

# **Cost Analysis and Efficiency Indicators for Health Care:**

**Report Number 3**

**Summary Output for El Gamhuria General Hospital, 1993-1994**

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## Acronyms

ALOS	Average Length of Stay
CEA	Cost-Effectiveness Analysis
DALY	Disability Adjusted Life Year
DOP	Department of Planning
DDM	Data for Decision-making
ENT	Ear, Nose, and Throat
FTE	Full Time Equivalent
L.E.	Egyptian Pound
Gyn/Obs	Gynecology and Obstetrics
ICU	Intensive Care Unit
CCO	Occupancy Rate
MOHP	Ministry of Health and Population
PWAF	Present Worth of Annuity Factor
PV	Present Value
QALY	Quality Adjusted Life Years
RP	Reference Period
GGH	Gamhuria General Hospital
TC	Total Cost
na	Not available/not applicable

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## Arabic Executive Summary

## Executive Summary

The governorates of Alexandria, Suez, Bani Suef, Dakahlia, Port Said, North Sinai, South Sinai and Aswan undertook detailed costing studies to define costs and in Ministry of Health and Population hospitals. This study presents the results of the costing of Gamhuria General Hospital at Alexandria Governorate. The data collection and analysis were conducted by a team from the Alexandria Health Directorate in collaboration with the Data for Decision-making project (DDM). The DDM project is a collaborative effort between the Department Of Planning (DOP), Ministry Of Health and Population (MOHP), United States Agency for International Development (USAID), the Harvard School of Public Health, and the University of California, Berkeley, School of Public Health.

Operating costs of the Gamhuria General Hospital from July 1993 to June 1994 were allocated to the individual cost centers. These cost centers are classified as overhead, intermediate service and final service departments. The overhead departments such as, personnel, finance and maintenance, provide support to intermediate and final service departments. The intermediate service departments, such as laboratory and operating theaters, provide procedures and services to patients in final service departments in the inpatient wards and outpatient clinics.

Fifty functional departments were identified as cost centers at the hospital. Overhead, intermediate service, and final service departments account for 11, 26, and 63 percent, respectively, of total hospital-wide costs.

Five major categories of costs were selected to estimate the total costs: building and permanent structures, equipment and furniture, drugs and medical supplies, food and clothing, utilities, and personnel.

The study uses the step-down technique for allocating overhead and intermediate service departments costs to final service departments. The step-down technique was also used to allocate overhead and intermediate service department staff to final service departments, and to estimate the full-time equivalents for each department and clinic.

The largest expenditure in hospitals is on personnel, which includes take-home pay and all related benefits. Annual personnel costs account for 51 percent of the total expenditures at the Bani Suef General Hospital. Costs for personnel at intermediate service and final service departments constitute 89 percent of personnel costs, while salaries for personnel at overhead departments represent 11 percent of the total cost of personnel. Physicians' and nurses' salaries account for 69 percent, while other staff categories constitute 31 percent of the total costs of personnel.

Sixteen percent of the total annual costs for 1993-94 was spent on drugs and medical supplies. The total annual cost of drugs and medical supplies include not only the drugs actually used but also donated and wasted drugs. This total annual cost of drugs and medical supplies is estimated at L.E. 552,877. This does not include prescription drugs purchased by patients out-of-pocket. The average cost of drugs per inpatient day is 2.75 L.E. This low expenditure suggests the magnitude of the dependency of the system on patient drug purchases outside the hospital or it suggests low quality of care. A small portion of the drugs and medical supplies (7 percent of the annual total) is consumed by the Renal Dialysis Unit. The cost of drugs and medical supplies varies significantly across final service departments. Drugs and medical supplies account for only 0.7 percent of the inpatient treatment for the incubator department, while they constitute 56 percent of expenditures on the renal dialysis unit.

The study assessed the actual cost of renal dialysis as an example of one of the interventions financially supported by the MOHP in spite of its high cost. The average cost per visit is 102 L.E., which totals 10,608 L.E. per patient annually taking into account that the renal failure

patient needs 2 weekly visits (104 visits yearly on average, 4-6 hours for each visit). The cost of drugs and medical supplies constitute 56 percent of the total cost. See table 27 for the distribution of costs per outpatient visit.

The average cost per admission is 223 L.E. Costs range from 127 L.E. for gynecology and obstetric department to 853 L.E. for the incubator department. The cost per admission is highest in departments with low occupancy rates and long average lengths of stay (see Table 29). Some departments were very well staffed with an average of 2.49 staff for every occupied bed; however, the average occupancy rate is 43 percent resulting in high admission costs (see Graph 24 for annual admissions per full time physician output versus cost per admission).

The average cost per day, 45 L.E., varies depending on the occupancy rate. This daily cost ranges from 15 L.E. (general medicine department) to 139 L.E. (incubator) resulting from lower occupancy rates and higher input costs in these departments.

The average annual cost per bed is 7,876 L.E. This ranges from 6,655 L.E. in the pediatric department to 21,484 L.E. in the incubator department. General medicine has the lowest cost of 3,084 L.E. per bed. See Graph 22 for the total annual cost per bed.

The total maintenance cost in this hospital is about 83,100 L.E., which represents 0.28 percent of the annual recurrent cost. The international average percentage of maintenance costs ranges between 10 -15 percent of the annual recurrent costs to uphold effective hospital operation (Mills 1991).

Outpatient visits in this hospital cost an average of 5.21 L.E. Drugs account for 11 percent (0.58 L.E.), while personnel costs consume more than 61 percent of the total. The cost of an outpatient visit depends on the number of visits to each clinic. It ranges from 3 L.E. in the general medicine clinic to 40 L.E. for physiotherapy clinic, with respectively treat 145 and 3 patients daily. (see Table 27 for the distribution of costs per outpatient visit). Cost per visit for the emergency unit is 5.82 L.E. Drugs and medical supplies make up 18 percent (which is more than the cost of drugs and medical supplies for outpatient clinics). Outpatient care at GGH absorbs 34 percent (1,208,201 L.E.) of total hospital recurrent expenditures.

The average occupancy rate in 1993-94 was 48 percent. This rate ranges from 29 percent in the ENT department to 94 percent in the orthopedics department. Both the gynecology and obstetrics and ICU departments have the highest turnover rates (71 and 48 patients per bed, per year, respectively). Turnover rate decreases in the urology department with 18 patients per bed per year and is at its lowest in the general medicine department at 15 patients per bed per year. The turnover rate in the Alexandria General Hospital is 35 patients per bed per year.

This study assessed the average length of stay for 74 diagnoses to help determine the diseases with the longest length of stay. Deliveries present the highest number of admissions (17.45 percent of total hospital annual admissions, ALOS 1.9 days), and appendectomies present the second highest number of admissions (10.13 percent of total hospital annual admissions, ALOS 2.4 days). In general, average lengths of stay appear appropriate for the most common diagnoses. Patients in the ophthalmology department stay an average of 11 days, while they stay only 3 days in the ENT departments. These figures are based on an analysis of the admission and discharge sheets of the hospital. This was one way to ensure the accuracy of the results. See Tables 12,13,14 and 15 for a list of average lengths of stay at Gamhuria General Hospital.

The average number of inpatient days per full-time equivalent physician was 463 patient days. Based on the fact that each physician works 270 days a year, each physician attends to 1.7 patients during his/her 6 hour day. This number decreases to 61 patient days for a physician in

the incubator department, meaning he/she is responsible for fewer than one patient per working day, which is a very low ratio.

Recommendations: Improving the efficiency of this hospital will require an increase in occupancy rates. This can be achieved through a number of changes in management.

Recommended changes include:

1. Increase hospital autonomy and decision-making by the hospital director in budget allocations, staffing, drugs purchases, etc. A performance-based incentive system is one feasible and practical method for rewarding good management practices and performance.
2. Staffing ratios per bed or bed day are not an infallible proxy for quality of service. Training and skill level, supporting technology, team work, and organization of services are all essential complementary co-determinants of quality. In addition, differences in the case mix inside and between departments has an important role. For example, ICU patients need more staff than orthopedics patients.
3. Increases in the budget for drugs and medical supplies. This will increase the total annual cost of the hospital; on the other hand, the availability of drugs will likely increase the quality of care and the utilization rate (number of admissions) and this, in turn, will decrease the total cost per admission.
4. Treatment protocols for the same cause of admission vary among physicians of the same department. The average length of stay can be reduced by more than 50 percent by changing the standard practice for specific cases of admissions.
5. Maintenance has important implications for the overall technical efficiency of the hospital. Unfortunately, maintenance costs are directed mainly towards repairing hospital equipment and not towards regular and preventive maintenance, for which there are no plans.
6. Reducing the average lengths of stay by increasing the occupancy rate would enable the turnover rate to increase and would extend hospital benefits to a greater number of people to benefit from hospital services. The study investigated the main causes of long average lengths of stay for different diagnoses.

The following factors contribute to extended lengths of stay:

- Most of the cases admitted to inpatient care for diagnostic tests are confined until results are received before being given medical or surgical treatments.
  - Physician's lateness or absence due to conflicting appointments arising from dividing their time between their hospital service and private practice. It is critical for the hospital to work out arrangements with the physicians to ensure that such conflicts are minimized.
  - Absence of standard practices. Treatment protocols for the same cause of admission vary among different physicians of the same department.
  - Hospital infections as a result of poor sterilization (although very little data is available on the magnitude of hospital infections and their effect on ALOS).
7. It is evident that the existing information systems rarely produce the required information. Research is required into how routine systems can best be altered and augmented. Reliable data will help in identifying resource allocation problems and in planning changes to health sector resource allocation patterns.

8. The results of this study will provide a definitive basis for negotiating a price for the daily reimbursement rate for these private patients based upon the average cost per day of 45 L.E. It can also be used for negotiating a reimbursement rate from health insurance companies and for health insurance companies to set insurance prices based on estimated annual costs for hospitalization and utilization in the population covered.
9. For Gamhuria General Hospital, increasing the capacity of the general hospital to perform ambulatory surgery and other treatments would potentially assist in increasing hospital occupancy and efficiency while fulfilling patient demand for improved hospital care. This would require upgrading the skills of the surgeons and anesthesiologists, and possibly require some specialized equipment.

The current system of hospital admissions and management, which is divided between the governorate, the Ministry of Health and Population, and the hospital administration, provides no incentive to improve management, quality, and efficiency. Changing the decision-making system so that efficient, high quality care is rewarded will likely have the greatest impact. This change will require increased decision-making autonomy in the hospital regarding staffing patterns, maintenance budgets, and drug purchases, among other considerations. These changes might also lead to the hospital's increased accountability to provide efficient and client-oriented services. The role of the central and governorate level health administration would expand to developing hospital policy and monitoring as well as assuring quality services.

## **I. Introduction**

In Egypt, as in other developing countries, the demographic and epidemiological transition is putting increasing pressure on scarce government resources.

Government spending on health care in Egypt, as a percentage of the gross domestic product, has remained fairly constant in the last decade. The budget tracking system of the Department of Planning demonstrates that scarce health resources are allocated towards services which are costly and result in limited benefits in terms of increased life expectancy. Only 5 percent is allocated to primary care services which are known to be most cost-effective. Under these circumstances, the challenge facing policy makers is to optimize returns on investments in health care.

Two major avenues for increasing health benefits from scarce resources are 1) increasing the efficiency and improving the management of existing health facilities and health programs and 2) increasing the allocation of resources to those programs that are most cost-effective. In order to increase the use of scarce resources for more cost-effective and efficient services, the Ministry of Health and Population undertook a cost-effectiveness exercise.

Cost-Effectiveness is a method for identifying interventions that achieve the greatest level of health impact per unit of expenditure. Effectiveness is typically measured in terms of improvements in health status. An important aspect of cost-effectiveness analysis is that it can be used to assess technical and allocative efficiency.

Allocative efficiency measures the optimal distribution of resources among a number of competing uses. Technical efficiency is the extent to which the choice and utilization of input resources produce a specific health output, intervention or service at the lowest cost (WDR 1993). Inefficiency of inputs can lead to high costs per unit of service delivered to patients. Technical inefficiency occurs when output is less than is technically possible with the mix of inputs used by the hospital (Barnum 1993).

The governorates of Alexandria, Suez, Bani Suef, Dakahlia, Port Said, North Sinai, South Sinai and Aswan undertook detailed costing studies to determine costs and efficiency in hospitals. This study presents the results of the study of Gamhuria General Hospital at Alexandria Governorate. The data collection and analysis was conducted by a team from Alexandria Health Directorate in collaboration with the Data for Decision-making project (DDM). The DDM project is a collaborative effort between the Department of Planning (DOP), Ministry of Health and Population (MOHP), Harvard University School of Public Health, and the University of California Berkeley, School of Public Health.

The study uses step-down analysis to cost hospital-based services in general hospitals run by the MOHP. Efficiency indicators point to significant technical and economic inefficiencies. Nearly half of the expenditures in the hospital go to salaries, leaving less than optimal resources for drugs and medical supplies. Major intra-hospital differences exist in cost per admission, total full time equivalent staff per bed, output per physician, bed turnover rate and bed occupancy rate. The analysis shows that with better allocation for resources (human and financial), major efficiency gains can be achieved.

### **A. Why Hospital Costing and Efficiency Indicators for Gamhuria General Hospital?**

The main objectives of the cost and allocative efficiency study of the Gamhuria General Hospital are the following:

- Develop a clear and appropriate methodology for calculating the service cost.

- Increase the technical capability of professionals at the governorate in undertaking costing studies and using the information for decision-making.
- Estimate the actual economic costs of services delivered by each medical department of the hospital.
- Increase the efficiency of resource use by not only understanding the cost of services under the current operating system, but also providing some understanding of how resources can be used to provide the optimal level of service.
- Create a basis for a pricing system of medical services delivered by the hospital that can be used to establish fees for services and contracts.

## **B. Use of Data to Detect Inefficiencies in Resource Allocation and Identify Strategies to Improve Them**

The data from the Gamhuria General Hospital can be used to identify areas of inefficiencies by comparing the costs and outputs with other similar facilities, both nationally and internationally.

By comparing results of the various facilities, the range of costs for outpatient and inpatient services becomes evident and reasons for the differences can be better analyzed: low utilization, high administrative costs, personnel staffing, equipment and maintenance budgets, etc. Strategies can then be developed to address the problems, which may include increasing utilization of under-utilized facilities, changing staffing patterns, closing under-utilized facilities, etc.

## **C. Description of Gamhuria General Hospital**

Alexandria governorate is located 220 km north of Cairo. Alexandria is an urban governorate with a total population of 3.9 million. Gamhuria General Hospital (GGH) is one of the 8 general hospitals in Alexandria governorate. It was built in 1963 and currently has about 244 beds. The hospital is operated by the MOHP and its primary objective is to provide general medical and surgical services to the local community.

Gamhuria General hospital is a full-service general hospital with the following specialties: ear, nose, and throat (ENT), general medicine, general surgery, gynecology and obstetrics (Gyn/Obs), intensive care unit (ICU), incubator, ophthalmology, orthopedics, pediatrics and urology. The hospital also houses operating theaters, a laboratory, radiology services, and a renal dialysis section. Outpatient services are provided in all of these specialties, as well as in dental, dermatology, rehydration, treating rabies, psychiatry, diabetes and cardiology.

Being an MOHP hospital, GGH is administered under MOHP regulations and guidelines, as well as those of the Ministry of Manpower. Funds allocated from the Ministry of Finance to MOHP for personnel, including physicians, are controlled by the Ministry of Manpower and assigned by the MOHP to the Alexandria governorate. The governorate, through the office of Medical Affairs, assigns individuals to local health facilities. This system does not give hospitals sufficient control to select the type and number of specialties or the quality of appointed personnel. This puts hospitals in a difficult position in terms of management autonomy and financial decision-making.

The primary mission of the Gamhuria General Hospital, as many other MOHP hospitals, is to provide free medical care. Unfortunately, in recent years the MOHP's budget has not been adequate to meet the financial needs of such hospitals and other health units across the country. In order to help counterbalance overall costs, some facilities have introduced limited user fees.

These fees are collected from inpatients and outpatients and are used as bonuses for physicians and other staff, for drug purchases and other expenditures.

There are 650 employees, including 290 physicians and 155 nurses. This staffing level provides a ratio of employees to occupied beds, assuming Gamhuria Hospital's most recent occupancy rate of 47.91 percent, of 1.59 to 1. In relation to total beds, this ratio decreases to 0.76 to 1.

The total annual admissions in 1993-94 was 8,611 with an average length of stay of 4.96 days. Total annual outpatient visits (including emergency and renal dialysis units) was 293,817 visits.

## **II. Methods**

### **A. Allocation of Costs Between the Three Tiers**

Economic costs are used for the purpose of this analysis. The Gamhuria General Hospital is organized into three tiers based on the nature of service provided. These are identified as overhead, intermediate service, and final service departments. Intermediate service departments provide support and services to patients in final service departments. Table 1 identifies the functional departments of the hospital in the overhead, intermediate and final services categories.

The costs of the overhead departments are distributed to the intermediate and final service departments through a step-down method, according to allocation criteria devised to reflect as closely as possible the actual use of resources by each of the departments. The resources for the director's office, the overhead department serving the most departments, are distributed first; the resources for finance, the overhead department serving the second-largest number of departments is distributed next. Resources are then allocated to the intermediate service and final service departments.

### **B. Cost Allocation Among Departments**

Total costs consist of recurrent costs and the discounted present value of capital costs. These are allocated to the overhead, intermediate service, and final service departments according to the proportion of support required by each department. Data collected for cost estimation were grouped under five broad categories: major and minor equipment, building and permanent structures, labor (personnel costs), utilities, drugs and medical supplies.

1. Capital Costs are the annual costs of resources that have a life expectancy of more than one year. They include depreciated annual costs for buildings, equipment and furniture. The study uses replacement costs for capital items. The replacement value is the cost of the item if it were to be replaced at the current market price. The study was conducted and the data collected from Gamhuraia General Hospital between 1 July 1993 to 30 June 1994.

The costs of buildings and equipment are depreciated according to the unified accounting method currently practiced in Egypt, or 25 years useful life for the building.

2. Recurrent Costs are costs associated with inputs that will be consumed or replaced in one year or less, such as salaries, training (refresher courses), drugs, food and utilities.

### **C. Cost Categories**

#### ***Capital Costs***

##### ***1. Annual Depreciation Cost For Equipment and Furniture***

The study used the replacement cost of equipment and furniture during the period of reference time, the period of data collection from July 1, 1993 to June 30, 1994. (See appendix V for the data collection sheet for equipment). Six categories of equipment and furniture, each with a secondary categorization of 2, 3, 5, 10, 15 or 20 working life years, were assessed. This categorizing system was designed with the assistance of MOHP experts in the field of medical

supplies who are familiar with the actual productive lifetime for equipment and furniture in Egypt according to the level of maintenance and used frequency of the equipment.

The number of units of equipment and furniture and their locations were obtained through a physical inventory and technical description in log books no. 118, 112, 121. Table 2 shows the total cost of equipment and the annual depreciation cost.

## *2. Annual Building Depreciation Costs*

The study used the replacement cost for the building during the reference time. The replacement cost was 575 L.E. per sq. meter (including the cost of elevators and oxygen lines). These figures were obtained from the DOP at the MOHP, which is responsible for budget allocation in different governorates to establish and renovate health facilities. The building costs that are depreciated assume an effective life of 25 years. The price of the land has not been included in this estimation.

For allocation of corridors to cost centers (departments), we first allocated the special corridors, or the spaces located between departments. (See the diagram at the bottom of Table 3). These corridors were allocated according to the following rules:

- For overhead and intermediate departments (125 sq.m.), allocation was set according to the percentage of personnel using the corridors within each department.
- For inpatient departments (299 sq. m.), allocation was set according to the percentage of admissions using the corridors within each department
- For outpatient clinics (311 sq. m.) allocation was set according to the percentage of outpatient visits using the corridors within each clinic.

The other type of corridors are general corridors (255 sq. m.), which include all space outside the departments. These corridors have been allocated to the three main departments (overhead, intermediate and final services departments) of the hospital according to the proportion of occupied space from the total space area of the hospital. Again, inside each department of the three main departments, general corridors have been allocated according to the number of personnel at each cost center. This data was collected by preparing a floor plan of the hospital identifying and categorizing rooms according to their activities, and estimating the size of each room and corridors. The information about building characteristics was obtained from the engineering (maintenance) department.

Table 3 shows the base cost center space and the total space for each cost center after allocating special and general corridors. It also shows the total cost of the building for each cost center and the annual depreciation cost using 25 years as useful life and 3 percent for the Present Worth Annuity Factor (PWAF).

## ***Recurrent Costs***

### *1. Annual Personnel Costs*

Staff are allocated to five categories, (see Table 4 for personnel allocation):

1. Physicians: Includes all medical doctors working in the intermediate and final service departments, in addition to dentists. Pharmacists are not included in this category.
2. Nurses: Includes all nurses who graduated from either the high school of nursing or from the high institute of nursing.

3. Technicians/ skilled personnel: Includes personnel with a university degree or a some special skill at his/her field of work. It includes lab technicians, dietitians in the kitchen, pharmacists and drivers for vehicles or ambulances. The largest numbers of personnel included in this category work in the intermediate department, while a minimal number work in the final services department.
4. Administration: Includes personnel performing administrative work. Most personnel in this category are working in the overhead department while very few work in the final service department.
5. Unskilled personnel: Includes all personnel working as janitors and messengers.

The annual personnel cost or the "total pay" for each person working at the hospital, includes:

- Take-home pay.
- Benefits (including exceptional honoraria and family planning), health insurance contributions, labor day allowance, feast honoraria, pay for working overnight, accommodation and food for doctors and nurses.
- Deductions such as insurance, pension and income tax.

All staff have been assigned to the three main departments. The Full-Time Equivalent (FTE) was calculated dividing the physician's work by the ratio of his/her work in outpatient, inpatient, operations and emergency departments. The numbers shown in the personnel column are equal to the full time equivalent of personnel working at each cost center. Table 5 shows the breakdown cost centers and final services expenditures by percentage of each specialty's working hours amongst different departments. Graph 7 shows distribution of hospital staff for inpatient departments. Physicians accounted for the highest percentage (52.89percent) of annual personnel costs, followed by the annual costs for nurses (19.19 percent). See Graph 8 for the distribution of personnel costs for each staff category. The study used the step-down technique to allocate personnel of overhead and intermediate departments to final service departments according to criteria devised to closely resemble the actual use of personnel for each department. Table 6 shows the criteria for the distribution of overhead and intermediate department personnel to final service departments. Tables 7 and 8, display the proportion of overhead and intermediate department personnel used by the final service departments. The average number of hospital personnel per bed is 1.21. As the occupancy rate is 48 percent, this means an FTE staff of 2.52. The incubator department has the highest number with 8.05 FTE staff per occupied bed. See Table 9 and Graphs 1, 2 and 3 for the total number of personnel working at final services departments before and after using the step-down technique for hospital staff.

Data on personnel salaries were collected from Sheets no. 50 and 132 A.H. at the finance and personnel departments. Cost analysis shows that 51 percent of annual hospital expenditure was spent on personnel.

In addition, trying to allocate personnel not working in specific cost centers was somewhat ambiguous. For example, there are 25 personnel in inpatient departments as head nurses, but not affiliated with a specific department. The allocation of these personnel was computed according to the percentage of admissions for each inpatient department in which they work.

The allocation rules of such personnel are:

- In overhead departments: Because all non-allocated personnel in this department are non-skilled workers (working in cleaning services), they are allocated according to the space area in each cost center.
- In intermediate departments: The same rule as in overhead departments.
- In direct service departments: Allocation is assigned according to the percentage of days of stay for inpatient departments or outpatient visits for outpatient clinics.

## 2. Annual Utility Costs

This category includes electricity, water, telephone lines, vehicle gas, and kitchen oil. The annual costs of meals, patient and personnel apparel, stationery, building and equipment maintenance and travel per diem were also added to this category. Data on the cost of utilities were obtained from the financial department and the official records of invoices. Table 10 shows the total annual cost of utilities and their allocation to cost centers. Cost analysis shows that 13 percent of annual hospital expenditures was spent in annual utility costs (see Annex IV for data sources).

The following are the criteria for the allocation of each utility cost to cost centers:

- Personnel food costs: Allocated according to the number of meals for personnel in each department.
- Patient food costs: Allocated according to annual number of patient days in each department.
- Personnel apparel: Allocated to intermediate and final service departments according to the number of personnel in each of them. Personnel in overhead departments do not receive apparel.
- Stationary: Allocated to the overhead department according to the percentage of personnel at each cost center.
- Equipment maintenance: Allocated to each department according to the equipment cost at each cost center as a total cost of equipment at the hospital.
- Building maintenance: Allocated to different cost centers according to the space area as a percentage of the total space area of the hospital.
- Vehicles maintenance: Completely allocated to the vehicle and ambulatory departments.
- Travel per diem and mail: Allocated completely to the personnel department.
- Fuel and oil: Allocated completely to vehicles.
- Water: Allocated to all departments according to space area.
- Electricity: Allocated according to the electricity consumption measured by using an avometer. Locations of the highest consumption of electricity are the kitchens, laundry and operation theaters department. The electricity cost accounted for 43 percent of the total annual utility cost. See Graph 9 for the average distribution of the cost of utilities.
- Telephone: Allocated according to number of phone sets in each cost center.

### *3. Annual Cost of Drugs and Medical Supplies*

This category includes drugs and medical supplies provided by the hospital. It does not include prescribed drugs that patients purchase outside of the hospital. Table 11 shows the total annual cost of drugs and medical supplies in each department and outpatient clinic. The study used the price list of Drugs and Medical Supplies Department at the MOHP for purchasing drugs and medical supplies for its health facilities. Data related to drugs and medical supplies used by the final service departments were collected from the Pharmacy and Store Departments. Cost analysis shows that 16 percent of annual hospital expenditures were spent on drugs and medical supplies.

The renal dialysis department accounts for 31percent of the total expenditure on drugs and supplies. The second highest consumer is the emergency unit at 14 percent, followed by inpatient departments at 21percent (the general surgery and general medicine departments are at 10percent), outpatient clinics at 16percent ( of which the general surgery clinic is the highest consumer at 4percent). Operating theaters use 15 percent of the annual cost of drugs and medical supplies of the hospital.

### **III. Results**

#### **Description of Gamhuria General Hospital**

Gamhuria General Hospital (GGH) is a full service general hospital with 244 beds and 50 functional departments. Of these, 12 are overhead departments, 12 are intermediate service departments, and the remaining 26 are direct service departments. The hospital has a total area of approximately 6,037 square meters, with inpatient departments making up 40 percent of the total area. GGH has a total staff strength of 650 employees made up of 290 physicians, 155 nurses, and 205 other employees. Put another way, 89 employees are in the overhead departments, 158 are in intermediate service departments, and 403 are in final service departments. The emergency unit is the largest department in the hospital with 59 full-time equivalent employees. Operating theaters are the largest intermediate service department with 55 employees, and the general surgery department is the largest direct service department with 36 full-time equivalent employees. See Table 7 for the allocation of hospital personnel. There were a total of 8,611 admissions in 1993-94 with an average length of stay of 4.96 days. Total outpatient visits (including the emergency and renal dialysis units) was 294,817 visits.

#### **Results of Costing Study**

This section presents the main findings from the cost study. To recapitulate, the total annual cost is the sum of the annualized capital costs and recurrent costs. In turn, capital costs and recurrent costs are subdivided into five subcategories. The total annual cost for GGH in 1993-94 was L.E. 3,557,672.

#### ***Cost by Budget Category***

Graph 5 presents the breakdown of total costs by capital and recurrent costs.

- Annualized capital costs represented 20percent of total costs. Of these building costs accounted for 6percent and equipment and furniture 14percent. For the analysis, the cost of land is not taken into consideration.
- Recurrent costs represent 80percent of the total cost. Personnel accounted for 51percent of total cost, followed by drugs and medical supplies at 16percent and utilities at 13percent.
  - Physicians account for 45 percent of personnel costs, followed by nurses at 20 percent, and other personnel making up the remaining 35 percent.
  - A large portion of the cost of drugs and medical supplies - 30percent - is attributable to the renal dialysis department.
  - Only 0.28 percent of the total annual recurrent costs are spent on maintenance.

#### ***Cost by Department***

Hospital costs are initially broken down into three departments: overhead, intermediate service and final service. Graph 6 gives the breakdown of costs by these three departments.

- Eleven percent of total annual costs are attributable to overhead departments. From Table 16 it can be seen that of this, 27 percent are for capital costs, 60 percent for personnel, and 13 percent are for other recurrent costs.

- Twenty-six percent of total annual costs are attributable to intermediate service departments. Again, from Table 16 it can be seen that, of this, 32 percent are for capital costs, 40 percent are for personnel costs, and 28 percent are for other recurrent costs.
- Sixty-three percent of total costs are attributable to direct service departments. Of these, 14 percent are for capital costs, 54 percent for personnel, and 32 percent are for other recurrent costs.

### ***Step-down Allocation of Overhead and Intermediate Service Departments Costs***

Capital and recurrent costs are assigned to overhead, intermediate service and final service departments through direct distribution (as in the dental lab and emergency pharmacy) or step-down allocation.

Costs of the overhead departments are first allocated to intermediate service and final service departments. The total costs of the intermediate service departments after the allocation of ??? overhead costs are then allocated to the final service departments. Finally, final service department costs are allocated to inpatient departments, outpatient clinics, emergency and renal units. See Graph 10 for the distribution of annual hospital costs to the direct service departments after step-down allocation.

#### *a. Allocation of the Overhead Departments*

Table 17 shows the allocation criteria for the distribution of overhead and intermediate departments costs to the final departments. Fifty percent of cost centers within overhead departments are allocated according to their proportion of the total annual costs of the hospital. Table 18 shows the allocation of overhead departments and the total cost of intermediate service and final service departments after the allocation of overhead department costs. Approximately 24 percent of overhead department costs were distributed among intermediate service and 76 percent to final service departments. The emergency unit, operation theaters and gynecology and obstetric department received the largest share of overhead department allocations (2, 5 and 5 percent, respectively).

#### *b. Allocation of Intermediate Service Departments*

Intermediate departments costs were distributed among the final service departments according to the number of procedures or services used. The proportion of intermediate service department procedures and services used by the final service departments and the amount of the costs distributed are shown in Table 19. The general surgery department is the largest user (39 percent) of intermediate department services, followed by 17 percent for the gynecology and obstetric department. The emergency unit uses 5 percent of intermediate department services.

#### *c. Composition of Costs for Inpatient Departments*

Distribution of costs and percentages for inpatient departments by major categories are presented in Tables 22 and 23. Overhead departments represent 5 percent of the total final cost of inpatient departments, while intermediate services departments procedures and services represent 45 percent. Cost of FTE personnel within inpatient departments (hospital staff working only at inpatient departments) represent 24 percent of total annual costs of inpatient departments. See Graph 11 for the average distribution of costs by category in inpatient departments.

There are wide variations in the composition of costs by departments. Personnel costs are the highest cost for departments without surgical procedures, while operation theaters absorb a large percentage of the total cost of departments with surgical procedures. Graphs 12 and 13 present the average distribution of costs per admission in the general medicine and surgery departments.

ENT, general surgery, orthopedics and urology departments are the final departments where more than 50 percent of the total costs were allocated from the operating theaters in the intermediate services department. Inpatient departments represent 54.01 percent (1,921,663 L.E.) of the total annual hospital cost. See Table 10-1 for the total annual cost of inpatient departments.

#### *d. Allocation of Costs for Inpatient Departments*

Estimates were made of the number of admissions in inpatient departments from July 1993 to June 1994 (see Graph 14). The average cost per admission for inpatient care at Gamhuria General Hospital (ALOS 4.96 days) was L.E. 223 (see Graph 15 for the average cost per admission). There is a substantial variation in inpatient admission costs by department. Table 24 and Graph 16 show the distribution of costs per admission.

The highest cost per admission was in the incubator department (L.E. 854), which is the result of a relatively low turnover rate (25 patients per bed per year). The lowest cost per admission was in the gynecology and obstetrics department (L.E. 127), which is a result of a low average length of stay (2.28 days) and a high number of admissions and turnover rate (2,970 admissions and 71 patients respectively).

The average cost of an inpatient day is estimated to be L.E. 45. The annual cost per bed rose as high as L.E. 21,484 for the incubator unit with an annual average cost per bed of L.E. 7,876 in Gamhuria General Hospital. See cost analysis and efficiency indicators for inpatient departments for more details.

#### *e. Composition of Costs for Outpatient Clinics*

The distribution of costs and percentages by major categories of outpatient clinics are presented in Tables 25 and 26. Outpatient clinics, including the emergency and renal dialysis units, represent 46 percent of annual hospital costs. The cost of FTE personnel, hospital staff working only in outpatient clinics, (61 percent of total cost) and the cost of drugs (11 percent of total cost) are the largest cost items allocated to outpatient clinics. See Graph 17 for the average distribution of costs by category at outpatient clinics.

There are, however, wide variations in the composition of costs amongst different departments. About 77 percent of the cost for a family planning outpatient visit is absorbed by personnel costs. In the renal dialysis unit, drugs and medical supplies represented 56 percent of the visit cost, while personnel accounted for 12 percent. See Graph 18 for distribution of annual costs by category.

#### *f. Allocation of Costs for Outpatient Clinics*

Estimations were made according to the number of visits in outpatient clinics and emergency units from July 1, 1993 to June 30, 1994. There is substantial variation in outpatient visit costs. See Table 26 and Graph 19 for the distribution of costs per outpatient visit.

The physiotherapy outpatient clinic has the highest cost per outpatient visit at L.E. 40. Personnel represent more than 50 percent of the total visit cost. Table 27 presents the distribution of costs per outpatient visit by cost categories. The high cost is due to a low to a utilization rate (less than 692 visits per year). The second highest cost per visit is for the family planning clinic (L.E.16), which results from high personnel costs (77percent of the total visit). The lowest cost per visit is in the general medicine clinic where drugs represent 14 percent of the total visit cost, followed by 58 percent for personnel. The average cost per outpatient visit at Gamhuria General Hospital is L.E. 5.21. The average cost of drugs per visit is L.E. 0.58.

The average cost per visit for renal dialysis patients is L.E. 103. Of this, drugs and medical supplies cost L.E. 61. For the emergency unit, the average cost per visit is L.E. 5.82 which includes L.E. 1.09 for drugs and medical supplies. (see table 28 for the average cost per visit for outpatient clinics, emergency units, and the dental clinic.)

### ***Step-Down Allocation of Hospital Staff To Final Service Departments***

The total hospital staff of the Gamhuria General Hospital is comprised of five categories of personnel: physician, nurse, technician, administrative and unskilled. Each category is assigned to overhead, intermediate service and final service departments through direct distribution. They are then converted to FTEs.

Personnel of the overhead departments were first allocated to intermediate service and final service departments. The total personnel of the intermediate service departments, after allocation of overhead departments, is then allocated to the final service departments. Finally, personnel of the final service departments are allocated to the inpatient department, outpatient clinics, emergency and renal units. See Graphs 2 and 3 for the distribution of hospital staff to direct service departments after the step-down allocation.

#### *a. Allocation of Overhead Departments Personnel*

Table 7 gives the criteria used to allocate personnel within overhead departments to intermediate and final service departments. Eighty percent of hospital staff within overhead departments are allocated according to the proportion to total annual admission for each department (one admission is equal to three outpatient visits). Table 7 illustrates the allocation statistics of overhead departments and personnel of intermediate and final service departments after the allocation of overhead department personnel. Only 2.37 percent of overhead department personnel were distributed amongst intermediate service departments and 97.62 percent of final service departments. The emergency unit received the largest share of overhead department allocations (25.34 percent).

#### *b. Allocation of Intermediate Service Departments Personnel to Final Service Departments:*

Personnel within intermediate service departments were distributed among the final service departments according to the number of procedures or services used. Table 7 shows the allocation criteria for distributing intermediate service department personnel). The distribution of costs from intermediate service departments to final service departments for procedures and services are shown in Table 8.

### ***Cost Analysis and Efficiency Indicators***

#### *Cost Analysis*

For the year 1993-1994 the total annual cost for the Gamhuria General Hospital was L.E. 3.5 million. Personnel costs amounted to 51 percent of the total annual cost, followed by 13 percent for drugs and medical supplies (these figures represent averages for the hospital). Inpatient departments varied from 3 to 52 percent for FTE personnel, and from 0.7 to 12 percent for drugs and medical supplies, depending on the total number of annual admissions (see Graph 14). Table 24 presents the distribution of costs per admission by cost categories.

The study included the actual cost of renal dialysis patients as an example of an intervention financially supported by the MOHP in spite of its high cost. The average cost per visit for renal dialysis is L.E. 103. Since renal failure patients require 2 visits weekly (104 visits yearly), this adds up to an annual cost of L.E. 10,721 per patient. The cost of drugs and medical supplies constitutes 56 percent of the total cost which is a higher drug and medical supply cost compared with other MOHP general hospitals.

The average cost per admission is L.E. 223. The highest cost per admission is L.E. 853 for the incubator department, while the cost is L.E.127 for the gynecology and obstetric department, depending on the number of admissions in the departments (see Table 29). It was observed that some departments were very well-staffed with an average of three physicians per bed.

The average cost per day is L.E. 45, which varies depending on the occupancy and turnover rates. It was found that this daily cost could vary from L.E. 34 (orthopedics department) to L.E. 139 (incubator unit) due to the large difference in the annual admissions and occupancy rates in these departments.

The average annual bed cost is L.E. 7,876 and varies between L.E. 6,000 in the pediatric department to L.E. 21,000 in the incubator department. The least cost was in the general medicine department where the cost was L.E. 3,084, per bed (see Graph 22 for the total annual cost per bed).

The total cost of maintenance in this hospital is about L.E. 8,059, which represents 0.28 percent of the annual recurrent cost. The international average percentage of maintenance costs ranges between 10 to 15 percent of the recurrent cost.

In general, drugs and medical supplies absorb 2 to 32percent of total costs of outpatients visits, versus 0.7 to 12 percent of total costs per admission. These variations are due to the absence of ambulances, operating rooms, food costs and the relatively fewer diagnostic procedures in outpatient clinics. Salaries and drugs together take up a higher share of outpatient clinics than inpatient expenditures.

Outpatient visits in the Gamhuria Hospital cost an average of L.E. 5.21. The cost of drugs reaches 11percent of the total amount, while personnel consume more than 61percent of costs. The cost of outpatient visits depends on the number of visits to each clinic. The cost varies from L.E. 3 per visit in the general medicine clinic, which sees 145 patients daily, to L.E. 40 per visit in the physiotherapy clinic which sees 3 patients daily. See Table 27 for the distribution of costs per outpatient visit and Graph 20 for the cost of an outpatient visit.

The cost per visit for the emergency unit L.E. 5.82. Drugs and medical supplies represent 18 percent of total costs, which is more than the cost of drugs and medical supplies for the outpatient clinics.

### ***Efficiency Indicators in Inpatient Departments***

The study prepared some efficiency indicators in the general hospitals that will help decision makers to evaluate the level of performance in both the inpatient and outpatient departments.

#### ***Occupancy Rate***

The average occupancy rate in 1993-94 was 48 percent. This rate varies from 94percent in the orthopedics department to 29 percent in the ENT department. Graph 21 shows the occupancy rate versus the turnover rate. The occupancy rate in Suez General Hospital is 46 percent and 55 percent in Gamhuria General Hospital.

#### ***Turnover Rate***

Both gynecology and obstetrics and the ICU have the highest turnover rate per bed per year (71 and 49 patients, respectively). This rate decreases for the urology department with 18 patients and reaches the minimum of 15 patients in the general medicine department. This translates into an average length of stay of 7 to 11 days, respectively, for these departments. The average

turnover rates in Gamhuria, Suez and Bani Suef General Hospitals is 35, 18 and 42 patients per bed per year, respectively.

#### *Number of Inpatient Days per FTE Physician*

The average number of inpatient days per full-time equivalent physician was 463 patient days. Based on 270 working days per year, each physician treats 2 patients during his/her 6-hour working day. This number decreases to 61 treatment days per year for a physician in the incubator department, meaning he/she is responsible for 5 patient per month.

#### *Number of Physicians per Bed*

The average number of FTE physicians per bed is 0.38. If we base our computations on an occupancy rate of 48percent, there are 0.79 physicians for each occupied bed. The incubator department has the highest number of physicians or 6.03 per occupied bed.

#### *Hospital Staff*

Using the step-down technique for the allocation of overhead and intermediate service departments, the study obtained an estimate of the total hospital staff working for final service departments. The general medicine, general surgery and obstetrics and gynecology departments have the largest number of hospital FTE staff (36, 88 and 62 FTE personnel respectively). The emergency unit absorbs 14 percent of hospital FTE staff or 92 personnel.

#### *Number of FTE staff per Bed*

The study used the step-down technique to allocate personnel in the overhead and intermediate departments to the final service departments. The average number of hospital personnel per bed is 1.21 or 2.52 FTE staff per occupied bed. The incubator department has the highest figure at 8.05 FTE staff per occupied bed. The department with the lowest FTE staff per occupied bed is general medicine (1.17).

#### *Number of Nurses per Physician*

The average number of nurses per physician is 0.93. This number varies from 1.68 nurses in the general medicine department to 0.27 nurses in the ENT department. In Suez General Hospital the average number of nurses per FTE physician is 1.72; in Bani Suef General Hospital the average number of nurses per FTE physician is 4.07.

#### *Number of Annual Admissions per FTE Physician*

The average annual admissions per FTE physician is 93, or 8 admissions per month. This figure drops to 13 admissions per year (one case a month) in the incubator department (see Figure 26 for the annual number of admissions per FTE physician).

#### *Average Length of Stay By Diagnosis*

The study measured average length of stay by diagnosis for 74 diagnoses at Gamhuria General Hospital from July 1993 to June 1994. The data was collected from the admissions and discharge sheets of the hospital to assure the accuracy of results. Unfortunately, the diagnoses do not follow the international classification of diseases. Deliveries make up the highest number of admissions (17.45 percent of total hospital annual admissions, ALOS 1.9 days), and appendectomies are the second highest cause of admissions (10.13 percent of total hospital annual admissions, ALOS 2.4 days). In general, the average length of stay appear appropriate for the most common diagnoses. Patients in the ophthalmology department stay an average of 11 days while they stay only 3 days in the ENT department. One third to one half of the diagnoses appear to require longer lengths of stay than commonly occurs in U.S. hospitals. (See

Tables 12, 13, 14, and 15. for a list of average lengths of stay for the Gamhuria General Hospital.) However, without further information about the severity of cases, it is not possible to assume that the patients are hospitalized appropriately. One third to one half of the diagnoses appear to require longer lengths of stay compared to similar diagnoses in U.S. hospitals.

Graph 21 summarizes some of the efficiency indicators of the Gamhuria General Hospital. The x-axis represents the occupancy rate while the y-axis represents the annual turnover rate. The graph is divided into four regions by two intersecting lines, the vertical line representing the average bed occupancy rate and the horizontal line representing the average turnover rate. The graph is more useful for descriptive than policy purposes (as it deals only with indicators), since it does not answer the question of whether a given department is performing efficiently. Other efficiency indicators (unit cost, number of FTE personnel) are required for policy purposes. See Appendix I for a glossary.

Departments in Region I account for 8 percent of the total annual cost of inpatient departments and 7percent of total annual admissions. Departments in this region (intensive care units) may be characterized by:

- Small proportion of unused beds.
- High bed turnover rate.

Departments in Region II account for 5percent of the total annual cost of inpatient departments and 2 percent of total annual admissions. Departments in this region (ophthalmology and orthopedics) may be characterized by:

- Small proportion of unused beds.
- Low bed turnover rate.
- Long lengths of stay.

Departments in Region III account for 46percent of the total annual cost of inpatient departments and 40percent of total annual admissions. Departments in this region (pediatrics, gynecology and obstetrics and ENT) may be characterized by:

- Excess bed availability.
- High bed turnover rate.

Departments in Region IV account for 41percent of the total annual cost of inpatient departments and 51percent of total annual admissions. Departments in this region (urology, general surgery, incubator and general medicine) may be characterized by:

- Excess bed availability.
- Low bed turnover rate.

### ***Efficiency Indicators In Outpatient Clinics***

Using the step-down technique, the study was able to obtain some indicators of the efficiency level in the outpatient departments.

The average number of visits per physician in outpatient clinics is less than 5 visits a day, ranging from 2 visits in family planning to 11 in orthopedics. Graph 27 show the annual outpatient visits for each clinic. The highest number of visits was in the general medicine clinics with an average of 145 daily visits (see Graph 28 for annual outpatient visits per physician). The larger figure may be attributed to the fact that large percent of the cost of outpatient visits goes to drugs. (See Graph 29 for the distribution of costs per outpatient visit).

The number of staff in each clinic (physicians, nurses, administration and support services, which includes personnel at overhead and intermediate departments) can be as high as 28, as in the pediatric clinic with 23.4 physicians and 4.6 support services personnel. The total number of personnel working for outpatient clinics (including overhead and intermediate personnel) is 207, with an average of 0.0012 personnel per outpatient visit per staff. For the emergency unit this figure is 92 personnel with an average of 0.0009 personnel per emergency unit visits.

## Department Specific Results

### A. Ear, Nose and Throat Department

#### ***Cost Analysis***

- Annual cost of the department; L.E. 111,476 (5.80percent of total annual expenditures of inpatient departments)
- Cost per inpatient admission: L.E. 296
- Cost per day: L.E. 104
- Annual cost per bed: L.E. 11,148

#### ***Efficiency Indicators***

- Annual admissions: 376 (4.37percent of total annual admissions)
- Number of beds: 10 (4.10percent of total hospital beds)
- Annual patient-days of stay: 1,072 (2.51percent of annual patient-days)
- Occupancy rate: 29.37
- Bed turnover rate: 38
- Average length of stay: 2.85

#### ***Department Staff***

- Number of full time equivalent physicians: 8.4
- Annual admissions per FTE physician: 45
- Annual patient-days per FTE physician: 128
- Number of FTE physicians per bed: 0.84
- Number of nurses per FTE physician: 0.27
- Staff in the department (including overhead and intermediate departments personnel):
  - Number of FTE staff: 14.19
  - Number of FTE staff per bed: 1.42
  - Number of FTE staff per bed (according to occupancy rate): 4.83
- Staff in the inpatient department (only personnel working for the inpatient departments, not including overhead and intermediate department personnel):

- Number of FTE staff: 9.49
- Number of FTE staff per bed: 0.95

The cost per day is considered the second highest in the hospital at L.E.104 after the incubator department at L.E. 136. The high cost per day is a result of the low admissions at 376 patients per year and the low average length of stay of 2.85 days.

The operating rooms absorb 66.48 percent of the total admission cost per patient, which is almost equal to L.E.197.11. This is considered to be the highest cost for operating rooms. The cost of operating rooms is high because most ENT patients need surgical procedures (tonsillectomies present the fifth cause of admission with low ALOS (1.51). See Table 13. Personnel costs account for 5.3 percent of the total, representing the second lowest cost after the ophthalmology department at 3.04 percent. Drugs and medical supplies constitute 0.89 percent (L.E. 2.63) of admission costs, representing the second lowest drug cost percentage after the incubator department at 0.70 percent.

The numbers of annual patient days and the rate of admissions per physician are among the lowest in the hospital, at 128 and 45 respectively, due to low annual admissions of 376 patients.

The numbers of nurses per FTE physician is 0.27, which is the lowest figure in the hospital. Step-down allocation of hospital staff shows that the total number of FTE staff is 4.83 per occupied bed, which is the second highest number for inpatient departments after the incubator department at 8.05. The number of FTE physicians is 2.86 per occupied bed, one of the highest in the hospital.

## **B. General Medicine Department**

### ***Cost Analysis***

- Annual cost of the department: L.E. 209,722 (10.91percent of total annual expenditure of inpatient departments).
- Cost per inpatient admission: L.E. 205
- Cost per day: L.E. 19
- Annual cost per bed: L.E. 3084

### ***Efficiency Indicators***

- Annual admissions: 1,024 (11.89 percent of total annual admissions)
- Number of beds: 68 (27.87percent of total hospital beds)
- Annual patient-days of stay: 11,323 (26.53percent of total annual patient-days)
- Occupancy rate: 45.62
- Bed turnover rate: 15
- Average length of stay: 11.06

### **Department Staff**

- Number of full-time equivalent physicians: 4.4
- Annual admissions per FTE physician: 233
- Annual patient-days per FTE physician: 2,573
- Number of FTE physicians per bed: 0.06
- Number of nurses per FTE physician: 1.68
- Staff at the department (including overhead and intermediate department personnel):
  - Number of FTE staff: 36.37
  - Number of FTE staff per bed: 0.53
  - Number of FTE staff per bed (according to occupancy rate): 1.17
- Staff within the inpatient department (only personnel working for inpatient departments, not including overhead and intermediate departments personnel):
  - Number of FTE staff: 21.37
  - Number of FTE staff per bed: 0.31

This department 64 beds or 28 percent of the total beds, the largest number in the hospital. Patients stay for a very long time with an average length of stay at 11.06 days. This is considered the second longest average length of stay after the orthopedics department at 12.33 days. This long ALOS resulted in the following:

- Lowest number of physicians per occupied bed (0.14).
- Lowest cost per day (L.E.19)
- Longest duration of stay per year at 11,323 days, representing the second highest length of stay after general surgery (11,896).
- Highest number of patient-days of 2,573 per FTE physician.
- Lowest FTE staff per occupied bed (0.31).
- Lowest bed turnover rate (15 patients per year).

Drugs and medical supplies accounted for 12.28 percent at L.E. 25.15 of the total cost of admissions. This is the highest percentage among all inpatient departments.

See graph 12 for the average distribution of costs per admission for general medicine departments, and Table 24 for the distribution of costs per admission at GGH.

The department has the highest number of admissions, 233 per FTE physician, because of the low number of FTE physicians working at the department (4.40). Note that the occupancy rate is still relatively low, at 45.62 percent, resulting from the large number of beds (68) in spite of the long lengths of stay for per year.

## **C. General Surgery Department**

### ***Cost Analysis***

- Annual cost of the department: L.E. 625,849 (32.57 percent of total expenditures of inpatient departments).
- Cost per inpatient admission: L.E. 300
- Cost per day: L.E. 53
- Annual cost per bed: L.E. 9,779

### ***Efficiency Indicators***

- Annual admissions: 2,087 (24.24 percent of total annual admissions)
- Number of beds: 64 (26.23 percent of total hospital beds)
- Annual patient-days of stay: 11,896 (27.88 percent of total annual patient-days)
- Occupancy rate: 50.92
- Bed turnover rate: 33
- Average length of stay: 5.70

### ***Department Staff***

- Number of full-time equivalent physicians: 13.5
- Annual admissions per FTE physician: 155
- Annual patient-days per FTE physician: 811
- Number of FTE physicians per bed: 0.21
- Number of nurses per FTE physician: 0.85
- Staff of the department (including overhead and intermediate departments personnel):
  - Number of FTE staff: 87.82
  - Number of FTE staff per bed: 1.37
  - Number of FTE staff per bed (according to occupancy rate): 2.69
- Staff of the inpatient department (only personnel working for inpatient departments, not including overhead and intermediate departments personnel):
  - Number of FTE staff: 38.56
  - Number of FTE staff per bed: 0.69

This department has the highest annual expenditure in the hospital at L.E. 625,849 representing 32.57percent of the total annual expenditures for inpatient departments of the hospital. The higher annual costs are due to the following:

- High cost of operating rooms, absorbing 54.27 percent of the cost.
- The department is over-staffed. Using the step-down technique for allocation of hospital personnel, the number of personnel serving this department, including overhead and intermediate departments, is equal to about 87.82 FTE personnel. This is the highest number of FTE personnel for an inpatient department. Graph 2 shows the distribution of hospital personnel to final service departments.
- High annual patient-days of stay. The department is considered to be having the highest annual patient-days of stay at 27.88percent of total annual days of stay.

The cost per admission is L.E. 300 (see Graph 15 for the cost per admission). Of this, the intermediate departments absorb 62.17 percent (L.E. 188.13) and drugs and medical supplies absorb 4.92 percent (L.E. 14.74) of the total cost per admission. See Graph 13 for the average distribution of costs per admission for the general surgery department.

## **D. Gynecology and Obstetrics Department**

### ***Cost Analysis***

- Annual cost of the department: L.E. 376,135 (19.57 percent of total annual expenditures of inpatient departments)
- Cost per inpatient admission: L.E.127
- Cost per day: L.E. 67
- Annual cost per bed: L.E. 8,956

### ***Efficiency Indicators***

- Annual admissions: 2,970 (34.49 percent of total annual admissions)
- Number of beds: 42 (17.21 percent of total hospital beds)
- Annual patient-days of stay: 6,768 (15.86 percent of total annual patient-days)
- Occupancy rate: 44.15
- Bed turnover rate: 71
- Average length of stay: 2.28

### ***Department Staff***

- Number of full time equivalent physicians: 17.50
- Annual admissions per FTE physician: 170

- Annual patient-days per FTE physician: 387
- Number of FTE physicians per bed: 0.42
- Number of nurses per FTE physician: 1.06
- Staff at the department (including overhead and intermediate departments personnel):
  - Number of FTE staff: 62.14
  - Number of FTE staff per bed: 1.48
  - Number of FTE staff per bed (according to occupancy rate): 3.35
- Staff within the inpatient department (only personnel working for the inpatient department, not including overhead and intermediate department personnel):
  - Number of FTE staff: 43.12
  - Number of FTE staff per bed: 1.03

This department has the second highest annual total cost, L.E. 367,135, constituting 19.57 percent of the total annual expenditures for inpatient departments. The high annual admissions rate of 2,070 patients, which is the highest annual admission, leads to the low cost per admission at L.E.127. This high cost per day is a result of the low average length of stay at 2.28 days, resulting from the relatively low total annual days of stay.

The high annual total cost in the department is a result of:

- The high number of personnel working for one inpatient department at 43.12 FTE.
- Large number of hospital staff. Using the step-down technique for allocation of hospital personnel, the number of personnel serving this department (including overhead and intermediate departments) is equal to about 62.12 FTE personnel, the second highest number of FTE personnel for an inpatient department after general surgery. See Graph 2 for the distribution of hospital personnel to final service departments.
- Operation theaters absorb 27.91 percent of the cost.
- At 42 beds, the number of beds represents 17.21 percent of total hospital beds.

The department has the highest number of FTE physicians at 17.5. This large number leads to low numbers of annual patient days and admissions per physician at 387 and 170 respectively.

Intermediate departments, including the operating theaters, account for 44.63 percent of the total cost per admission, while overhead departments account for 5.63 percent. The five main broad categories of equipment, building, personnel, utilities and drugs of the Gyn/Obs department represent 49.74 percent of the total cost per admission. See Table 24 for the distribution of costs per admission.

## **E. Intensive Care Unit**

### ***Cost Analysis***

- Annual cost of the department: L.E. 154,405 (8.03 percent of total expenditures for inpatient departments)
- Cost per inpatient admission: L.E. 244
- Cost per day: L.E. 41
- Annual cost per bed: L.E. 11,877

### ***Efficiency Indicators***

- Annual admissions: 632 (7.34 percent of total annual admissions)
- Number of beds: 13 (5.33 percent of total hospital beds)
- Annual patient-days of stay: 3,811 (8.93 percent of total annual patient-days)
- Occupancy rate: 80.32
- Bed turnover rate: 49
- Average length of stay: 6.03

### ***Department Staff***

- Number of full time equivalent physicians: 7.50
- Annual admissions per FTE physician: 84
- Annual patient-days per FTE physician: 508
- Number of FTE physicians per bed: 0.58
- Number of nurses per FTE physician: 1.24
- Staff at the department (including overhead and intermediate departments personnel):
  - Number of FTE staff: 18.42
  - Number of FTE staff per bed: 1.42
  - Number of FTE staff per bed (according to occupancy rate): 1.76
- Staff of the inpatient department (only personnel working for the inpatient department, not including overhead and intermediate departments personnel):
  - Number of FTE staff: 15.33
  - Number of FTE staff per bed: 1.18

In spite of low annual admissions, the occupancy rate is still one of the highest at 80.32, which is a result of the limited number of beds(13) in the department and a relatively high turnover rate.

The admission cost for the ICU department is L.E. 244. Annual depreciation costs of equipment and furniture constitute 34.59 percent of the admission cost, followed by the personnel at 17.29 percent and utilities at 17.29 percent. Drugs and medical supplies absorb the least amount or 2.41 percent of the cost of admission. This is one of the departments where the cost for drugs and medical supplies is less than the cost for utilities. ICU cases usually require many drugs and supplies, but the cost for drugs used is L.E. 1.08 per day. This low cost suggests that ICU patients must purchase additional drugs.

## **F. Incubator Department**

### ***Cost Analysis***

- Annual cost of the department: L.E. 107,415 (5.59 percent of total annual expenditure for inpatient departments)
- Cost per inpatient admission: L.E. 853
- Cost per day: L.E. 136
- Annual cost per bed: L.E. 21,484

### ***Efficiency Indicators***

- Annual admissions: 126 (1.46percent of total annual admissions)
- Number of beds: 5 (2.05percent of total hospital beds)
- Annual patient-days of stay: 787 (1.84percent of total annual patient-days)
- Occupancy rate: 43.12
- Bed turnover rate: 25
- Average length of stay: 6.25

### ***Department Staff***

- Number of full time equivalent physicians: 13.00
- Annual admissions per FTE physician: 10
- Annual patient-days per FTE physician: 61
- Number of FTE physicians per bed: 2.6
- Number of nurses per FTE physician: 1.03
- Staff at the department (including overhead and intermediate departments personnel):
  - Number of FTE staff: 17.35

- Number of FTE staff per bed: 3.47
- Number of FTE staff per bed (according to occupancy rate): 8.05
- Staff of the inpatient department (only personnel working for inpatient department, not including overhead and intermediate departments personnel):
  - Number of FTE staff: 16.37
  - Number of FTE staff per bed: 3.27

The incubator department is considered as one of the least efficient departments at the hospital for the following reasons:

- One of the highest numbers of FTE physicians (13) working in one department.
- Lowest rate of admissions per physician (10).
- Lowest number of patient-days per physician (61), because of low admission rates and relatively average lengths of stay.
- Second highest number of FTE physicians per bed (2.60). The ophthalmology department has 2.67.
- Highest number of FTE physicians per occupied bed (6.0, a result of the low occupancy rate).
- Highest number of FTE staff per occupied bed (7.59), a result of low occupancy rates.
- Annual cost per bed at L.E. 21,484 is the highest in the hospital. This is because the department has only 5 beds, the least in the hospital, or 2.05 percent of total hospital beds.
- Highest average cost per admission (L.E. 853), which is a result of low annual admissions, 126 patients, or only 1.46 percent of total annual admissions.
- Highest cost per day reaching L.E. 136.
- Drugs and medical supplies account for 0.70 percent of admission costs (L.E. 0.32 per day), representing the lowest drug costs per admission of all inpatient departments. This suggests either the additional purchase of drugs by patients' families or low quality of care.
- Personnel absorb 52.01 percent of the cost of admission, which is equal to 73 times the cost of drugs.

Overhead support departments absorb 8.27 percent of total annual costs of the incubator department and 2.95 percent of intermediate service departments. The five cost categories -- department equipment, building, personnel, utilities and drugs -- represent 88.78 percent of the total annual costs of the department. Tables 22 and 23 presents the distribution of annual costs.

## **G. Psychiatry Department**

### ***Cost Analysis***

- Annual cost of the department: L.E. 55,554. (2.89 percent of total annual expenditures for inpatient departments)
- Cost per inpatient admission: L.E. 661
- Cost per day: L.E. 61
- Annual cost per bed: L.E. 18,518

### ***Efficiency Indicators***

- Annual admissions: 84 (0.98 percent of total annual admissions)
- Number of beds: 3 (1.23 percent of total hospital beds)
- Annual patient-days of stay: 918 (2.15 percent of total annual patient-days)
- Occupancy rate: 83.84
- Bed turnover rate: 28
- Average length of stay: 10.93

### ***Department Staff***

- Number of full-time equivalent physicians: 8.00
- Annual admissions per FTE physician: 11
- Annual patient-days per FTE physician: 115
- Number of FTE physicians per bed: 2.67
- Number of nurses per FTE physician: 0.53
- Staff at the department (including overhead and intermediate department personnel):
  - Number of FTE staff: 9.71
  - Number of FTE staff per bed: 3.24
  - Number of FTE staff per bed (according to occupancy rate): 3.86
- Staff within the inpatient department (only personnel working for inpatient department, not including overhead and intermediate department personnel):
  - Number of FTE staff: 9.24
  - Number of FTE staff per bed: 3.08

The department has the lowest rate of admissions, 84 patients, and 0.83 percent of total annual admissions. This low figure increases the total cost per admission or L.E. 661 in spite of the high cost per day at L.E. 61, resulting from the high ALOS at 10.93 days. Again, the number of admissions per FTE physician is very low at 11 admissions per year, or less than one patient per month.

This department represents the second lowest total annual cost of L.E. 55,554 per year or 2.89 percent of total annual expenditures for inpatient departments. The orthopedics department is the lowest costing L.E. 47,157 per year or 2.45 percent of total annual expenditures for inpatient departments.

The annual cost per bed in the ophthalmology department is one of the highest of the inpatient departments at L.E. 18,518, resulting from the limited number of beds (3 beds) in the department.

There are 8 or 2.67 FTE physicians per bed, the highest in the hospital, and only 3 beds. In spite of the high occupancy rate, the number of FTE physicians per occupied bed is at 3.18, which is the second highest rate after the incubator department at 6.03. The number of FTE staff in the department is the highest at 3.08.

Operation theaters absorb 44.47percent of admission cost, followed by the personnel at 27.44percent, while the drugs and medical supplies represent only 2.14percent.

Overhead support departments account for 5.36percent of the total annual cost of the ophthalmology department. The intermediate service departments account for 53.57. The main five board categories of equipment, building, personnel, utilities and drugs of the ophthalmology department represent 41.08percent of the total cost per admission, see table 24 for distribution cost per admission.

## **H. Orthopedics Department**

### ***Cost Analysis***

- Annual cost of the department: L.E. 47,157 (2.45 percent of the total annual expenditure for inpatient departments).
- Cost per inpatient admission: L.E. 425
- Cost per day: L.E. 34
- Annual cost per bed: L.E. 11,789

### ***Efficiency Indicators***

- Annual admissions: 111 (1.29 percent of total annual admissions)
- Number of beds: 4 (1.64 of total hospital beds)
- Annual patient-days of stay: 1,369 (3.21 percent of total annual patient-days)
- Occupancy rate: 93.77
- Bed turnover rate: 28
- Average length of stay: 12.33

### ***Department Staff***

- Number of full-time equivalent physicians: 1.00
- Annual admissions per FTE physician: 111
- Annual patient-days per FTE physician: 1,369
- Number of FTE physicians per bed: 0.25
- Number of nurses per FTE physician: 0.57
- Staff at the department (including overhead and intermediate departments personnel):
  - Number of FTE staff: 5.22
  - Number of FTE staff per bed: 1.3
  - Number of FTE staff per bed (according to occupancy rate): 1.39
- Staff within the inpatient department (only personnel working for the inpatient department, no including overhead and intermediate department personnel):
  - Number of FTE staff: 1.32
  - Number of FTE staff per bed: 0.33

Fifty-two percent of admission costs are absorbed by the operating theater, followed by personnel working in the inpatient department, and the accounting office at 3.04 percent, which is the lowest percentage of personnel costs in the inpatient departments. Drugs and medical supplies account for only 1.99 percent of admission costs.

The department has the lowest annual expenditure or L.E. 47,157. This represents 2.45 percent of the total annual expenditures for inpatient departments. The admission cost is as high as L.E. 425 because of the low admission rate at 111 patients per year. The cost per day is the lowest at L.E. 34 resulting from long average lengths of stay. Patients in orthopedics stay an average of 12.33 day, which is the longest ALOS in the hospital.

The department has the highest occupancy rate of 93.77, which is a result of the limited number of beds (4) beds, the low number of FTE physicians (1), and only 1.32 staff.

Intermediate departments account for 64.41percent of the total cost per admission, while overhead departments account for 5.89 percent. The five broad categories -- equipment, building, personnel, utilities, and drugs -- of the orthopedics department represent 29.7percent of the total cost per admission. See Table 24 for the distribution of costs per admission.

## **I. Pediatrics Department**

### ***Cost Analysis***

- Annual cost of the department: L.E. 139,764 (7.27 percent of total annual expenditure for inpatient departments).
- cost per inpatient admission: L.E. 147
- Cost per day: L.E. 48
- Annual cost per bed: L.E. 6,655

### ***Efficiency Indicators***

- Annual admissions: 952 (11.06 percent of total annual admissions)
- Number of beds: 21 (8.61percent of total hospital beds)
- Annual patient-days of stay: 2,920 (6.84 percent of total annual patient-days)
- Occupancy rate: 38.10
- Bed turnover rate: 45
- Average length of stay: 3.07

### ***Department Staff***

- Number of full-time equivalent physicians: 10.40
- Annual admissions per FTE physician: 92
- Annual patient-days per FTE physician: 281
- Number of FTE physicians per bed: 0.50
- Number of nurses per FTE physician: 1.27
- Staff at the department (including overhead and intermediate departments personnel):
  - Number of FTE staff: 29.62
  - Number of FTE staff per bed: 1.41
  - Number of FTE staff per bed (according to occupancy rate): 3.70
- Staff within the inpatient department (not including overhead and intermediate departments personnel):
  - Number of FTE staff: 25.16
  - Number of FTE staff per bed: 1.2

The turnover rate of 45 patients and an occupancy rate of 39 per year are considered to be relatively low rates. The cost per day is L.E. 147., which is the second lowest after the gynecology and obstetrics department (L.E. 127). This low day cost is a result of the low total annual expenditures of the department at L.E. 139,764.

Drugs and medical supplies represent 8.14 percent of the admission cost, which is equal to L.E. 11.95, while personnel costs absorb 48.24 percent. The cost of personnel is so high because of the large number of FTE personnel working at the department (25.16). Physicians represent 41.33 percent of the working staff. The number of FTE physicians per occupied bed is 1.3.

Intermediate departments account for 7.7 percent of the total cost per admission, while overhead departments account for 8.41 percent. The main five broad categories -- equipment, building, personnel, utilities, and drugs -- of the department represent 83.89 percent of the total cost per admission. See Table 23 for the distribution of costs per admission.

## **J. Urology Department**

### ***Cost Analysis***

- Annual cost of the department: L.E. 94,183 (4.90 percent of total annual expenditure for inpatient departments)
- Cost per inpatient admission: L.E. 378
- Cost per day: L.E. 52

- Annual cost per bed: L.E. 6,727

### ***Efficiency Indicators***

- Annual admissions: 249 (2.89 percent of total annual admissions).
- Number of beds: 14 (5.74 of total hospital beds)
- Annual patient-days of stay: 1,809 (4.24 percent of total annual patient-days)
- Occupancy rate: 35.40
- Bed turnover rate: 18
- Average length of stay: 7.27

### ***Department Staff***

- Number of full-time equivalent physicians: 8.4
- Annual admissions per FTE physician: 30
- Annual patient-days per FTE physician: 215
- Number of FTE physicians per bed: 0.60
- Number of nurses per FTE physician: 0.59
- Staff at the department (including overhead and intermediate department personnel):
  - Number of FTE staff: 13.56
  - Number of FTE staff per bed: 0.97
  - Number of FTE staff per bed (according to occupancy rate): 2.74
- Staff within the inpatient department (not including overhead and intermediate department personnel):
  - Number of FTE staff: 9.12
  - Number of FTE staff per bed: 0.65

The average cost per admission is relatively high at 378 L.E. because of the low occupancy and turnover rates at 35.4 and 18 respectively. The operating rooms constitute 52.46 percent of the total as most admissions need surgical treatment. Personnel costs account for 48.24 percent of admission costs followed by drugs and medical supplies for only 3.4 percent of the total.

The average length of stay is long at 7.27 days. This places the department in region IV in Graph 21 where excess beds are available with low bed turnover rates.

Intermediate departments account for 59.09 percent of the total cost per admission (operating rooms absorb 52.46 percent), while overhead departments account for 3.65 percent. The five

main categories--equipment, building, personnel, utilities and drugs -- of the urology department represent 37.26 percent of the total cost per admission. See Table 24 for the distribution of costs per admission.

## IV. Conclusion

Average costs are customarily used to provide data needed to rate hospital performance. Knowing the average cost only, however, is not sufficient to reach decisive conclusions regarding the sources of hospital efficiency. Ideally, a comparative study of the cost per unit of output for several hospitals would provide useful data on the hospitals that have provided optimal services with the greatest efficiency. Understandably, several minimum conditions, including quality of services provided and the clinical composition of the patients for each hospital, would have to be known to give credibility to such results.

Without an understanding of the differences in quality and the case mix across the different departments of Gamhuria General Hospital, the efficiency implication of variation in average costs cannot be properly interpreted. High average costs may reflect high quality -- expensive equipment and adequate provision of drugs, as in the renal dialysis unit. Low average costs may be a result of inadequate provision of drugs and thus would represent poor quality -- as is the case in the incubator department where drugs and medical supplies account for only 1 percent of the total cost of admission. If information on the quality of services and the case mix of patients is added to cost data, the efficiency implications of average cost information become comprehensible.

The average length of stay (ALOS) is an important indicator of the efficiency of hospital resource utilization. Differences in the average length of stay among comparable types of departments imply differences in prevailing treatment practices across the hospital. However, without information about case mix and severity, it is difficult to use length of stay as a direct indicator of efficiency. However, stays that are unusually long raise many questions regarding efficiency and prompt a closer look at the possible causes.

A high bed occupancy rate does not always indicate better hospital performance. Indeed, bed occupancy rates can be too high, meaning that the volume of services is above the designed level of the hospital. The implications of high occupancy for average costs and hospital efficiency are ambiguous without information on other service indicators. The explanation for such a case could be that a high occupancy rate may reflect relatively efficient situations, as when many patients with modest lengths of stay are served (that is, the department has a high bed turnover rate).

Long lengths of stay tend to have lower than average costs per day because the treatment costs for the additional days are likely to fall below the average. Under the assumption that treatment cost profiles are relatively similar, high occupancy rates tend to result in lower than average costs per patient per day as overhead costs are spread over the beds that are usually filled and thus the lower than average cost would actually mask the inefficient hospital performance. Preferably, following a policy to increase the bed occupancy rate through a greater number of admissions per bed rather than longer stays will allow more patients to be served and thus boost the hospital productivity.

The study measured average length of stay by diagnosis for 113 diagnoses at Gamhuria General hospital from July 1993 to June 1994. Tables 12, 13, 14 and 15 present the average length of stay and number of cases for November 1993 and March and April 1994.

The study demonstrated many inefficiencies in the operation of Gamhuria General Hospital, particularly in low occupancy rates and excessive staffing in many departments. The following section details recommendations to improve management.

## **V. Recommendations to Help Improve the Performance and Efficiency in Gamhuria General Hospital**

Hospitals perform a range of different functions, including provision of inpatient treatment services within various medical specialties, specialist and general outpatient care, medical and paramedical support services, and other support services such as administration. It is important to know the balance of resources absorbed by different functions. To examine the efficiency with which departments of the hospital carry out their intended functions it would be desirable to have studies which specify cost functions and estimate average costs.

In nearly all countries, the largest share of public sector health expenditure is for hospitals, regardless of a country's health status and income level. It is both conventional and traditional to describe developing-country health systems as hospital-dominated (Mills 1990).

Hospitals internationally absorb approximately 30-50 percent of health sector expenditures, and 50-60 percent of current government health sector expenditures. General and central hospitals account for 60-80 percent of the total budget for hospitals, the remainder going to district hospitals (Mills 1990). In Jordan in 1987, the MOH spent 75 percent of the total recurrent health budget on hospitals. In Tunisia, hospitals represent 85 percent of national government health facilities expenditure (Mills 1990).

In Egypt, as in other developing countries, the distribution of recurrent resources within the government health sector strongly favors hospitals. The available data reveal that 50 percent of MOHP resources are assigned to hospitals (National health account, 1995).

Recommendations to improve the efficiency of Gamhuria General Hospital include:

### **1. Hospital Autonomy**

Currently, the hospital director has relatively little power for determining the number of staff, types and amount of items in the budget, drugs, maintenance, and equipment purchases. Increased hospital autonomy is the foundation for making hospitals more responsive and accountable to local conditions and demands for health services. In addition to increased hospital autonomy and decision-making power for the hospital administration, an incentive system that rewards increased efficiency and improved performance and good management is key. The rewards for good management and efficiency might include, for example, financial gain, recognition, or more rapid advancement. In the United States, the incentive to improve management, efficiency, and quality is frequently health insurance reimbursement and contracts only for those hospitals demonstrating the highest standards. Reimbursements are essential for the hospitals to remain in business.

A performance-based incentive system that incorporates efficiency indicators as those assessed in this cost analysis, plus additional indicators of quality of care, patient satisfaction, and rewards for the hospitals and managers that achieve outstanding gains is one feasible method for improving management.

In a system with greater hospital autonomy, the role of the Ministry of Health and Population could change into one of determining policies, developing incentive systems, guidelines and regulatory systems to ensure quality of care, and access for the poor and undeserved. This would diminish the role of the ministry in determining staffing, but would increase its role in developing standards of care, and potentially clinical guidelines.

## **2. Quality of Care**

This cost study does not address how quality of care and efficiency interact. Quality of care depends upon technically skilled staff, effective operation of equipment used for diagnosis and treatment, adequate drugs, medical supplies, and proper sanitary conditions. This hospital is deficient in several areas and ideally should improve both its efficiency and quality. Improved quality of care is likely to increase patient utilization, while improving the operating efficiency of the hospital.

## **3. Hospital Staff**

There is no internationally accepted protocol for staffing ratios, because staffing choices must be made in the context of local constraints. Staffing ratios per bed or bed day are not an infallible proxy for quality of service. Training and skill level, supporting technology, drugs and supplies, team work, and organization of services are all essential complementary co-determinants of quality. In addition, differences in case mix between departments have an important role. For example, ICU patients need more staff than orthopedics patients.

An examination of staffing ratios reveals cross hospital variation in the total staff per bed and composition of staff. The numbers show that inpatient departments as well as outpatient clinics probably have excess personnel. The number of personnel (working in inpatient departments only) per bed is as high to more than one person, while 57 percent of the time (more than 6 months per year) the bed is not used because of low occupancy rates (incubator department). These numbers will be translated to 16 persons per occupied bed in some departments. Using the step-down technique to allocate hospital staff to final service departments shows that the number may reach up to 8 personnel per occupied bed. These numbers are the highest compared to other developing countries.

Each department has to assess its need for physicians and nurses in different specialties through the efficiency indicators and studies of patient case mix. Current figures imply discrepancies between the number of staff needed in each department with the actual patient number and occupancy rates. This study recommends linking the hospital needs for staff according to the level of occupancy rate for each department.

## **4. Drugs and Medical Supplies**

Drugs and medical supplies account on average for 6.11 percent of the total costs per admission. This number decreases to less than one percent in the incubator department. Increases in the budget for drugs and medical supplies will increase the total annual costs of the hospital, but on the other hand, the availability of drugs will likely increase the quality of care and the utilization rate (number of admissions) and this, in turn, will decrease the total admission cost. See Graph 29 for the annual number of outpatient visits compared to drug costs. Graph 30 shows the annual bed days against the cost of drugs.

This study did not assess the availability of drugs in the hospital. However, during the study the team members heard informal comments about temporary lapses in drug supplies during which patients had to purchase their pharmaceuticals from private pharmacies to ensure a continuous supply to the hospital. A continuous, reliable supply of drugs is a sine qua non for quality care.

Increasing the autonomy of hospitals in managing the supply of drugs may assist in preventing these lapses in supplies and therefore maintaining a better quality of care. Hospitals could hold a portion of the drugs budget and not use it all to purchase drugs through the MOHP. The MOHP may have access to favorable pricing; however, turn-around-time for drug orders can be many months. During this interim, hospitals could purchase needed drugs from the private sector in emergencies. Alternatively, some income from the hospital services could be set aside in an

emergency drug purchase fund. Hospitals could consider joining with other private and public sector health agencies to pool drug purchasing and negotiate for lower prices.

## **5. Treatment Protocols**

Physicians exert ultimate control over the way in which treatment procedures are used and the subsequent length of stay of patients. Diagnosis and treatment procedures for the same cause of admission vary among physicians of the same department. The quality of care may likely be improved by establishing a standard practice for specific admissions. However, there may be considerable professional controversy concerning the development of treatment standards.

## **6. Maintenance**

Maintenance has important implications for the overall quality of the hospital environment and the services provided. Clean and attractive surroundings increase patient satisfaction and demand for services. The total cost of maintenance represents 0.28 percent of the annual recurrent costs. Unfortunately, maintenance costs are directed mainly towards repairing hospital equipment and not towards regular and preventive maintenance, for which there are no plans. The level of required maintenance depends on the operating environment, but the international average of maintenance costs ranges between 10-15 percent of the annual recurrent costs to uphold the hospital operation effectively (Mills 1991).

## **7. Average Length of Stay**

Reducing the average length of stay by increasing occupancy rate would increase the turnover rate and would extend hospital benefits to a greater number of people. Without information about case mix and severity, it is difficult to use length of stay as a direct indicator of efficiency for departments. However, stays that are unusually long raise questions regarding efficiency and should provoke a closer search for an explanation of the cause.

The study informally investigated the main causes of long average lengths of stay for different diagnoses. The following factors present some sources of extended lengths of stay:

- Most of the cases admitted to inpatient care for diagnostic tests are confined until results are received and then proceed for medical or surgical treatments.
- Physicians' lateness or absence due to the conflicting appointments arising from their dividing their time between hospital service and private practice. It is critical for the hospital to work out arrangements with the physicians to ensure that such conflicts are minimized.
- Absence of standard treatment practices and treatment protocols for the same cause of admission vary among the physicians of the same department.
- Hospital infections as a result of poor sterilization (although very few data are available on the magnitude of hospital infections and their effect on ALOS). International data calculate 13.2 percent of surgery cases and 10.3 percent of orthopedics cases may obtain nosocomial infection (Blanpain 1987).

## **8. Information Systems**

It is evident that the existing information systems rarely produce the required information. Research is required into how routine systems can best be altered and augmented to provide reliable data which will help identify resource allocation problems, planning changes in health sector resource allocation patterns, monitoring changes, taking adequate account of the

recurrent cost burden of the hospital in investment decisions and implementation of plans. Collection and analysis of the data required to calculate average costs can be made a routine hospital activity with the objective of improved planning, management and budgeting. A detailed, reliable information system for the collection of admissions, discharges, lab tests, drugs, personnel and other costs is needed for the implementation of any performance-based incentive system.

## **9. Use of Results for Pricing and Contracts**

Gamhuria General Hospital currently has a “economic ward” where private patients or patients covered by corporate plans stay when hospitalized. The results of this study will provide a definitive basis for negotiating a cost plus price for the daily reimbursement rate for these private patients based upon the average cost per day of L.E. 45. It can also be used for negotiating a reimbursement rate from health insurance companies and for health insurance companies to set insurance prices based on estimated annual costs for hospitalization and utilization in the population covered. In the current health sector reform environment in which the government is considering social insurance schemes, this information will provide a basis for estimating costs of hospitalization in the population.

## **10. Ambulatory Surgery**

In industrialized countries, the hospital admission rate per capita has steadily declined. For example, in the United States, the number of occupied hospital beds per capita has declined more than 30percent in the last 15 years despite the increasing age of the population. This phenomenon has resulted from an increasing transfer of inpatient services to outpatient care. most dramatically, surgical procedures have changed to outpatient services. The development of new techniques, instruments, better diagnostic tests and improved anesthesia with fewer side effects have resulted in short non-traumatic operations, rapid patient recovery and improved patient outcomes despite dramatically shorter hospitalizations.

Ambulatory surgery can be located either in hospitals or in independent sites. When located outside of the hospital, operations within the hospitals have decreased resulting in lower occupancy rates. However, when located within hospitals, the capacity to perform ambulatory surgery can assist in maintaining or even increasing utilization. In a study in Cali, Colombia, the costs per surgical case is about 30percent of the cost of traditional surgical procedures, while patients satisfaction was greater for the outpatient procedure (Shepard, Walsh, et al., 1994). Other types of procedures have also been transferred to the outpatient department from inpatient, such as, long-term therapy for cancer or chronic infections and diagnostic procedures. In Cali, as an alternative to building new hospitals when the general hospital became overcrowded, ambulatory surgical and reference units were built around the city.

For Gamhuria General Hospital, increasing the capacity of the general hospital to perform ambulatory surgery and other treatments would potentially assist in increasing efficiency in terms of cost per admission while fulfilling the patient demand for improved hospital care. This would require upgraded skills, on the part of the surgeons and anesthesiologist, as well as specialized equipment. The average length of stay for many operative admissions is many days longer than the U.S. See Table 14.

## **11. Nosocomial Infection**

A study in one university hospital in Cairo revealed that the overall hospital-acquired infection rate was 5.6 percent of the total patients discharged. Post-operative wound infection is the most frequent infection site. The infection rate reached 10 percent of the total patients discharged From special surgery departments. Gamhuria General Hospital should use a surveillance

system for the continuous monitoring of hospital-acquired infection. Controlling hospital-acquired infection will increase the bed turnover rate and reduce both the average length of stay and the total cost per admission.

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## **Annex I: Text Tables**

## Annex II: Text Figures

## Annex III: Definitions and Data Notes

**Admission per physician:** The average number of patient admissions per full time equivalent physician during one year.

= annual admissions / total number of FTE physicians

**Allocative efficiency:** The extent of optimality reached in the distribution of resources among a number of competing uses.

**Ancillary service cost:** These include the cost of all cost centers in intermediate service departments except kitchen and laundry cost centers.

**Annual admissions:** Total number of admissions during reference time (July 1, 1993 to June 30, 1994).

**Annual days of stay:** The total number of patient-days from admission to discharge during one year.

**Annual cost of department:** The total annual cost of the department after allocation of overhead and intermediate departments using the step-down allocation method (see table 17).

**Annual hospital expenditures:** Includes the annual cost of personnel, medications, depreciation of buildings and equipment, and food and utilities.

**Annual values:** Values of the use of capital items for health services, such as equipment, vehicles and building, for one year.

**Average cost (unit cost):** Defined as the total cost divided by number of units of output, e.g., cost per admission, cost per patient-day and cost per outpatient visit. Similarly, marginal cost is the additional cost required to produce one more unit of output.

**Average length of stay (ALOS):** The mean number of days from admission to discharge for diagnosis and inpatient department.

**ALOS** = Annual number of inpatient days/Annual number of admissions.

**Bed turnover rate (T):** The average number of patient admissions per bed during one year.

T = Annual number of admissions/Average number of available hospital beds during a year.

**Costs:** The products of price (or unit costs) and the number of units consumed (or service intensity). The higher the average level of unit costs, the more important the variation in service intensity.

**Capital cost:** The annual cost of resources that have a life expectancy of more than one year, e.g., buildings, equipment and vehicles. Staff training also can be classified as capital cost if the new skills are expected to last for one year or more. The costs of refresher training courses that occur throughout the year should be classified as recurrent.

**Cost-effectiveness analysis:** The technique used for identifying which health interventions achieve the greatest level of health impact per unit of investment.

**Cost per admission** = Total annual cost of inpatient department/total annual number of admissions for the department.

**Direct costs of department:** The costs attributed to each cost center prior to the allocation of the cost centers associated with hospital outputs.

**Disability-adjusted life year (DALY):** The unit used for measuring both the global burden of disease and the effectiveness of health interventions, as indicated by reductions in the disease burden. It is calculated as the present value of the future years of disability-free life that are lost as the result of the premature deaths or cases of disability occurring in a practical year.

**Equipment operation and maintenance:** Cost of maintaining equipment in operating order.

**Economic cost:** Presents the opportunity cost of using resources and inputs in one intervention rather in their next best intervention use. More formally, it is the payment required to keep that input in its present employment, or... the remuneration the input would receive in its best alternative employment (Nicholson, W., *Microeconomics Theory: Basic Principles and Extensions*, Fourth Edition, Dryden Press, New York, 1989, p. 309).

**Economic efficiency:** Economic inefficiency occurs when the hospital is not using the least expensive combination of inputs for a given output (Barnum 1993).

**Final service departments:** Cost centers which provide services directly to patients and not to other departments, e.g. inpatient departments and outpatient clinics.

**Financial cost:** The actual expenditures or outlays made for a specific intervention.

**Full-time equivalent (FTE) physician:** FTE was calculated by dividing each physician's work by specialty by the ratio of his/her work in outpatient clinics, inpatient departments, operation theaters and the emergency unit (table 6 presents the percentage of working time per activity for physicians for each department).

**FTE physician for inpatient departments:** The total number of physicians working at inpatient departments and operating rooms.

**FTE physician per bed:** Measures the number of physicians working full-time per bed for inpatient departments.

= Total number of physicians working at inpatient departments and operating rooms/total number of beds.

**FTE staff step-down:** The study used the step-down allocation technique to allocate overhead and intermediate department personnel to final service departments to get the total number of full-time equivalent personnel working in each final service department.

**Hotel services cost:** This includes food and laundry costs.

**Intermediate service departments:** Intermediate service departments are those that offer services both directly to patients and to other final medical departments. Examples include: operating theaters, laboratory and X-ray. In this analysis, kitchen and laundry departments were also included in the intermediate category because costs in these centers were estimated and distributed in a way similar to those of other intermediate departments.

**Intervention (in health):** A specific activity meant to reduce disease risks, treat illness, or palliate the consequences of disease and disability.

**Number of nurses per FTE physician:** Measures the number of nurses working with a full-time physician.

= Total number of nurses/total number of FTE physicians

**Overhead departments:** Cost centers which produce only those services that are consumed by other departments (cost centers) of the hospitals, not by patients. Examples include: maintenance, legal affairs and finance.

**Overhead cost:** These costs remain essentially constant regardless of whether a bed is occupied.

**Occupancy rate (OCC):** Measures the percentage of total available beds that are occupied by patient during on year.

**OCC =** (Annual number of patient days) X 100 / (Average number of available hospital beds during a year) X 365 days.

**Patient days per FTE physician:**

= annual number of patient days at inpatient department/ Total number of FTE physicians working at the inpatient department.

**Per Diem:** Cost of daily stipends for health workers involved in supervision activities.

**Personnel cost:** Value of labor, including health professionals, administrative staff, and non-health personnel (e.g., drivers), used to provide health services during the reference period.

**Present value (current values):** Estimates the current value of the capital item – the amount you would have to pay to purchase a similar item at the present time (the replacement value rather than the original price). It is the market value of the item e.g., equipment, square meter of constructions (WHO cost analysis manual 1992).

**Reference time:** The period of data collection for costing of the health facilities from July 1, 1993 to June 30, 1994.

**Recurrent cost:** The cost associated with inputs that will be consumed or replaced in one year or less, for example, staff salaries, utilities, drugs and medical supplies.

**Step-down method:** The technique used to distribute costs from the overhead departments to other overhead departments and finally to intermediate and final service departments, according to allocation criteria devised to resemble as closely as possible the actual use of resources by each department. The term “step-down” is used because of the format in which the distribution of costs is made.

**Technical efficiency:** The extent to which choice and utilization of input of resources produces a specific health output, intervention or service at the lowest cost (WDR 1993).

**Tertiary-based health services:** A hospital or other health facility that offers a specialized, highly technical level of health care for the population of a large region. Characteristics include specialized intensive care units, advanced diagnostic support services and highly specialized personnel.

**Useful life:** Estimates the number of years of useful life the item realistically can be expected to have after being acquired.

## Annex IV: Data Sources

### I. Hospital Cost

#### A. Capital Cost

##### 1. Building space:

- Engineering Department
- Maintenance Department

##### 2. Equipment, vehicles and furniture:

- Physical inventory
- Log books no. 118, 112, and 121
- List of received items for nurses at different departments.
- Purchase dept. at health directorate.

#### B. Recurrent Cost

##### 1. Personnel:

- Sheet no. 132 A.H.
- Sheet no. 50 A.H.
- Log book for salary
- Personnel Department

##### 2. Drugs and medical supplies:

- Log book for inpatient, outpatient and emergency pharmacies

##### 3. Utilities, include

- Water: Receipts for water
- Electricity: Receipts for electricity
- Telephone: Receipts for telephone
- Gas: Receipts for gas
- Benzene, oil: Receipt for benzene and oil

##### 4. Others, include

- Food: Receipts for food
- Stationery: Receipts for stationery

5. Maintenance, include:

- Building: Receipt for maintenance
- Equipment: Receipt for maintenance
- Vehicle: Receipt for maintenance

II. Hospital Statistics

Number of admission: Admissions discharge log book for 1993-94.

ALOS: Admissions discharge log book for 1993-94.

Outpatient visits: Outpatient log book for 1993-94.

Surgical procedures: Log book for operation theaters for 1993-94.

Lab tests: Log book for inpatient laboratory for 1993-94.

X ray: Log book for inpatient and outpatient radiology departments.

## **Annex V: Data Collection Forms**