-mix and cost profile of patients, and likely changes over time, was not possible for this analysis.

The use of electronic medical records, as is being established now at the General Hospital, will greatly enable the estimation of the costs of specific diseases, track changes in case-mix over time, and help

assess the implication of the changes in case-mix. By having all patient files available electronically, the processes of data extraction (and the potential for errors involved therein) are eliminated; only data on unit costs will need to be collected in order for the analysis to occur.

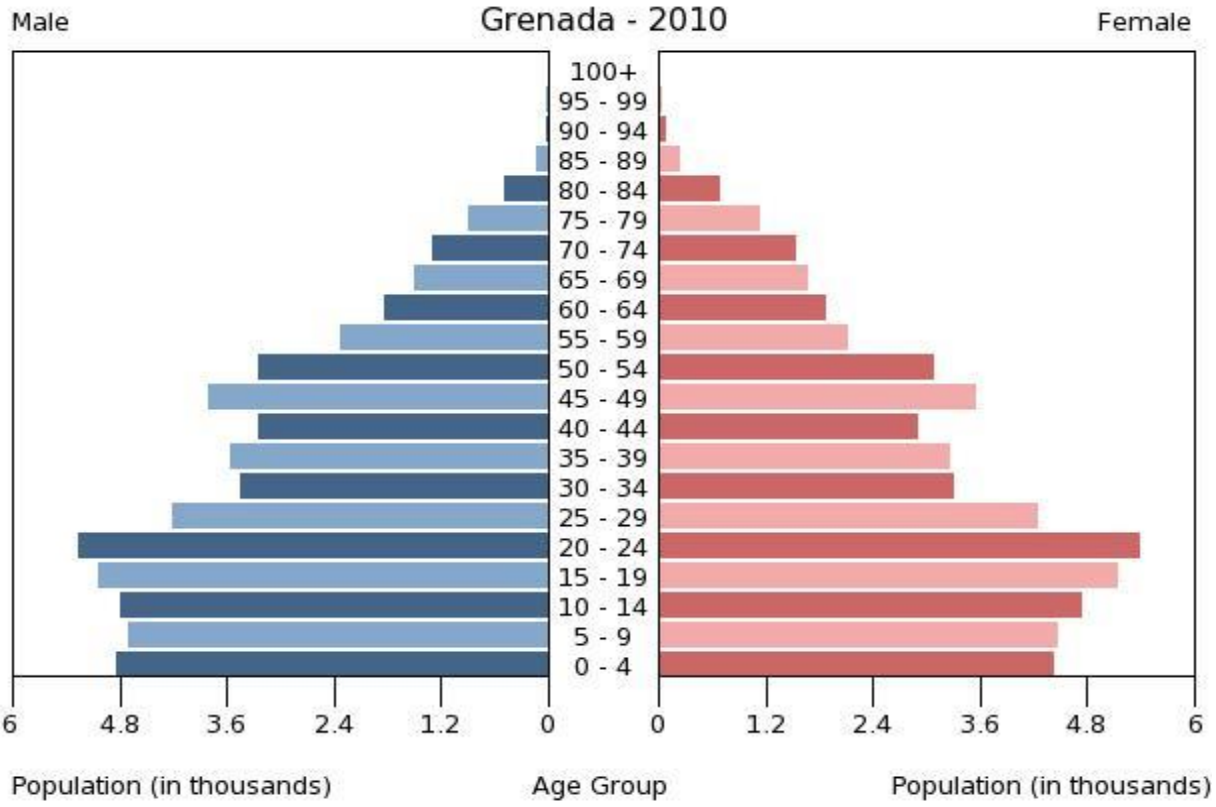
This analysis is limited in the number of diseases assessed and it assesses the costs for one year only, and cannot inform how costs and prices are changing over time.

4.2 DEMOGRAPHIC PROJECTIONS

As suggested in the previous section, demand for health services, and for what type of health service, likely will not remain at the levels experienced in 2012. For example, as the population of Grenada, on average, ages, the demand for treatment of NCDs likely will increase. This section provides a preliminary look at how changing demographics could affect to demand for health services at the General Hospital.

Figures 4.3 and 4.4 show the population age distribution "pyramids" for Grenada as projected by the United States Census Bureau for the years 2010 and 2050, respectively. Note that the total population is projected to decrease slightly from 104,000 in 2010 to 95,000 in 2050. It is projected that the age structure will shift from a 'bottom-heavy' pyramid, with large numbers of people under 30 years of age, in 2010 to a 'flat' pyramid, with the population distributed fairly evenly across ages (although with a slight bulge around 60-70 years of age), by 2050.

FIGURE 4.3: POPULATION PYRAMID FOR GRENADA, 2010[15]



[15] Source: United States Census Bureau, International Data Base, "Population Pyramid Graph - Custom Region – Grenada", http://www.census.gov/population/international/data/idb/informationGateway.php, accessed 26 August 2013.

FIGURE 4.4: POPULATION PYRAMID FOR GRENADA, 2050[16]

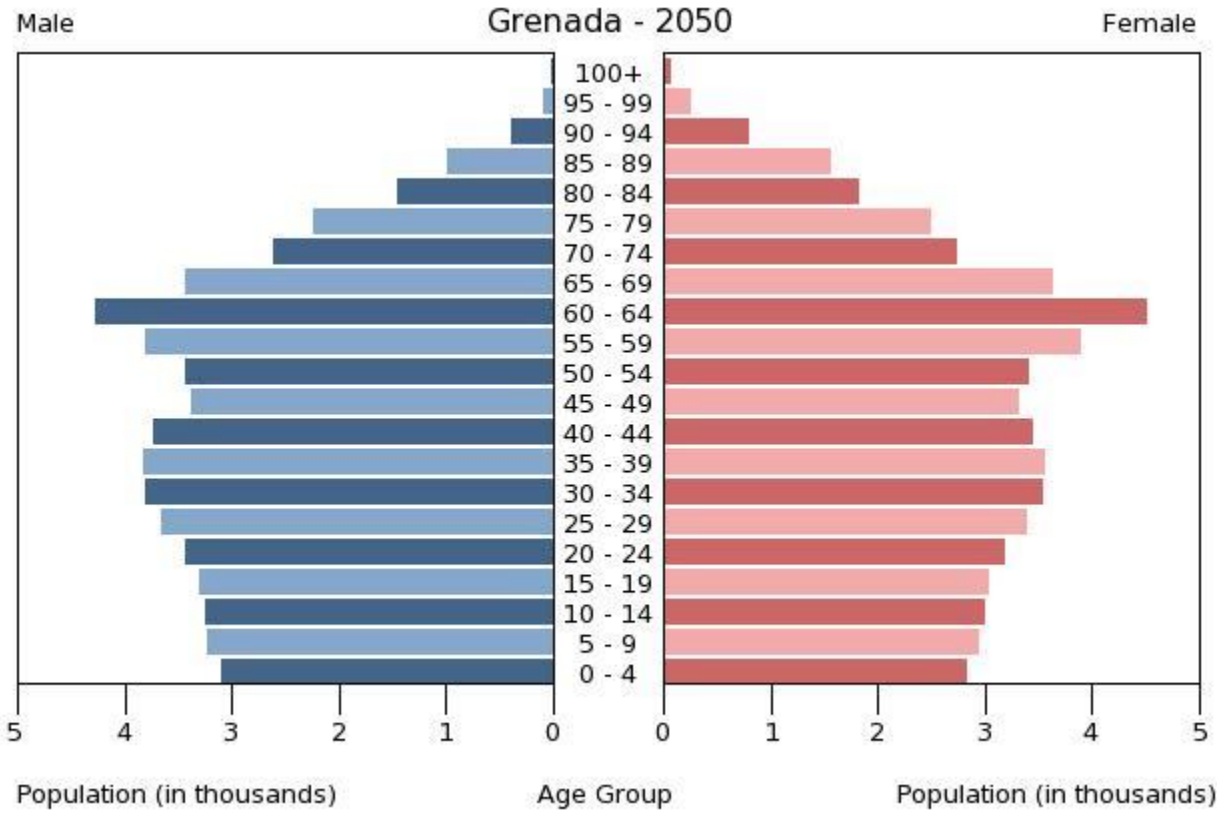


Table 4.6 presents the projected numbers of future hospital admissions for the five diseases, based on changing disease prevalence rates as the population's age profile changes. Overall, admissions are projected to increase, especially for CVD, diabetes, and hypertension, and in some cases more than double by 2050, despite a smaller total population. Annex E contains more details on the projections by age category and disease. We discuss the results for each of the five diseases in turn. Projections for HIV, in particular, should be treated with caution, since age parameters are not a strong or even valid predictor of admission.[17]

[16] Source: United States Census Bureau, International Data Base, "Population Pyramid Graph - Custom Region – Grenada", http://www.census.gov/population/international/data/idb/informationGateway.php, accessed 26 August 2013.

[17] Note again that the analysis, unlike the cost per admittance, includes anybody diagnosed with a particular condition. Thus, some admittances may be included in multiple disease categories (if, for example, they were diagnosed with both hypertension and diabetes during the admittance, they would be included in both of these analyses).

TABLE 4.6: NUMBER OF ADMISSIONS BY DISEASE IN 2012, AND PROJECTED NUMBER OF ADMISSIONS IN 2025 AND 2050 BY DISEASE

Disease	Number of admissions in 2012	Projected admissions in 2025	Percentage increase in admissions in 2025 over 2012	Projected admissions in 2050	Percentage increase in admissions in 2050 over 2012
Cancer	705	988	40%	1,190	69%
CVD	31	49	59%	70	125%
Diabetes	982	1678	71%	2,196	124%
HIV	19	24	24%	25	30%
Hypertension	1,270	2,100	65%	2,773	118%

4.2.1 CANCER

There were 705 cancer-related admissions to the Grenada General Hospital in 2012. When looking at the number of admissions per 1,000 population by age block (See Annex E Figure E.1), the rate of admissions per 1,000 population generally increases for the older age categories, with admissions at 8.4 per thousand for 25-54 year olds, 12.2 per thousand among those 55-64 years old, and 21.2 for those 65 and over. Note, however, this trend is much stronger for males than for females; for females the relationship between age and admittance rate does not change substantially among adults.

If these admission rates are applied to the projected population in 2020, there would be 988 cancer admissions in that year, and increase of 40 percent over the number of admissions in 2012. By 2050, if there were no changes in disease patterns or demand for services, the number of admissions could reach about 1,190, or 69 percent more admissions than seen in 2012.

About 23 percent of cancer admittances were for one day or less; these patients likely were admitted to the hospital for ongoing chemotherapy. Patients with admittances for one day or less tend to be slightly older than patients who stayed multiple days in the hospital. This is reflected in the admission rate per 1,000 persons (Annex E Figure E.2), with women over 65 years old having a slightly higher rate of admission than younger women. Based on these numbers, the number of multi-day admissions with a cancer diagnosis will increase 41 percent by 2020 and 69 percent by 2050, while the number of admissions one day or less will increase 38 percent by 2020, and 69 percent by 2050.

4.2.2 CVD

There were 31 CVD-related admissions to the Grenada General Hospital in 2012. The most common admissions were for patients aged 70 and over, which constituted 65 percent of admissions. The rate of admissions per 1,000 population (Annex E Figure E.3) generally increases for the older age categories, with admissions at 0.1 per thousand for 25-54 year olds, 0.4 per thousand among those 55-64 years old, and 2.1 for those 65 and over.

The number of individuals admitted for CVD in 2012 is likely too small to make predictions with any confidence. However, given the generally older ages of the majority of patients diagnosed with these conditions, admissions will likely increase over the coming years.

4.2.3 DIABETES

There were 982 diabetes and associated blood glucose disorder admissions to the Grenada General Hospital in 2012. The most common admissions were for patients aged 50 to 79, which constituted 57 percent of admissions. However, when looking at the number of admissions per 1,000 population by major age block (Annex E Figure E.4), the rate of admissions per 1,000 population generally increases for the older age categories, with admissions at 5.7 per thousand for 25-54 year olds, 27.2 per thousand among those 55-64 years old, and 48.2 for those 65 and over.

If these admission rates are applied to the projected population in 2020, there would be 1,678 diabetes admissions in that year, and increase of 71 percent over the number of admissions in 2012. By 2050, if there were no changes in disease patterns or demand for services, the number of admissions could reach about 2,196, more than double the number of admissions than seen in 2012.

4.2.4 HIV

There were 19 HIV-related admissions to the Grenada General Hospital in 2012. The rate of admissions per 1,000 population (Annex E Figure E.5) does not show a strong directional relationship with age.

These numbers are likely too small to make predictions with any confidence. Further, the lack of strong apparent correlation between age and HIV admissions indicates that changes in the age structure may not have a strong impact on the number of HIV-associated admissions. The number of HIV inpatient admissions was less than 0.3 percent of the total admissions in 2012; barring major changes in the burden of the HIV/AIDS epidemic in Grenada, it is likely that HIV will continue to constitute a relatively minor component of inpatient care at the General Hospital.

4.2.5 HYPERTENSION

There were 1,270 hypertension-associated admissions to the Grenada General Hospital in 2012. The most common admissions were for patients aged 50 to 84, which constituted 72 percent of admissions. When looking at the number of admissions per 1,000 population by major age block (Annex E Figure E.6), the rate of admissions per 1,000 population generally increases for the older age categories, with admissions at 8.0 per thousand for 25-54 year olds, 30.4 per thousand among those 55-64 years old, and 64.7 for those 65 and over.

If these admission rates are applied to the projected population in 2020, there would be 2,100 hypertension admissions in that year, and increase of 65 percent over the number of admissions in 2012. By 2050, if there were no changes in disease patterns or demand for services, the number of admissions could reach about 2,773, more than double the number of admissions than seen in 2012.

4.2.6 LIMITATIONS AND CONCLUSIONS FOR THE DEMOGRAPHIC PROJECTIONS

This analysis shows that admissions for three diseases – hypertension, cancer, and diabetes – will likely increase over the coming years. Even by 2020, admissions could increase by over 50 percent. These findings are based on only two observations: (1) Older people have higher rates of admittances for these diseases, and (2) the population structure in Grenada is likely to shift to older age groups in the coming years.

The analysis is not intended to accurately predict the future, but simply to highlight potential order of magnitude changes in admittances. It should not be taken as a full actuarial analysis of need, demand, and costs of providing services. Dealing with only one year of admittances, this analysis does not deal with

how admission rates have been changing over time. For example, if admission rates have been going up over time holding age constant (e.g., if admission rates have been going up over time amongst people 65 years of age and older), then this analysis might under-predict future admissions. A fuller analysis would include changes in admission rates over time, and may even be extended to include changes in population-level determinants of disease incidence (e.g., obesity rates), determinants of demand for services (e.g., changes in income), and the like. Further attention to dealing with multiple diagnoses is also needed.

A full actuarial model would also include costs and changes in the costs (due to inflation or technological changes) over time. This analysis also does not take into account potentially favorable changes over time, such as reduction of disease burden due to preventative activities, socio-economic changes, etc.

With these limitations in mind, this analysis does provide two important insights. First, the changing demographics in Grenada are likely to influence how much health care is demanded. At a minimum, these changes need to be considered when conducting medium- to long-term planning for the provision of health services or financial resource needs estimation. Second, there is a need to start tracking and analyzing data on resource utilization and costs over time in order to gain a better understanding of the implications of the demographic transition occurring in Grenada.

5. FINDINGS: NATIONAL INFECTIOUS DISEASE CONTROL UNIT

The NIDCU had 1,318 visits in 2012; 878 visits were related to treatment of persons living with HIV, 717 visits for voluntary counseling and testing, and 45 visits related to sexually transmitted diseases (staff additionally completed 717 voluntary counseling and testing visits off-site, which are not included in this analysis because staff time spent off-site were also not included in the hospital costs). This included 21 new HIV patients and 90 people on anti-retroviral therapy, suggesting just fewer than 10 visits per HIV positive person per year.

The costs for the NIDCU were EC$ 580,421, or EC$ 440 per visit. Disaggregating the cost per visit by type of input was not possible due to difficulties in allocating drug costs to particular types of visits. However, it should be noted that 53 percent of the costs were for drugs, and about EC$ 284,000 of the EC$ 306,368 spent on drugs was for anti-retroviral drugs, equivalent to about 93 percent of the drug costs or just under half of the total costs of the NIDCU. In 2012, the Global Fund paid for antiretroviral drugs. The cost for anti-retroviral drugs alone was also more than the cost of drugs for the outpatient clinic in general, and about EC$ 10,000 less than the entire cost of the eye clinic. Dividing the costs for antiretroviral drugs by the number of patients suggests that these drugs cost about EC$ 3,156 per patient per year, although this may underestimate the costs since some of the patients were not on treatment the entire year.

The staff cost per visit is estimated to be EC$ 162, compared with EC$ 129 for the outpatient clinic in general. Further, other costs at the NIDCU were EC$ 46 per visit compared with EC$ 18 per visit in the outpatient clinic. This may is in part accounted for by CD4 and viral load tests, which were about EC$ 8 per visit. It is also accounted for in part by the allocation assumptions used in the step down approach; for example, pharmacy overhead is allocated according to drug costs and consequently more pharmacy overhead is allocated to the NIDCU than is to the outpatient clinic.

6. RECOMMENDATIONS

1. Strengthen accounting systems to comprehensively capture costs

Costing studies such as this one are a valuable tool to provide hospital managers with ad hoc information on hospital performance. However, such studies cannot substitute for routine financial management information systems which should produce performance data on a regular basis to assist managers to monitor performance. It is the responsibility of hospital management to demand such information and to make sure that the financial information systems are robust enough to deliver the required information. During the course of conducting this study, some data were not easily obtainable even though they ought to be regularly available to managers for their day-to-day decision-making. Some data that were missing included: volume of surgical procedures performed by type of surgery and the wards of origin of the patients; inpatient days data from wards differed from data from the Health Management Information System (HMIS) department; cost of fixed assets in use.

The hospital accounting system operates on the cash basis of accounting, rather than the more accurate and more business-oriented accruals basis. The accrual basis recognizes expenditures as soon as the obligation to pay is established, and not just when cash is actually paid out. The international public service accounting standards recommend that governments consider moving to an accruals basis for the sake of accuracy and better capturing of the costs of providing services.

The hospital did not have an available inventory of total capital assets and costs associated with them. A current and accurate inventory of all capital items is important for costing because capital costs represent real expenditures by the hospital and inclusion of these costs will provide a more accurate understanding of the true cost of hospital operations. In addition, capital inventories are important for management and planning purposes. Inventories keep track of all capital items in the hospital, as well as their age and status of usage. Having this information in one location allows hospital managers to track large upcoming expenditures and will flag any items that have remained out of use or in disrepair for an extended period of time. If the GoG wanted to include an estimate for capital costs, the unit costs provided in this report could be marked up by 10 to 20% and this would give some assurance that the total unit costs are not significantly understated.

2. Improve the use of hospital service data

Once data are available from the financial information system and/or the HMIS, management should make every effort to analyze them on a regular basis and use them to monitor hospital performance. Some analyses that could easily be performed include: comparing patient load with staff numbers in each department/cost center to assess productivity; reviewing the cost structure of the hospital to determine how the available financial resources are allocated across different expenditure items.

3. Standardize and track pharmaceutical usage data

Pharmaceuticals, including medical supplies and reagents, accounted for about 12 percent of the hospital's total costs in 2012. It is important that there is close monitoring of the efficiency with which pharmaceutical supplies are used in all areas of the hospital. Expenditure on laboratory supplies was an item of concern as this one item accounted for 42 percent of all expenditure on pharmaceuticals. The

practice of performing multiple laboratory tests on patients on admission was cited as a possible area of wastage. It was not within the scope of this study to investigate this further but it is certainly an area that management should look into.

4. **As part of cost monitoring and management, track changes in utilization and case-mix over time.**

Our demographic analysis suggested that the number of admissions for diabetes, cancer, and hypertension will increase in the future. The disease-specific analysis suggested that the costs per admission for cancer and diabetes are about EC$ 1,000 higher or more per admission than they are on average for the entire hospital, while a hypertension admission may be moderately more expensive than the average for the entire hospital. The analysis could not show if admissions for these diseases will represent a greater proportion of overall admissions to the hospital in the future, but the two analyses suggest that the total cost of operating the General Hospital may increase in the future (holding everything else constant) even without considering price inflation, introduction of new or more expensive treatment technologies, etc. Tracking these changes over time can inform planning for hospital capacity as well as costs.

5. **Use cost information to inform disease-specific programs**

The costing of the General Hospital can help inform the planning for disease-specific programs, such as for HIV/AIDS. We found that the NIDCU represented 1.7 percent of the total costs of the hospital, with drugs representing 53 percent of the total costs at the NIDCU. We estimate that about 93 percent of the NIDCU drug costs, or over EC$ 284,000, come from anti-retroviral drugs, which are currently paid for by the Global Fund. As the Global Fund and other partners start to withdraw financial support for ARVs, this means that funds on the order of what was spent by the outpatient eye clinic will need to be found to continue the anti-retroviral treatment program (assuming that the number of patients does not increase over time).

ANNEX A: COST CENTER ASSIGNMENTS

TABLE A.1: GENERAL HOSPITAL COST CENTER ASSIGNMENTS

Administrative	Intermediate	Final
Building Maintenance/	Laundry	Outpatient General
Bioengineer/transport/ security/switchboard	Nutritionist	Accident & Emergency
Domestics	Kitchen	NIDCU
General Administration/	Pharmacy	Eye Clinic
Finance	Laboratory	Inpatient Obstetrics and Neonatal
Medical Records	Digital Imaging	Male Medical
	Operating Room	Female Medical
	ICU/CCU	Male Surgical
	Physiotherapy	Female Surgical
		Gynecology
		Eye Ward
		Pediatrics
		Private Ward

ANNEX B: GENERAL HOSPITAL COSTING ALLOCATION RULES

The following lists assumptions for calculating and allocation expenditures. Table B.I explains the allocation base used for each cost center.

Staffing

- Orderlies were included in non-medical staff, and are evenly distributed between all final cost centers, Operating Theater (OT), ICU/CCU, and Physiotherapy (1.67 orderlies per cost center).
- Nursing supervisors were evenly divided across final cost centers (except NIDCU), plus OT and ICU/CCU (11 positions including the acting supervisor, divided across 13 centers = .85 FTE per ward).
- Number of medical staff for outpatient clinics was calculated from outpatient clinic schedule (4 hours per physician listed for clinics).
- Interns were not included in the direct staffing calculations, but are included in contract / un-established positions.
- Volunteers were included separately in the direct/indirect cost sheets.
- There were 67 trainees who received a $700 stipend. They were assigned to cost centers based on a list received from the Hospital Accounts team: 29 to kitchen, 5 to lab, 6 to administration, 15 to maintenance, 2 to digital imaging, 1 to pharmacy, 1 ward clerk assigned to each inpatient ward (9 total). These costs are counted as direct cost to the appropriate cost center.
- Medical missions were assigned to the outpatient clinics:
- Gynaecologic Oncologist – one specialist for eight days a year, assuming full days for 1.5 weeks (reported as visiting once or twice per year), but spending two days at St. George's University
- Children Health Organization Relief and Educational Services (CHORES)– assumes four specialists for 0.5 days for two weeks a year but with some time at St. George's University, so a total of six days (reported as two times per year)
- Martha Johnson Foundation – assumes ten days per year, two full-time weeks with four days spent at St. George's University, by specialists (reported twice yearly in Obstetrics/Gynecology, surgery and orthopedics)
- Three days each for a cardiologist and ophthalmologist.
- The remaining allowances not directly allocated to staff were allocated to the cost centers based on the proportion of allowances, by cost center, that were assigned directly to staff.

Eye Ward vs. Eye Clinic

- All minor surgeries and 40 percent of intermediate surgeries reported by the eye ward were allocated to the outpatient eye clinic.
- Three doctors each run their own clinic for four hours a week; one staff nursing and one nursing assistant from the eye ward staff the clinic.

- Ratio of nurses in the eye clinic versus the eye ward determines the number of nursing supervisors assigned to each. This ratio was also used to divide the cost of the orderlies serving each cost center.
- The allocation of the eye ward's drug consumption was based on the ratio of outpatient clinic's drug consumption compared to the male and female surgical wards' consumption.

Drug Consumption

- Based on the Pharmacy medical records, where medication bills were included in the consumption order or medical supplies (this applies to the Private Ward and Oncology clinic).
- Discussions with staff noted that prescriptions listed in medical records were written for discharges. Thus, prescriptions allocated to outpatient clinics included: outpatient clinic, oncology clinic, discharge, RHOGRAM, Narcotics/Psychiatric, ICU discharges, male surgical, female surgical, and Post Exposure Prophylaxis.
- The line in the Pharmacy monthly reports labeled "Medications/Medical Supplies Rec CPU" were not included in consumption.

In order to conduct the step-down allocation, each cost center was given an allocation base, which was used to allocate the total costs from that cost center across all the remaining cost centers at lower levels. The following table lists the allocation bases used for each cost center, as well as any assumptions or calculations used to determine the amount of the base unit to be applied to each of the remaining cost centers.

TABLE B.1: COST CENTER ALLOCATION BASES AND ASSUMPTIONS

Cost Center	Allocation Base	Assumptions
Administrative Services and Logistics		
Building Maintenance/ Bioengineer/ Transport/ Security/ Switchboard	Square Feet	• Building space by square feet was measured and reported by the Chief Engineer based on blueprints for the hospital.
Domestics	Square Feet	• Building space by square feet was measured and reported by the Chief Engineer
Medical Records	• For intermediate and outpatient final cost centers: staff salaries • For inpatient final cost centers: staff salaries + patient days	• Staff salaries were calculated based on staff directly attributable to a cost center

Cost Center	Allocation Base	Assumptions
General Administration/ Finance	FTE Staff	• Orderlies were included in non-medical staff, and are evenly distributed between all final cost centers, OT, ICU, and Physiotherapy (1.67 orderlies per cost center) • Nursing supervisors were evenly divided across final cost centers (except NIDCU), plus OT and ICU (11 positions including acting, divided across 13 centers = .85 FTE per ward) • Number of medical staff for outpatient clinics was calculated from outpatient clinic schedule (4 hours per physician listed for clinics) • Interns were not included in the direct staffing calculations • Volunteers were included separately in the direct/indirect cost sheets • There were 67 trainees who received a $700 stipend. They were assigned to cost centers based on a list received from the Hospital Accounts team: 29 to kitchen, 5 to lab, 6 to administration, 15 to maintenance, 2 to digital imaging, 1 to pharmacy, 1 ward clerk assigned to each inpatient ward (9 total); these costs were calculated separately from other labor costs.
Intermediate Medical Services		
Laundry	Percentage estimates	• Estimated that 10% of laundry is coming from the Operating Room, based on available survey data over one month. • Assumed 5% of laundry done at the hospital is coming from other health facilities, which was assigned to the laundry cost center • Assumed an additional 10% used by physiotherapy and outpatient clinics • Remaining 75% was allocated across inpatient wards based on number of beds
Nutritionist	Actual visits per unit	• As reported by the nutritionist's statistics • 1 of the visits was to Princess Alice Hospital, and was assigned to the Nutritionist's office
Kitchen	Patient bed days	• Allocations with .5 are rounded down • Staff meals allocated to overhead
Pharmacy	Direct consumption	• Based on direct consumption (cost) reported by the pharmacy records, plus the expenditures reported by CMS for domestic stocks, lab, operating theatre, and x-ray. • For reagents, total consumption was estimated by reviewing invoices in the hospital accounts office.
Laboratory	Actual proportion of tests	• Actual number of tests were only obtained from September through December, so total costs for the full year were were allocated assuming the same proportions for the remaining nine months of the year.

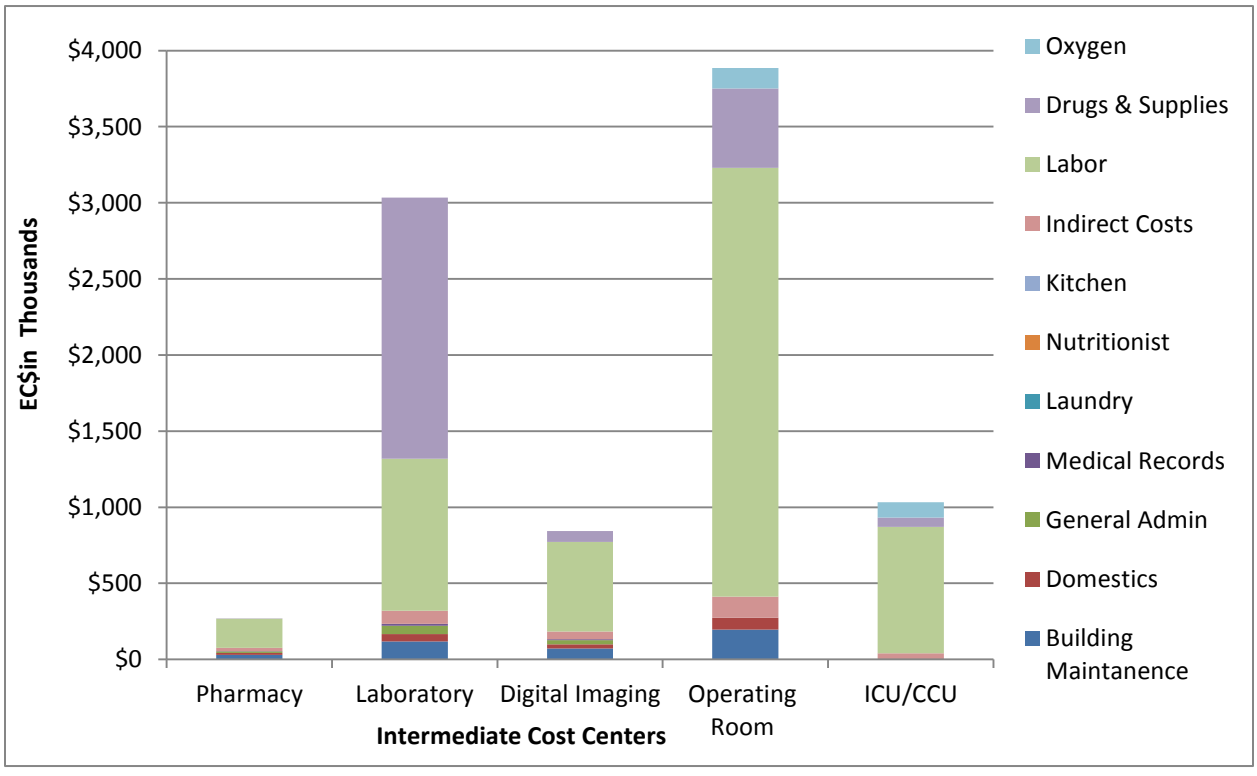
Cost Center	Allocation Base	Assumptions
Digital Imaging	Projected number of tests	• Inpatient ward calculations were completed by digital imaging staff reviewing log books for x-ray, and costing team reviewing log books for ultrasounds • Outpatient x-rays taken from Radiology statistics 2012 report summary of all outpatients seen minus reported casualty unit x-rays from log books • Note: there were discrepancies in the numbers reported in the statistical report. • The number left in the digital imaging cost center represents Princess Alice Hospital, Rathdune, prison, and Mt. Gay patients, and were assigned to the digital imaging department.
Operating Room	Number of surgeries	• As reported by operating room and ward records.
ICU/CCU	Patient bed days	• Calculated from the average length of stay reported by the nursing department multiplied by the number of admissions per ward (47,669 total) • Note that this calculated figure does NOT align with reports from the Medical Records Unit (47,652 total) • Obstetrics ward patient days includes neonatal admissions
Physiotherapy	Number of treatments	• All outpatient treatments were allocated to outpatient costs centers • Number of treatments for inpatients were recorded by orthopedics, surgical, medical, neurology, and gynaecology • Medical and Surgical sessions were allocated to the male and female wards at the same ratio as the ratio of male to female medical/surgical ward admissions • All orthopedic sessions were allocated to surgical wards using the male/female ratio • Neurology was allocated between the medical and surgical wards using the ratio of all medical admissions to surgical admissions, and then by male/female • Gyneacology treatments were allocated to the gyneacology ward

ANNEX C: BREAKDOWN OF COSTS FOR INTERMEDIATE COST CENTERS

The step-down allocation of costs in the MASH tool does not directly report the final costs associated with intermediate cost centers, which may be as important for hospital staff to understand as the breakdown for the final cost centers. To provide additional cost information, this Annex will focus on the following intermediate cost centers: Pharmacy, Laboratory, Digital Imaging, Operating Room, and ICU/CCU.

There are three types of costs that make up the total cost for each center: direct, indirect, and allocated costs from higher-level cost centers. For the intermediate cost centers, the direct costs include labor, and drugs and medical supplies (light green and lavender, respectively, in the figure below). The indirect costs consist of utilities, oxygen, and stationary. Oxygen was only used in the Operating Room and ICU, and for the purpose of the figure below, is considered a separate cost area (light blue) from other indirect costs. For the Operating Room and ICU, oxygen accounts for 49 and 72 percent of the indirect costs, respectively. Finally, the costs allocated from each of the higher-level cost centers have also been broken out. These include both the administrative cost centers as well as the broader intermediate cost centers (Laundry, Nutritionist, and Kitchen). Figure C.1 demonstrates that these allocated costs average about 13 percent of the total cost, except for the Pharmacy, where allocated costs make up 20 percent of the total.

FIGURE C.1: BREAKDOWN OF COSTS FOR INTERMEDIATE COST CENTERS



Labor is the largest cost driver in all intermediate cost centers except the laboratory, where it is a close second. A detailed breakdown of staff allocated to each cost center is shown in Table C.1 below.

TABLE C.1: HOSPITAL STAFF BY INTERMEDIATE COST CENTER

Hospital Staff	Intermediate Cost Centers				
	Pharmacy	Laboratory	Digital Imaging	Operating Room	ICU/CCU
Physicians	-	0.5	0.5	12.0	1.0
Nurses/Medical staff	-	-	-	30.9	12.9
Non-Medical staff	4.0	21.0	10.0	1.7	1.7
TOTAL	**4.0**	**21.5**	**10.5**	**44.5**	**15.5**

ANNEX D: BREAKDOWN OF STAFF SALARIES

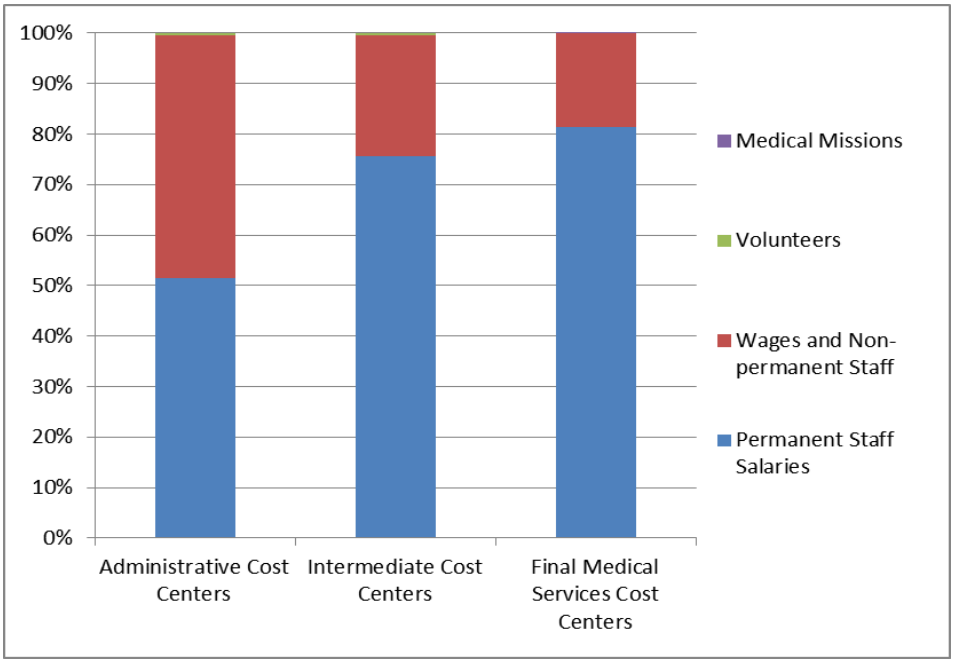
As shown in Section 3.1.1, Figure 3.1, salaries accounted for 73 percent of the total hospital expenditures in 2012. As Table D.1 demonstrates below, 76 percent of the total cost of salaries is generated by permanent staff salaries and allowances, and most of the remaining salaries costs went to non-permanent staff wages. Less than 0.3 percent of the total cost of salaries was generated by volunteers and medical mission workers.

TABLE D.1: BREAKDOWN OF SALARY COSTS

	Permanent Staff Salaries & Allowances	Non-permanent Staff Wages	Volunteers	Medical Missions	Total Labor
Administrative Cost Centers	1,575,520	1,472,101	14,700	-	3,062,320
Intermediate Cost Centers	4,572,015	1,442,579	25,900	-	6,040,494
Final Medical Services Cost Centers	12,829,191	2,927,626	6,300	6,202	15,769,319
Total	**18,976,726**	**5,842,306**	**46,900**	**6,202**	**24,872,134**
% of Total	*76.3%*	*23.5%*	*0.2%*	*0.0%*	*100.0%*

Figure D.1 below shows the breakdown of percentages by type of cost center.

FIGURE D.1: PERCENTAGE OF TOTAL SALARY SPENT BY STAFF AND COST CENTER



ANNEX E: DETAILS FOR THE DEMOGRAPHIC PROJECTIONS

FIGURE E.1: ADMISSIONS BY AGE AND SEX FOR CANCER

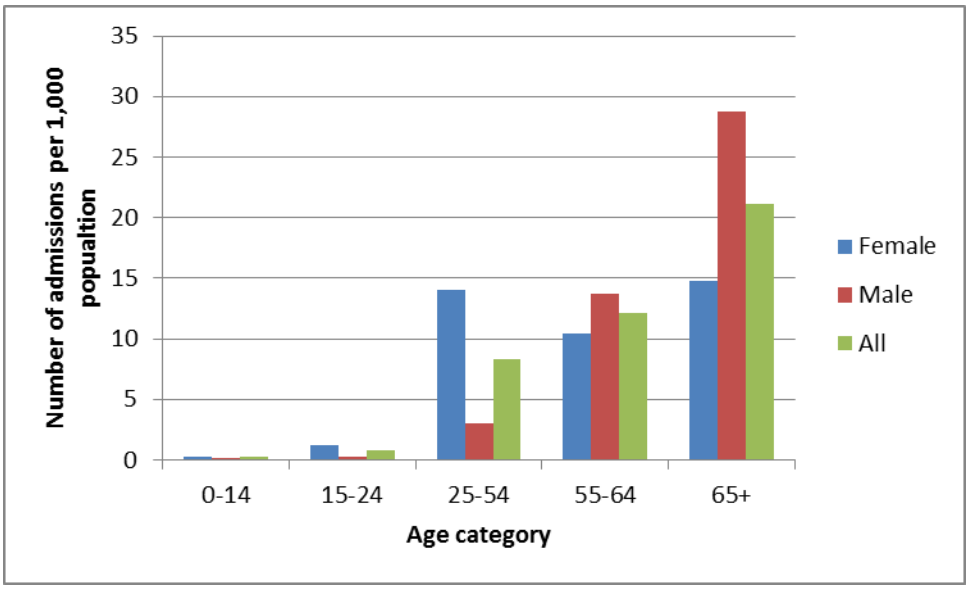


FIGURE E.2: ADMISSIONS OF 1 DAY OR LESS BY AGE AND SEX FOR CANCER

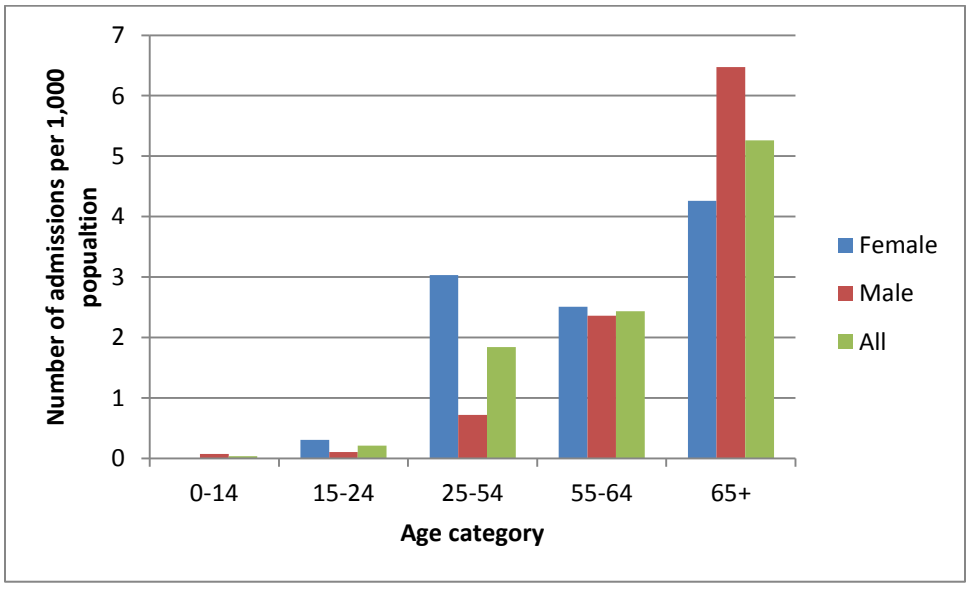


FIGURE E.3: ADMISSIONS OF MORE THAN 1 DAY BY AGE AND SEX FOR CANCER

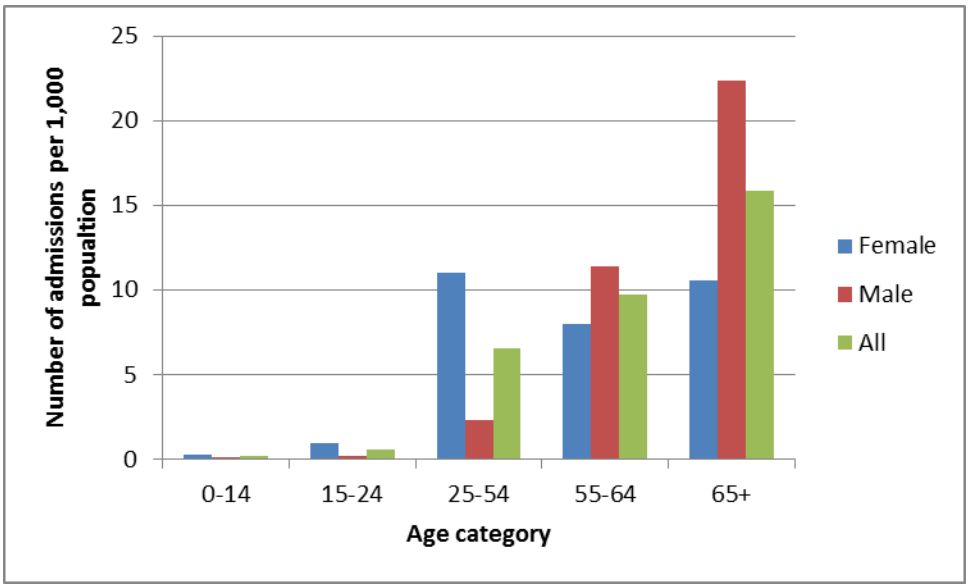


FIGURE E.4: ADMISSIONS BY AGE AND SEX FOR CVD

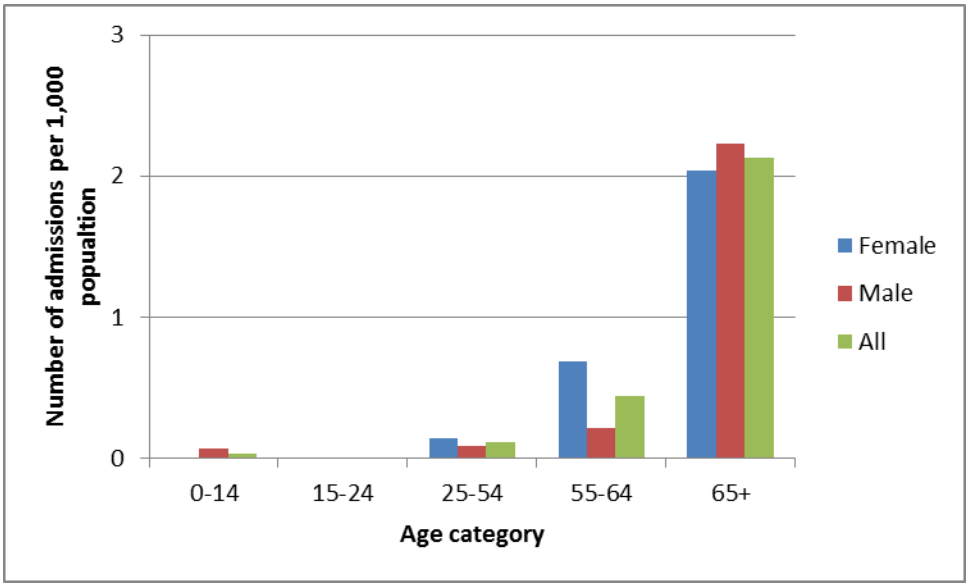


FIGURE E.5: ADMISSIONS BY AGE AND SEX FOR DIABETES

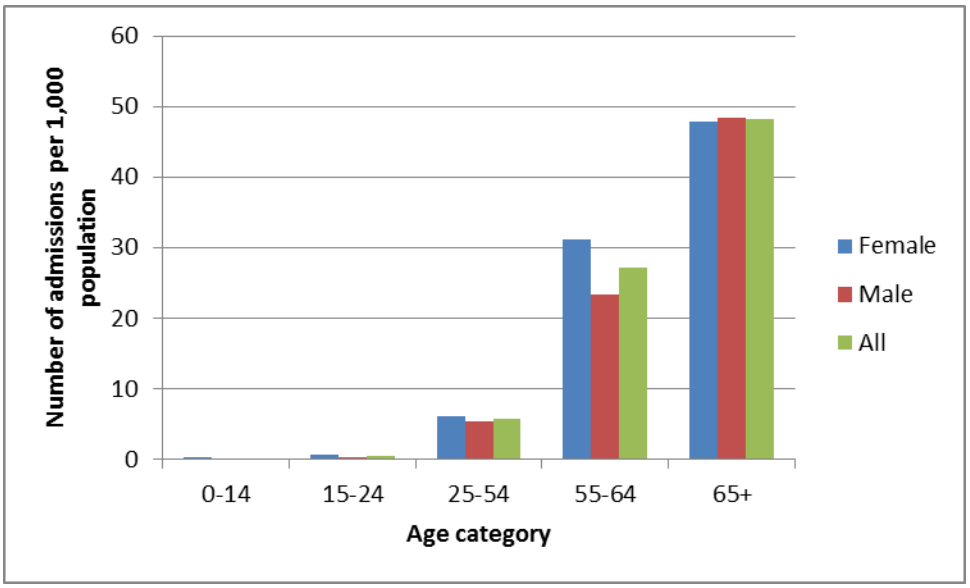


FIGURE E.6: ADMISSIONS BY AGE AND SEX FOR HIV

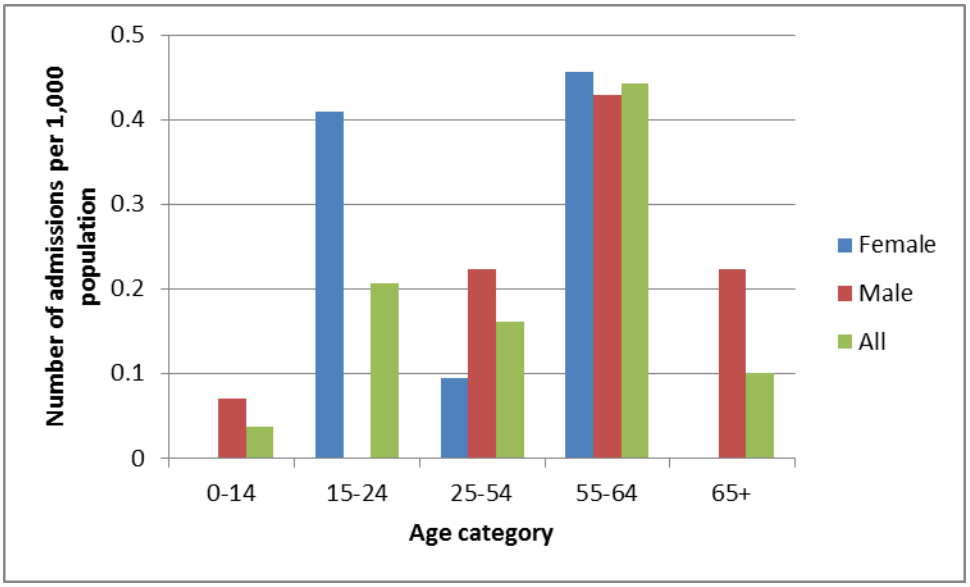
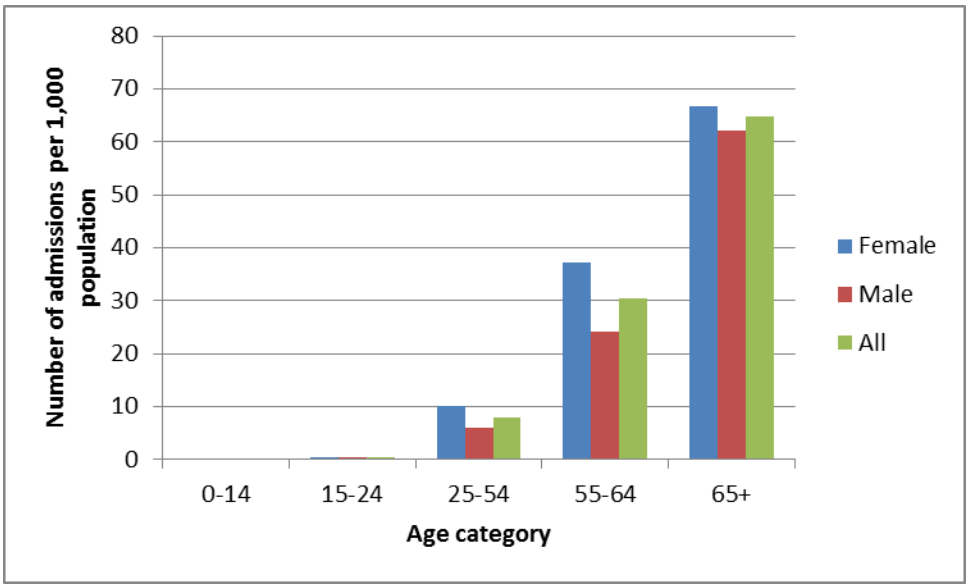


FIGURE E.7: ADMISSIONS BY AGE AND SEX FOR HYPERTENSION



ANNEX F: DETAILS FOR THE DISEASE-SPECIFIC COSTS

TABLE F.1: COST PER ADMISSION FOR CANCER, BY MAJOR AGE GROUP

Age category	Average cost per patient admitted	95% confidence interval	Average cost per patient admitted for 1 day	Average cost per patient admitted for more than 1 day
Under 15	1,916	N/A	N/A	1,916
15-24	10,138	0 to 26,098	1,463	14,476
25-54	5,194	4,060 to 6,329	1,405	5,806
55-64	3,372	1,520 to 5,225	1,869	3,936
65+	4,864	2,831 to 6,897	1,677	6,457
Average	**4,980**	**3,908 to 6,052**	**1,614**	**5,942**

Note that the reported overall average is for all patients. Since there are different numbers of patients in each age group, it does not reflect the average of the numbers reported in the table, but the average of these numbers weighted by the number of patients in each age group.

TABLE F.2: COST PER ADMISSION FOR CVD, BY MAJOR AGE GROUP

Age category	Average cost per patient admitted	95% confidence interval
Under 15	N/A	N/A
15-24	N/A	N/A
25-54	2,376	1,235 to 3,518
55-64	2,352	491 to 4,213
65+	5,026	1,847 to 8,204
Average	**4,153**	**1,977 to 6,330**

Note that the reported overall average is for all patients. Since there are different numbers of patients in each age group, it does not reflect the average of the numbers reported in the table, but the average of these numbers weighted by the number of patients in each age group.

TABLE F.3: COST PER ADMISSION FOR DIABETES, BY MAJOR AGE GROUP

Age category	Average cost per patient admitted	95% confidence interval
Under 15	3,232	N/A
15-24	439	N/A
25-54	2,811	1,850 to 3,772
55-64	5,207	3,045 to 7,370
65+	4,704	2,747 to 6,660
Average	**4,190**	**3,147 to 5,233**

Note that the reported overall average is for all patients. Since there are different numbers of patients in each age group, it does not reflect the average of the numbers reported in the table, but the average of these numbers weighted by the number of patients in each age group.

TABLE F.4: COST PER ADMISSION FOR HYPERTENSION, BY MAJOR AGE GROUP

Age category	Average cost per patient admitted	95% confidence interval
Under 15	N/A	N/A
15-24	N/A	N/A
25-54	3,849	1,918 to 5,781
55-64	3,245	1,712 to 4,778
65+	3,421	2,539 to 4,302
Average	**3,587**	**2,787 to 4,387**

Note that the reported overall average is for all patients. Since there are different numbers of patients in each age group, it does not reflect the average of the numbers reported in the table, but the average of these numbers weighted by the number of patients in each age group.

TABLE F.5: COST OF ADMISSION BY COST CENTER AND DISEASE

Cost center	Average cost per admission (EC$)				
	Hypertension	*Diabetes*	*Cancer*	*CVD*	*HIV*
Accident and Emergency visit	83	87	46	90	66
Pharmaceuticals	194	179	363	228	518
Laboratory procedures	421	422	404	337	372
Surgery	254	355	1,078	185	120
Physiotherapy	1	1	1	1	-
ICU	305	-	179	-	-
Ward costs	2,330	3,140	2,910	3,312	4,127
All costs	**3,587**	**4,184**	**4,980**	**4,153**	**5,203**

Note: Columns may not add to total due to rounding error

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