

Technical Note No. 32

**COST ANALYSIS FOR HOSPITAL CARE
THE CASE OF EMBABA HOSPITAL
CAIRO, EGYPT**

Submitted to

**The Division of Health Services
Office of Health
Bureau for Research and Development
United States Agency for International Development**

By

**Samir Zaman
Abt Associates Inc.**

May 1993

**Health Financing and Sustainability Project
Abt Associates Inc., Prime Contractor
4800 Montgomery Lane, Suite 600
Bethesda, Maryland 20814 USA
Tel: (301) 913-0500 Fax: (301) 652-3916**

**Management Science for Health, Subcontractor
The Urban Institute, Subcontractor**

AID Contract No. DPE-5974-Z-00-9026-00

ABSTRACT

This study was undertaken primarily to help Embaba Hospital in Cairo to establish fees for services once it converts to a cost recovery system. The main objectives of the study were to estimate the actual cost of a service delivered by each medical department of the hospital; to develop a clear and appropriate methodology for calculating the service cost at the other hospitals that will be the target of the Cost Recovery for Health Project; and to create a solid base for a pricing system for medical services delivered by hospitals run by the Ministry of Health in general and by Embaba Hospital in particular.

To achieve these objectives, the organizational structure of Embaba Hospital was studied; the jobs carried out in each hospital department were reviewed; the interrelationships among the departments were analyzed to determine patterns of resource utilization; and the use within the hospital of the services of individual departments was mapped. Five major categories of cost were examined to estimate the total expenditure of the hospital: buildings and permanent structures, equipment, personnel, utilities, and materials and supplies. All costs of operating the hospital were allocated to the departments, which were identified as either overhead, intermediate service, or final service departments.

The study found that overhead, intermediate service, and final service departments account for 11, 41, and 48 percent, respectively, of total hospital-wide costs. The cost of materials and supplies consumed by the departments was found to be the prime determinant of the sharp variation in cost among departments. Personnel costs also were found to differ substantially across departments.

CONTENTS

LIST OF TABLES	iv
LIST OF ACRONYMS	v
EXECUTIVE SUMMARY	1
1.0 INTRODUCTION	4
2.0 EMBABA HOSPITAL	7
3.0 STUDY DESIGN FOR COST ANALYSIS	9
3.1 METHODOLOGY FOR ESTIMATING COST OF PROCEDURE AND SERVICE	9
3.2 PROCEDURES FOR DATA COLLECTION	19
4.0 COST ANALYSIS AND FINDINGS	23
4.1 ANALYSIS OF EXPENDITURES AT EMBABA HOSPITAL THROUGH STEP-DOWN ACCOUNTING METHOD	23
4.2 COST OF RESOURCES USED IN FREQUENTLY PROVIDED PROCEDURES	40
4.3 SENSITIVITY ANALYSIS	53
5.0 CONCLUSION	55
APPENDIX: DETAILED METHODOLOGY OF THE COST STUDY	58

LIST OF TABLES

TABLE 3-1	Functional Departments at Embaba Hospital	11
TABLE 3-2	Distribution of Cost	12
TABLE 3-3	Allocation Criteria for Distributing Overhead and Intermediate Department Costs	13
TABLE 4-1	Cost by Category and Functional Departments	25
TABLE 4-2	Average Monthly Labor Cost at Service Departments by Personnel Category	26
TABLE 4-3	Allocation of Overhead and Support Service Cost to Medical Department	29
TABLE 4-4	Allocation of Intermediate Department Costs to Final Departments	33
TABLE 4-5	Frequency of Services at Radiology Department by Procedures (During 1991)	35
TABLE 4-6	Frequency of Laboratory Procedures and Current Charges (Adjusted 1991)	36
TABLE 4-7	Distribution of Cost by Cost Categories in Final Service Department	38
TABLE 4-8	Breakdown of Cost by Patient Categories in Final Service Departments (1990 Data)	39
TABLE 4-9	Number of Cases Recorded in Final Service Department by Patient Categories (1990)	41
TABLE 4-10	Composition of Cost for All Patient Categories by Final Service Department	42
TABLE 4-11	Hospital-Wide Distribution of Average Costs by Patient Categories (Average of all Procedures, in L.E.)	46
TABLE 4-12	Composition of Inpatient Cost by Final Service Department	47
TABLE 4-13	Composition of Outpatient Cost by Final Service Department	49
TABLE 4-14	Hospital-Wide Distribution of Total Costs by Patient Category (Total for all Procedures in L.E.)	52
TABLE 4-15	Average Patient Contact Time by Personnel Category (Minutes Per Case by Patient Category)	54

LIST OF ACRONYMS

ALOS	Average length of stay
CCO	Curative Care Organization
CID	Cost of an inpatient day
CIS	Cost of an inpatient stay
CRHP	Cost Recovery for Health Project
ENT	Ear, nose, and throat
GOE	Government of Egypt
HFS	Health Financing and Sustainability
HIO	Health Insurance Organization
ICU	Intensive/Coronary Care Unit
MOH	Ministry of Health

EXECUTIVE SUMMARY

The bulk of the hospital cost studies in developing countries have been conducted to offer information for allocation of government resources between hospitals or primary and secondary health care services. These studies generally have adopted budget allocation or accounting approaches to distribute expenditure among hospital services.

Very few studies have been conducted to analyze hospital unit costs in order to offer information on efficiency and pricing objectives. Recently, new financing objectives in health care services have been pursued in several countries, and some researchers have analyzed the resource content of health services.

In Egypt, the provision of health care services has been largely the function of the public sector. In spite of the operation of a growing number of private health care facilities, publicly owned hospitals have continued to provide services at free or subsidized rates to a large segment of the population in Egypt.

Large increases in population and resulting growth in consumer demand for health care, dwindling government resources, and growing costs of health care have put tremendous financial pressure on the Government of Egypt (GOE). The GOE's inability to increase budgets to meet increases in health care needs has resulted in deteriorating quality of care in many of the frequently used Ministry of Health (MOH) facilities.

The GOE has recently rationalized health care in the public sector. With the assistance of USAID/Cairo and other donors, GOE transformed a number of MOH hospitals and polyclinics in various areas of the country into financially sustainable facilities. The users of the facilities are required to pay for the higher cost of providing better quality health care.

This study was developed primarily to help Embaba Hospital to establish fees for services once it converted to a cost recovery system. It therefore was necessary not only to understand the cost of services at the current operating system, but also to provide some understanding of how resources could be used to provide a desired level of service at competitive fees.

The methodology developed in this study to review costs has worked reasonably well. A small team of researchers was able to collect a substantial amount of useful information over a relatively short time. Valuable experience was gained from this study, with respect to both the logistics and administration of such a project and the improvement of the model itself.

Analyses to describe costs at Embaba Hospital were conducted in four stages. In the first stage, costs of supporting medical activities were estimated. In the second stage, overhead and final service costs of departments were estimated. In the third stage, costs of resources used to produce medical procedures and services were estimated. At the final stage, the unit of analysis was the cost of procedures at the level of inpatient, outpatient, or emergency cases. For inpatient cases, the cost of both an inpatient stay (from admission to discharge) and an inpatient day were estimated.

The main objectives of the costing study for Embaba Hospital were to:

- ▲ Estimate the actual cost of a service delivered by each medical department of the hospital;
- ▲ Develop a clear and appropriate methodology for calculating the service cost at the other hospitals that will be the target of the Cost Recovery for Health Project; and
- ▲ Create a solid base for a pricing system for medical services delivered by MOH hospitals in general and Embaba Hospital in particular.

To achieve these objectives, several tasks are carried out: studying the organizational structure of Embaba Hospital; understanding the jobs carried out in each hospital department; analyzing the interrelationships among the hospital departments to determine the nature and type of resource utilization in each department; and mapping the pattern of use of the output of a specific department by other departments in the hospital.

In this study, all costs of operating the hospital are assigned and allocated to the departments. These departments are identified as overhead, intermediate service, and final service departments. The overhead departments provide support to intermediate service and final service departments. Intermediate service departments provide procedures and services to patients in final service departments.

Forty-four functional departments were identified as cost centers at Embaba Hospital. Expenditures for materials used, personnel employed, and equipment physically present in and used by the departments were collected. Costs of overhead equipment and buildings, and expenditures on utilities were estimated for the whole hospital and allocated to each department in proportion to the area of the building occupied by respective departments.

Overhead, intermediate service, and final service departments account for 11, 41, and 48 percent, respectively, of total hospital-wide costs. Costs of materials and supplies consumed by departments are the prime determinant of the sharp variation in cost by departments. Personnel costs also differ substantially across departments.

Five major categories of cost were examined to estimate the total expenditure incurred by the hospital: buildings and permanent structures, equipment, personnel, utilities, and materials and supplies.

Embaba Hospital spends the largest amount on materials and supplies. Almost half of its total expense is accounted for by the cost of drugs, medical materials, and other medical and non-medical supplies. Medical and non-medical supplies at the operation theaters account for more than 25 percent of the cost of medical and other materials.

It also appears that the cost of operating theaters at Embaba is one of very few services that is higher than at other hospitals. Therefore, a more thorough examination of the use of medical materials, especially in the operating theaters, would provide useful information for efficiency and cost control decisions.

Fixed salary, fringe benefits, and other incentive payments to Embaba staff account for more than 40 percent of total expenditures at the hospital. Expenditure for personnel at intermediate service and final service departments amounts to slightly more than 85 percent of personnel cost, while salaries of personnel at overhead departments represent 15 percent of the total cost of labor.

An examination of the resource content of the final procedures and services shows that the cost of medical labor constitutes only about 15 percent of total cost (excluding the cost of drugs purchased from outside Embaba). Also, medical personnel were shown to spend only about 52 percent of their paid time on final service contact with the patients.

The difference is more remarkable in the outpatient cases than the inpatient cases. This discrepancy between labor time available and labor time actually used on final service patient care suggests that medical personnel at the service departments spend a substantial amount of their time on administrative and other managerial tasks or that there is considerable excess capacity of medical labor. Further examination of this situation should provide valuable insight into cost management and productivity increases.

The cost of ancillary procedures and services account for less than 15 percent of total cost. As expected, it is substantially higher among the inpatient cases (approximately 30 percent of total inpatient costs) than among the outpatient or emergency cases (approximately 10 and 2 percent, respectively). As explained above, the high cost of the use of the operating theaters contributes positively to the increase of the cost of ancillary procedures and services.

The high cost of procedures and services at the Renal Dialysis and the Plastics and Burn Units should be independently considered for any rate-setting strategy. The uniqueness of their procedures and services and the

difference in their cost structure sets them apart from procedures and services at the other departments at Embaba Hospital. The inclusion of procedures and services provided by these two departments with other departments will inflate the general rate.

Although it is not the purpose of this study to provide recommendations for a pricing strategy, but to provide cost information to the decisionmakers, an important observation can be made based on the findings. Considering the large number of procedures and services provided at comparatively low cost by the Obstetric and Gynecology department, the small number of very expensive procedures and services at Plastic and Burn, Renal Dialysis, and Ophthalmology departments, and the high cost but comparatively frequently provided surgical procedures at the Surgery departments, different prices should be considered for each of these categories for inpatient and outpatient cases.

1.0 INTRODUCTION

The Cost Recovery for Health Project (CRHP) in Egypt was formed under the Ministry of Health (MOH) to convert a number of government hospitals and polyclinics in Egypt into largely self-financing facilities. Funding is being provided by the GOE and USAID/Cairo to renovate the facilities and improve their service delivery system. Since July 1990, the Health Financing and Sustainability (HFS) Project has been providing technical assistance to CRHP in the areas of health financing, economics, and administration. The HFS project assisted in establishing initial procedures and systems for the CRHP and assisted Embaba Hospital in the conversion process. As part of the process, the HFS Project developed a cost analysis methodology and applied it in Embaba Hospital. An analysis of the ability and willingness to pay for health care was conducted among the people in the neighborhood of Embaba. Although these two activities jointly provided the information necessary to formulate pricing policy for Embaba Hospital, this paper will focus only on the methodology to assess and analyze cost at the hospital.

The remainder of this chapter will elaborate on the study rationale and discuss theoretical and conceptual base of cost and pricing under the hospital financing environment. Section 2 of the report provides perspective on the Embaba Hospital, including a description of the facility, its management organization, and some characteristics of the area it serves. Description of the methodology employed in this study is provided in Section 3. The results of the cost analysis at the Embaba Hospital is presented in Section 4. Composition of cost by department and by patient category, measured by a purely accounting method and a modified resource used method, are also described in this chapter. An attempt is also made to analyze the cost with assumed changes in composition of cost to reflect perceived quality change and changes in utilization level. Section 5 provides a conclusion and recommendations. Step-by-step procedures for collecting and analyzing data have been attached in the Appendix. This has been done to facilitate other analysts who conduct similar analyses at other public hospitals converting to cost recovery operation under the cost recovery program.

Fundamental to costing and pricing hospital services is an understanding of the product and production process. Many would argue that there is no clearly defined product in the hospital industry and therefore costing and pricing mechanisms in the hospital industry are completely different from the other competitive service industries. While services provided by hospitals are unique in many respects, they have many characteristics in common with other public and private goods.

The final product of a hospital is "a collection of sub-products assembled under the direction of a product engineer, that is, the physician. It is a case and the sub-product is comprised of procedures and services provided."¹ Since each case is unique with a different composition of sub-products, the hospital manager should have detailed information on cost and cost behavior of the procedures so that he or she can package and price the product in a manner consistent with pricing objectives.

The cost behavior pattern of any product is a function of the elements of cost in the product. Three types of cost behavior patterns are quite relevant for the hospital industry: fixed, incremental, and step costs. Fixed costs are costs that do not change with increases in volume over a specified period of time or with the capacity of the facility. Plants and capital equipment would fall in this category. The overhead cost is also often considered a fixed cost.

The marginal or incremental cost for each unit of additional output of this category of inputs is zero and therefore average cost falls with additional units of services produced. The incremental costs often pertain to final services and are proportionately related to incremental volume of the product. Changes in average variable cost will depend on the incremental cost of the increased volume of services. Under increasing cost conditions, the average variable cost will rise, and it will fall under decreasing cost conditions. Prescribed drugs and medical supplies would

¹ Johnson, K.F. Developing a costbase for pricing. "Topics in Health Care Financing," Vol.14, No.1, Fall/1987.

be included in this category. If not otherwise stated, this study assumes constant cost condition, that is, additional inputs in the variable cost category costs the same as the prior one.

The third category is step costs. The step-cost behavior patterns are fixed over relatively short ranges of output. This category is appropriate in the hospital industry, where many of the inputs used have substantial unit cost and each unit can provide many units of services. For example, hiring an additional specialist physician would result in a fixed cost increase for the hospital. This cost remains the same over a certain number of additional cases. Therefore, average step cost would fall over the short range of additional output.

Generally, two kinds of pricing units are considered for hospital services—à la carte prices and global. The à la carte pricing considers each treatment protocol as a separate chargeable unit and is priced accordingly. Under this system, prices for routine care, ancillary services, special procedures, drugs, and other procedures and services are each established separately for individual specialty departments. Global pricing, on the other hand, sets a price for a combination of predetermined services and materials into one global rate structure. The all-inclusive global rate concept packages routine, ancillary, and hotel services into a single daily rate of charge that varies by the number of days or the clinical nature of the services.

The pricing of hospital services is determined by many factors. These factors include the amount of competition from other providers, type of payers, and, most importantly, the cost of producing the services.

Pricing policy for health care and other products provided by the public sector is generally driven by efficiency, equity, and revenue objectives. Fee levels should be appropriate so that resources are allocated efficiently and the market operates on a more competitive basis. From the equity point of view, health care a necessity of life should not be made inaccessible to the poor because of high fees. It is for this reason that price discrimination in the health care industry is tolerated more than in any other industry. The revenue objective is determined by the proportion of the total cost that needs to be raised from the patients directly. To the extent that hospital care is to be financed fully through cost recovery, price level should be competitive with the private sector. Optimum price setting, in the absence of market distortions is set to equal marginal cost. In both cases, understanding the cost structure is crucial to price setting.

The bulk of the hospital cost studies in developing countries were conducted to offer information for allocation of government resources between hospitals or primary and secondary health care services. These studies have generally adopted budget allocation or accounting approaches to distribute expenditures among hospital services.

In a few cases, expenditure information from several sources was statistically analyzed to make inferences between hospital expenditure behavior and services provided across hospitals and over time. In either case, cost and expenditure had the same implied meaning.

Very few studies have been conducted in developing countries to analyze hospital unit costs to offer information on efficiency and pricing objectives. Recently, in the light of new financing objectives in health care services pursued in several countries, some researchers have analyzed the resource content of health services. These studies are extremely complicated and involve major efforts.²

Cost is the payment for the resources the hospital purchases and uses to produce and provide services. A thorough understanding of the costs associated with the delivery of each service or procedure offered by the hospital, as well as how these services are packaged into final products, is essential for setting prices in a competitive environment.

² See, for example, Lewis et al., "Estimating Public Hospital Costs by Measuring Resources: A Dominican Case." Urban Institute, Washington DC, No.3714-06.

The purpose of the current cost study was to develop a methodology that can be implemented quickly, with limited technical resources, and yet can provide reasonably accurate information on the use of resources to provide health care service. The information generated from applying this methodology to Embaba Hospital should help managers establish an appropriate level of prices for services, by the most appropriate units at points of delivery (e.g., inpatient day, outpatient visit, treatment episode, treatment plus hotel cost, etc.). Also, if the combination of inputs is changed due to quality consideration, the methodology will allow adjustments to be made and will estimate cost of services at various feasible points. For example, the methodology can be used to predict outcome of inpatient cost due to improvement of hotel services or changes in the technical inputs of treatment and diagnosis.

2.0 EMBABA HOSPITAL³

Embaba Hospital is located in the greater Cairo metropolitan area within a few kilometers of the west bank of the river Nile. It was built originally in 1958 and currently houses about 335 beds. The physical facilities consist of eight separate and relatively distinct buildings. The main building was constructed in 1958, and most of the other structures were completed in 1980. A new wing was constructed in 1989 as part of a renovation program. The hospital is operated by the Egyptian Ministry of Health (MOH) and its primary objective is to provide general medical and surgical services to the local community.

Embaba is a full-service general hospital providing numerous specialties and sub-specialties, including general surgery, orthopedics, urology, ear, nose, and throat (ENT), obstetrics and gynecology, internal medicine, pediatrics, ophthalmology, neurology, and psychiatry. The hospital also operates an Intensive/Coronary Care Unit (ICU), 13 operating theaters, a laboratory, radiology services, and a renal dialysis section. In addition, there is a 14-bed unit designed to handle burn and plastic surgery patients.

Outpatient services are provided in most of these specialties and subspecialties, along with dermatology and dentistry clinics. The hours of these clinics vary, depending on the specialty, with the longest operating four hours per day, six days per week. In total, the clinics average more than 220 patients per hour. The emergency/casualty department is also very active and acts as a separate service from the outpatient clinic.

As an MOH hospital, Embaba operates under MOH regulations and guidelines, as well as those of the Ministry of Manpower. Funds are allocated from the Ministry of Finance to the MOH. Personnel, including doctors, are regulated by the Ministry of Manpower and assigned by the MOH to the local Governorate. The Governorate, through the Offices of Medical Affairs, assigns individuals to local hospitals. For the hospitals, this system results in inadequate control over the numbers and quality of personnel, clearly a difficult position in terms of management autonomy and financial decisionmaking.

The staff of Embaba Hospital is therefore an interesting mix of the varied impacts of these three ministries and the Giza Governorate. The total staffing consists of 904 employees and 101 nursing students. Of these, 779 employees are assigned to intermediate service and final service departments, and the remaining 125 are assigned to overhead (administrative and support service) departments. In the intermediate service and final service departments, there are 307 physicians, 120 nurses, 234 technicians, and 118 other employees of various categories. This staffing level provides a ratio of employees to occupied beds (assuming Embaba's most recent occupancy rate of 80 percent) of 2.9 to 1. In relation to total beds, this ratio decreases to 2.3 to 1.

Another significant aspect of the management systems of Embaba and other MOH hospitals as well is the assignment of doctors as department directors rather than managers trained in their technical area and in management. Departments such as Radiology, Laboratory, Operating Theaters, and Physiotherapy are examples of this practice.

Embaba Hospital, like other MOH hospitals, has historically provided primarily free care in the completion of its mission as a government facility. From their inception, MOH general hospitals were intended to provide affordable services on behalf of the national government to the general population. In recent years, however, the MOH's budget has not been adequate to cover all the financial needs of the hospitals and other public health needs of the country. To help offset overall expenditures, these facilities have developed limited user fees. At Embaba Hospital in 1989 and 1990, the revenues from these fees were LE 462,538 and LE 484,920 respectively (19.6 percent and 21.0 percent of the total hospital revenues for these two years). While room fees for certain beds, called economic section or pay beds, are the largest component of this revenue, money is generated from numerous fees, and no single fee

³ This section was prepared with major inputs from the preliminary business plan prepared for Embaba Hospital in August 1991.

created more than 34.2 percent of total fees in either of these years. Embaba currently charges room and board fees for 56 of its 335 beds, generating LE 158,302 in 1989 from these fees out of total patient and visitor revenues of LE 462,538. The corresponding numbers for 1990 were not available at the time of our visit.

As mentioned earlier, Embaba Hospital operates about 335 inpatient beds in its current configuration, with eight additional "beds" for emergency observation, eight for recovery, and nine for renal dialysis. Inpatient admission and inpatient days remained fairly constant between 1989 and 1990. Outpatient visits, on the other hand, experienced a noticeable increase from 1989 to 1990. Emergency visits show a very slight increase in the period between 1989 and 1990.

In the inpatient areas, there is considerable consistency between the 1989 and 1990 volumes. This is also true in the listing of the top five services, ranked by volume of admissions. In 1989 and 1990, the respective volumes of admissions in OB/GYN to total admissions were 48.3 percent and 45.6 percent. The top five services, however, also tell a significant story, as the respective percentages of admissions to total admissions in these groups were 92.0 percent and 91.1 percent. Clearly, we can see that obstetrics and gynecology is almost half of the inpatient volume in terms of admissions, and the top five services comprise over 90 percent of admissions. In projecting future procedure and service volumes for Embaba, proposed changes to any of these five services are considered important in terms of their potential impact on the overall hospital.

Embaba Hospital is located in Giza Governorate. Across the river is Cairo, and together, these two Governorates form "Big Cairo," a metropolitan area of more than 10,500,000 people. The combined population of Cairo and Giza is more than 20 percent of the total population of Egypt. Nearby Governorates, including Beni-Suef, Fayoum, Kalyubia, and Sharkia, combine for an additional 9,646,000 people, or 18.6 percent of the total population.

In regard to the competitor hospitals around Embaba, over 60 government, specialty, institutional, Health Insurance Organization (HIO), Curative Care Organization (CCO), parastatal, and private hospitals exist in Giza Governorate alone, and many more are situated in nearby Cairo. The total number of beds for these hospitals is 7,322, according to GOE figures from 1986. At this time, though, it is not known how many of these beds are close enough to Embaba Hospital to be considered part of the service area.

3. 0 STUDY DESIGN FOR COST ANALYSIS

This chapter describes the cost study design and the data collection methodology. The study was developed primarily to help Embaba Hospital establish fees for services once it is converted to a cost recovery system. It was therefore necessary not only to understand of the cost of services at the current operating system, but also to provide some understanding how resources could be used to provide a desired level of service at competitive fees.

Analyses to describe costs at Embaba Hospital were conducted in four stages. In the first stage, costs of supporting medical activities were estimated. In the second stage, overhead and final service costs of departments were estimated. In the third stage, costs of resources used to produce medical procedures and services were estimated.⁴ At the final stage, the unit of analysis is the costs of procedures at the level of inpatient, outpatient, or emergency cases. For inpatient cases, costs of both an inpatient stay (from admission to discharge) and an inpatient day were estimated.

The following sections present the conceptual approach to the analysis as well as descriptions and estimations of procedures for determining relevant medical procedure and service unit costs. The allocation criteria and methodology are discussed in the Appendix.

3. 1 METHODOLOGY FOR ESTIMATING COST OF PROCEDURE AND SERVICE

The study employs accounting methods and tracks resource use in order to determine unit cost of procedure and service at Embaba Hospital. It follows the accounting approach to examine the cost of departments that provide procedures and services to patients in the inpatient, outpatient, and emergency areas.

In this study, all costs of operating the hospital are assigned and allocated to the departments at Embaba Hospital. These departments are identified as overhead departments, intermediate service departments, and final service departments. The overhead departments provide support to intermediate service and final service departments. Intermediate service departments provide procedures and services to patients in final service departments. *Table 3-1* identifies the functional departments of Embaba Hospital in the overhead, intermediate, and final service categories.

The attached flowchart (*Table 3-2*) describes the distribution of costs in this methodology. Costs related to the top two boxes (overhead departments) are distributed among the intermediate and final service departments shown in the third tier. These costs, together with the costs of procedures and services provided to patients by the intermediate service departments and costs that can be assigned directly to final service departments, such as personnel time, units of equipment, and materials provided directly to patients at the final service departments, become the cost of a unit of medical procedure and service received by inpatient, outpatient, or emergency patients.

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 resemble as closely as possible the actual use of resources by each of the departments. The step-down method is a more advanced cost-finding technique because it involves the distribution of costs from overhead departments to other overhead departments and finally to intermediate and final service departments. The term "step-down" is used because of the format in which the distribution of costs is made. The costs of an overhead department serving the most departments are distributed first (in this case, the Assistance and Support Services department); the overhead department serving the second-largest number of departments is distributed next (Maintenance department), and so on until the costs of all overhead departments are distributed to the intermediate service and final service departments. The step-down allocation criteria

⁴ In our analysis, a procedure is defined as a medical intervention that includes diagnosis and diagnostic tests, treatment protocol, and other services provided during one episode of illness. For inpatient, it is analogous to services in an inpatient stay, and for an outpatient or emergency visit, it pertains to services in one visit.

for distributing overhead and intermediate service departments costs among each department and final service departments are shown in *Table 3-3*.

The costs directly assigned to intermediate service departments⁵ are measured through a combination of interviews, physical verification, and examination of medical records and allocated to final service departments through a step-down method. First, the costs that can be directly attributed to the intermediate service departments are identified and assigned. These include personnel expenses, cost of units of equipment at the department, supplies and materials, and other costs. These costs are aggregated with the allocated overhead departments costs. The total aggregated costs are then allocated among the various procedures or services performed within the department according to the number and complexity of the procedure or service performed. The relative prices currently charged for various procedures or services at Embaba Hospital and other organizations, such as the Health Insurance Organization (HIO), Curative Care Organization (CCO), and private hospitals in the area were used as proxies of the complexity factor of the identified procedures and services.

The costs directly assigned to final service departments are measured through a combination of interviews, physical verification, and examination of medical records. First, the costs that can be directly attributed to the final service departments are identified and assigned. These include personnel expenses, cost of units of equipment at the department, supplies and materials, and other costs. These costs are combined with the allocated overhead and intermediate department costs and comprise the total cost of procedures and services of the final service department. The main focus of these activities is to determine the value of goods and services directly received by the patients.

⁵Intermediate service departments are those departments that offer services both directly to patients and to other medical departments. In this analysis, kitchen and laundry departments were also included in the intermediate category because costs in these centers were estimated and distributed similar to those of other intermediate departments.

TABLE 3-1
FUNCTIONAL DEPARTMENTS AT EMBABA HOSPITAL

OVERHEAD DEPARTMENTS	INTERMEDIATE DEPARTMENTS	FINAL SERVICE DEPARTMENTS
Assistance & Support Services Maintenance Director's Secretary Finance Cashier Telephone Systems Personnel Affairs Stores Security/Police Purchasing Patients' Affairs Social Services & Statistics Wireless Communication Resident Physicians Nursing School	Laboratory Dental Laboratory Radiology Serialization Anesthesiology Operation Theaters Inpatient Pharmacy Kitchen Laundry Outpatient Pharmacy Pharmacy Economic	Surgery Internal Medicine Urology Emergency Dental Family Planning Renal Dialysis Orthopaedics Dermatology Intensive Care Unit Ear, Nose, & Throat Ophthalmology Physiotherapy Pediatrics Neurology & Psychiatry Plastic & Burn Outpatient Obstetric & Gynecology

TABLE 3-2
DISTRIBUTION OF COST

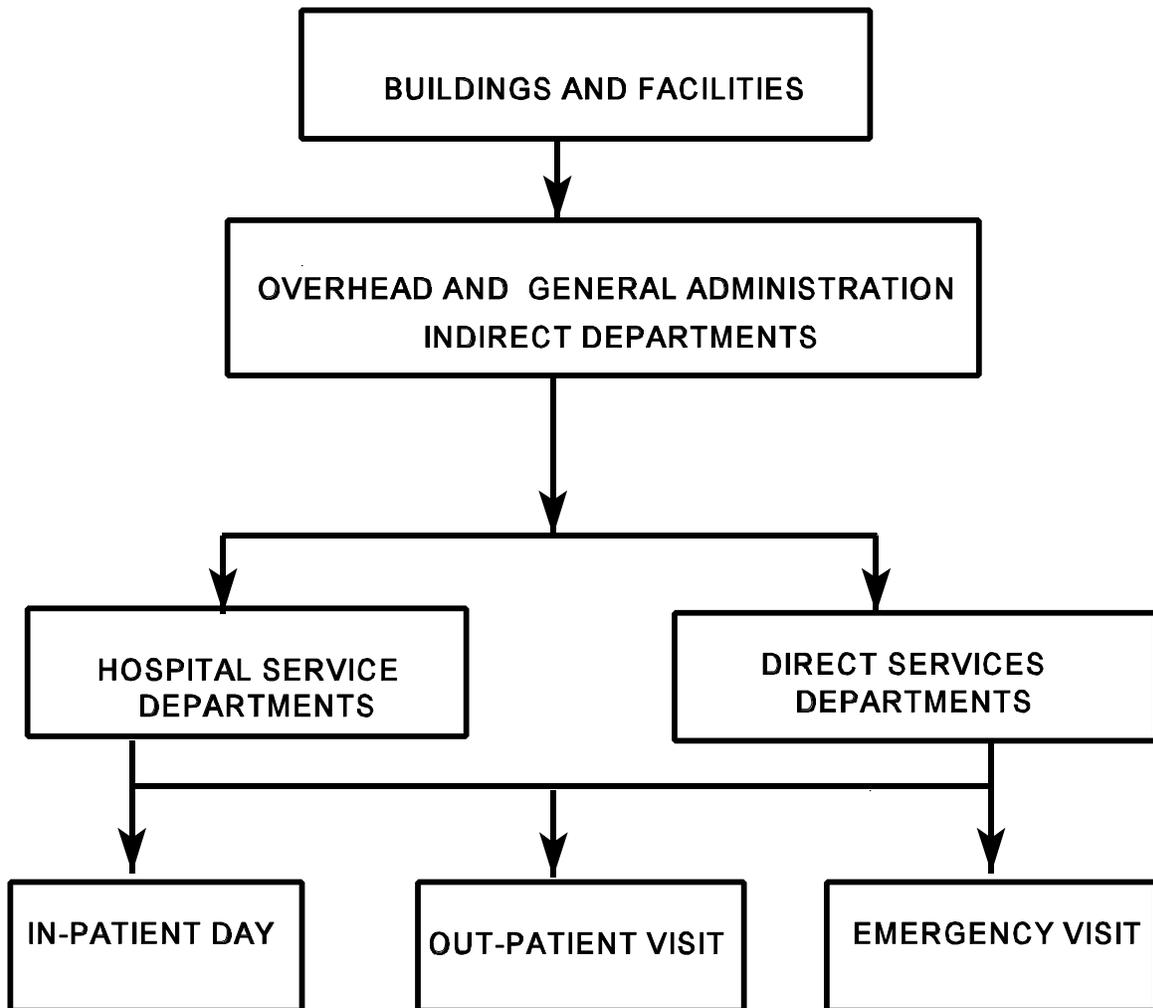


TABLE 3-3
ALLOCATION CRITERIA FOR DISTRIBUTING OVERHEAD
AND INTERMEDIATE DEPARTMENT COSTS

DEPARTMENTS	ALLOCATION CRITERIA
OVERHEAD DEPARTMENTS	
Assistance & Support Services	Proportion of total direct expense by department
Maintenance	Surface area by department
Director's secretary	Proportion of total direct expense by department
Finance	Proportion of total direct expense by department
Cashier	Proportion of total direct expense by department
Telephone System	Proportion of total number of telephone sets by department
Personnel Affairs	Proportion of total labor expense by department
Stores	Proportion of total material cost by department
Security/Police	Surface area by department
Purchasing	Proportion of total material and equipment cost by department
Patients' Affairs	Proportion of total number of patients by department
Social Services & Statistics	Proportion of total number of patients by department
Wireless communications	Proportion of total number of patients by department
Resident Physicians	Proportion of resident physicians by department
Nursing School	Not allocated to final services departments
INTERMEDIATE SERVICE DEPARTMENTS	
Laboratory	Proportion of total lab services rendered to each department
Dental Laboratory	Distributed to dental department
Radiology	Proportion of total radiological services rendered to each department
Sterilization	Proportion of total number of patients weighted by personnel time spent on patients, by department
Anesthesiology	Proportion of total number of surgical patients weighted by personnel time spent on surgical patients, by department
Operation Theaters	Distributed to surgical procedures and weighted by personnel time spent on the surgical procedures
Inpatient Pharmacy	Proportion of total number of patients by department
Kitchen	Number of inpatients served by department
Laundry	Kilograms of washed materials provided to each department
Outpatient Pharmacy	Distributed to outpatient department entirely

3. 1. 1 Cost to Be Allocated among All Departments

Fixed cost items 1, 2, 3, and 4 and operating cost item 5 are the total costs to be allocated to the overhead, intermediate service, and final service departments according to the proportion of support, materials, units of equipment, and procedures or services consumed by each department. Cost elements included in operating cost item 5 are variable costs only in the perspective of the overhead departments. For intermediate service and final service departments, however, they are fixed costs, since they do not change with the number of procedures and services provided.

The fixed cost items are used for a long period of time (conventionally, for more than one year), and therefore their costing poses two possible complications. The first is the concern of using historical cost versus replacement cost. The second involves the choice of the years to base the depreciation period to spread costs.

The historical cost is the price of the relevant item at the time of its purchase. The replacement value is the cost of the item if it were to be replaced at the current market price. This study uses replacement cost for fixed cost items for various reasons, dearth of historical data being the chief one.

The costs of buildings and units of equipment are depreciated according to the unified accounting method currently practiced in Egypt. As is apparent from earlier information, there are two categories of cost: buildings and permanent structures, and equipment and durable goods. The first includes those items used by all departments (buildings and permanent structures). Depreciated costs of these items are allocated to all departments according to the proportional use. The proportion of square meters of building space a department occupies compared to total building space was used as a proxy for cost allocation.

The second category, depreciated cost of units of equipment and durable goods exclusively used by specific departments, is assigned and allocated fully to the respective department. The cost of financing capital investments, if any, would be included in these costs. These include:

1. Cost of buildings and other permanent structures.
2. Cost of equipment and other durable goods, including transportation equipment that can be specifically assigned and allocated to a department.
3. Cost of medical equipment that can be specifically assigned and allocated to a department.
4. Cost of overhead equipment, such as generators, elevators, incinerators, and other equipment that cannot be specifically assigned and allocated by departments.

In the operating cost (or recurrent cost) group, three categories were included in this analysis: personnel working for each department, utilities (excluding electricity and water supply cost), and materials and supplies consumed by the department. Contracted services (excluding consultants for medical procedures and services) provided to the hospital are included in the Maintenance department. Cost of utilities are assigned to the Assistance and Support Services department. These include:

5. Recurrent costs of operating each department, including personnel, small equipment, supplies, material, electricity, fuel, general transportation (not ambulance), and other recurrent costs attributed to the department.

3. 1. 2 Overhead Departments' Costs to Be Allocated among All Departments

Support, administrative, and business services are provided by overhead departments. The costs associated with these departments are often termed overhead costs and are measured by aggregating all fixed and variable costs incurred by these departments. This was done through a combination of physical verification and examination of records from various support and administration departments.

Costs of the overhead departments comprise fixed and operating costs described earlier. The fixed cost items 6, 7, and 8, and operating (variable) cost item 9 are the total costs to be allocated to overhead, intermediate services, and final service departments.

The total cost of each overhead department is comprised of the following:

Fixed Costs:

6. Share of depreciation cost of buildings and other permanent structures.
7. Share of depreciation cost of equipment and other durable goods, including transportation equipment that can be specifically assigned and allocated to a department.
8. Share of depreciation cost of overhead equipment, such as generators, elevators, incinerators, and other equipment that cannot be specifically assigned and allocated by department.

Operating (Variable) Costs:

9. Recurrent cost of operating each overhead department, including personnel, small equipment, supplies, material, electricity, fuel, general transportation (not ambulance), and other recurrent costs attributed to the department.

The total estimated costs of each overhead department are then distributed to overhead, intermediate service, and final service departments according to criteria developed for each department (through the step-down methodology). These criteria are designed to reflect as close an approximation as possible of the proportion of cost that the departments consume. After step-down, there are no costs in the overhead departments.

3. 1. 3 Intermediate Service Departments' Costs to Be Allocated among Final Service Departments

Costs of intermediate service departments procedures and services are estimated through a two-step process. First, total final service cost of each of the intermediate service departments are estimated by a method similar to that used to determine direct overhead departments cost. To this estimated direct cost, the cost allocated from the overhead departments are added to determine the total cost of each intermediate service department. The total estimated cost of the intermediate service departments are then distributed to the procedures or services provided by each department according to the number of cases and a complexity factor.⁶

⁶ The relative prices charged for corresponding laboratory and radiological services by local private providers are used to measure the complexity factor.

The complexity factor varies by the type of intermediate service department procedure and service. For Radiology (see *Table 4-5*) and Laboratory (see *Table 4-6*) departments, the relative prices charged at private facilities for these procedures or services are used as proxy for complexity factor. The complexity factor for the Anesthesiology, Operation Theater, and Sterilization department costs are the amounts of personnel time used in the medical procedures that require these intermediate procedures and services.

The total cost of each intermediate service department is comprised of the following:

Fixed Costs:

10. Share of depreciation cost of buildings and other permanent structures.
11. Share of depreciation cost of equipment and other durable goods including transportation equipment that can be specifically assigned and allocated to a department.
12. Share of depreciation cost of overhead equipment, such as generators, elevators, incinerators, and other equipment that cannot be specifically allocated by department.
13. Depreciation cost of the various equipment used to perform medical procedures or services in the relevant final service department.

Operating (Variable) Costs:

14. Overhead department costs allocated to the intermediate service departments.
15. Recurrent cost of operating each intermediate service department, including personnel, small equipment, supplies, material, electricity, fuel, general transportation (not ambulance), and other recurrent costs attributed to the department.

Items 10, 11, 12, 13, and 15 are costs attributed and allocated directly to intermediate service departments. Item 14 is costs allocated from overhead to intermediate service departments.

3. 1. 4 Cost of Resources Used to Produce a Unit of Medical Procedure and Service

Costs of resources used in a unit of medical procedure or service are estimated from costs allocated to the final service departments and cost of time and materials directly involved in the procedure or service. First, the cost of building and facilities, equipment, supplies, and overhead and intermediate department costs allocated to the final service department is distributed among all procedures and services performed. This distribution is done according to the intensity factor of the resources used in the procedure. The intensity of the procedure is measured by the amount of personnel time applied to the procedure compared to the total personnel time of the department. The cost distributed to individual procedures in addition to the direct cost of personnel and material resources, equipment time, and the allocated cost of ancillary (intermediate service department) required procedures or services determine the total cost. The cost elements in a final service department procedure or service are described here:

Fixed Costs:

16. Share of depreciation cost of buildings and other permanent structures.

17. Share of depreciation cost of equipment and other durable goods, including transportation equipment that can be specifically assigned and allocated to a department.
18. Share of depreciation cost of overhead equipment, such as generators, elevators, incinerators, and other equipment that cannot be specifically allocated by departments.
19. Depreciation cost of the various equipment used to perform medical procedures or services in the relevant final service department.

Operating (Variable) Costs:

20. Overhead departments costs allocated to the final service departments.
21. Recurrent cost of operating each final service department, including small equipment, non-medical supplies, non-medical material, electricity, fuel, general transportation (not ambulance), and other recurrent costs attributed to the department.
22. Cost of time taken by each category of personnel to perform a specific medical procedure or service, offered in the relevant final service department.
23. Cost of drugs and medical materials used in a specific medical procedure or service, offered in the relevant final service department.
24. Cost of prescribed drugs for an episode involving a specific final service department procedure or service.
25. Cost of intermediate service department procedures or services used in an episode of a specific final service department medical procedure or service.

Items 19, 22, 23, and 24 constitute the cost of resources consumed by the final service department to perform a unit of medical procedure or service. Item 25 is the allocated cost of procedures or services provided by intermediate service departments during the treatment protocol. Item 20 constitutes the allocated overhead departments costs of a medical procedure or service. Items 16, 17, 18, and 21 are costs assigned or allocated to the final service department. The total of items 16 through 25 for all final service departments determines the total cost to the hospital to provide medical procedures and services.

3. 1. 5 Costing Inpatient Stay, Inpatient Day, Outpatient, and Emergency Visit

A medical procedure or service in this study relates to materials and services prescribed and provided in a diagnostic-related case. It is analogous to inpatient stay for inpatient cases, and outpatient or emergency visits for outpatients and emergency cases, respectively. For example, a general case of meningo-plasty involves several hours of physician time for examination and surgery, LE 10 of medicine, x-rays and laboratory tests, and equipment time over four days of inpatient stay. Similarly, an outpatient visit with a common case of gastritis involves seven minutes of physician time, LE 1 of medicine, and no diagnostic test. The following are descriptions and equations for estimating the unit cost of inpatient, outpatient, and emergency patient procedures and services or cases.

Cost of Inpatient Stay (CIS): The average cost of all inpatient medical procedures and services, including overhead, intermediate service, and final service department costs, weighted by their frequencies, constitutes the CIS. CIS can be estimated by the following equation:

$$CIS = \sum_{i=1}^n \sum_{j=1}^m F_{ij} MC_{ij} / \sum_{i=1}^n \sum_{j=1}^m F_{ij}$$

Where

F_{ij} = Number of inpatient procedures and services j, performed at final service department i
 MC_{ij} = Cost of inpatient procedures and services j, at final service department i

Cost of Inpatient Day (CID): The CIS, factored for the average length of stay (ALOS) of hospital patients, will determine CID. Estimate CID by dividing CIS (computed earlier) by ALOS for all hospital cases. As the formula is simple, an equation is not required.

Cost of Outpatient Visit: The weighted average cost of all outpatient procedures will constitute the cost of an outpatient visit. The following equation and procedure for estimating the CIS can be applied here.

$$CIS_o = \sum_{i=1}^n \sum_{j=1}^m Fo_{ij} MCo_{ij} / \sum_{i=1}^n \sum_{j=1}^m Fo_{ij}$$

Where

Fo_{ij} = Number of outpatient procedures and services j, performed at final service department i
 MCo_{ij} = Cost of outpatient procedures and services j, at final service department i

Cost of Emergency Case: The weighted average cost of emergency procedures will constitute the cost of an emergency case. The following equation and procedure for estimating CIS can be applied here.

$$CIS_e = \sum_{i=1}^n \sum_{j=1}^m Fe_{ij} MCe_{ij} / \sum_{i=1}^n \sum_{j=1}^m Fe_{ij}$$

Where

Fe_{ij} = Number of emergency procedures and services j, performed at final service department i
 MCe_{ij} = Cost of emergency procedures and services j, at final service department i

3. 2 PROCEDURES FOR DATA COLLECTION

A thorough understanding of the organizational structure of the hospital under study is the first step to an effective data collection procedure. An examination of the accounting practice of the hospital and its organization is helpful in identifying the cost centers (departments) under which expenses are aggregated.

The departments are usually classified by functional categories into overhead, intermediate service, and final service departments.⁷ Once the departments (cost centers) are identified, cost items/elements within the departments are identified and measured.

3. 2. 1 Procedure to Collect Data for Estimating Costs

Two quite distinct types of data were needed for the cost study, and the data collection methodology was organized around those needs, their sources, and the experience and training of the personnel responsible for collecting data. The cost data came mainly from accounting and recordkeeping sources. A health economist who had experience in step-down procedures and examination of ledgers was responsible for collecting cost data. Two physicians who also had experience with health procedures and service evaluations were responsible for the collection of data pertaining to final service departments medical procedures and services. Other physicians and accountants both from within and outside of Embaba Hospital helped in the data collection. The procedure of data collection by each group is described in this section.

Data for estimating costs were obtained primarily from Embaba Hospital sources of hospital expenditures. After discussions with administrative staff and accountants and verification of records, Embaba Hospital was divided into 44 functional departments or cost centers for cost analysis. These departments were then classified into 15 support services or overhead departments, 11 intermediate service departments (often called ancillary departments), and 18 final service departments (also termed medical departments).

Data collected for cost estimation were grouped under six broad categories: cost of building and permanent structures, major overhead equipment (which serves the whole hospital), units of equipment (located at individual departments), labor (personnel cost), utilities, and material supplies. Information on building characteristics and equipment were obtained from the Engineering and Equipment department of the CRHP.

These data were collected in a disaggregated form by department. For example, the floor space (square meters) of each department was estimated by identifying the location of the department on hospital blueprints and taking the measurements shown in the blueprint. The cost of building and permanent structures was determined by calculating the current construction cost of similar structures (construction was estimated at LE 1,250 per meter squared). The number of units and price of furniture, office equipment, and other durable goods were obtained through physical inventory of various departments conducted in the presence of the staff from the Stores department and verification of hospital asset records.

Data on personnel and salaries were collected from the documents and records at the Finance and Personnel Affairs departments. Detailed salary information, including fringe benefits, in-kind incentives, and other benefits was collected by department and category of staff. Salary information were collected for nine months, ending September 1991.

Data on the cost of utilities such as electricity, water, sewer, and telephone were obtained from the Assistance and Support Services department and the official records of invoices maintained by the Finance department. Data on

⁷ Intermediate service and final service departments are often referred to as medical departments.

the consumption of materials and supplies were obtained for two general types of supplies. Cost data on stationery and other general purpose materials were obtained from the official records of the Stores department. Collection of cost data relating to medical supplies consumed by the Final Services departments was more complicated. It was discovered that the quantity of medical materials supplied by the Stores department to individual departments did not always reflect the real consumption.

It was observed that portions of medical materials supplied monthly to a final services department were carried forward to several months, while in other departments they were used up before the end of the month and were operating without supplies. For this reason, a list of materials was prepared with the assistance of the Stores department and was distributed through the Head Nurse to all departments. The nursing staff responsible for the relevant department recorded the amount of each type of medical material the department consumed in the prior month. The data collected through this process were subjected to verification for reasonableness by the Chief of Medical Stores and the Head Nurse. Prices of medical materials were obtained from official records and verification of invoices at the department of Stores.

3. 2. 2 Cost Estimate of Resources Used to Produce a Unit of Medical Procedure and Service

Data collection described in this section was conducted to estimate the amount of resources used (personnel, material, and other) to provide a unit of medical procedure or service directly to the patient. Over a three-month period in the fall of 1991, a group of investigators (comprising six physicians) met with a focus group of doctors (residents, consultants, and specialists) from each department and discussed the most frequent medical procedures or services offered by the department.

The group then discussed the composition of material (drugs, supplies, equipment, etc.), and personnel time to provide each type of procedure or service. Interviews and discussions in each of the departments varied from a few hours to several sessions in some of the larger departments. This depended mainly on the extent of activities carried out in the department.

The investigators used three main interview schedules to collect the information related to the final service (medical service) departments. The first interview schedule was used to abstract data on personnel time required to provide a procedure or service by each category of personnel (consultants, specialists, residents, nurses, etc.). Information on their number, the actual daily working hours, night shift hours (if any), their input to any administrative work, whether it relates to the general hospital or to the department, and any extra compensated work that may be undertaken was also collected.

The second interview schedule was used to gather information on what frequent procedures are being carried out by the department. These are classified according to the location in which the procedure takes place (i.e., outpatient, emergency, or inpatient). The inpatient category is further subdivided to multiple-day stays and same-day case patients.

In the third interview schedule, the investigator observed and recorded information on the different steps involved in carrying out each of the procedures or services identified in the earlier interview. For each of these steps, information is sought on who carries it out, time required, how much and what type of medical materials are used, what type and quantities of medicines are prescribed, what diagnostic investigations are requested, and what medical equipment is used. For inpatient procedures, the ALOS is also noted. In addition, the respondent provides information on which prescribed medicines are supplied by the pharmacy at Embaba and which are bought by the patient from local pharmacy outlets. The same also applies for any diagnostic test and investigation that cannot be carried out at Embaba Hospital and is therefore obtained from an outside source.

Inevitably, there are wide variations in the combination of time and material spent to perform a procedure, depending on the type of patient and circumstances. The investigators, however, work to develop a consensus among the respondents to quote an average or typical procedure or service.

3. 2. 3 Pricing of Resources Used

Up to five cost elements usually constitute the total cost of a procedure or unit of service. These are 1) personnel time, 2) prescribed medicine, 3) medical materials, 4) ancillary (intermediary departments) procedures and services, and 5) equipment time. The cost of medical materials, ancillary (intermediary departments) procedures and services, and equipment time are allocated on a step-down process that was previously described in this report. The cost of personnel time was calculated based on cost per minute to provide a procedure or service. This was determined by dividing total monthly salaries of each category of personnel by the average time of official attendance of the personnel in that category.

The costs of more than 250 types of drugs regularly prescribed by Embaba Hospital physicians were obtained from two sources: 1) medicines supplied by the pharmacy at Embaba were obtained from the Stores department and costed at the specified fraction of the bulk price; 2) retail prices of medicines supplied from outside by the patients themselves were obtained from market pharmacies. These products were costed at the lowest unit at which they can be bought. For example, a patient prescription of 15 sulphamethoxazole tablets was purchased from a local pharmacy at a cost per package strip of 10 tablets of LE 1.00. The cost of that drug will be assessed at two units for LE 1.00 (equal to LE 2.00).

3. 2. 4 Frequency of Procedures

Data collectors were assigned to collect information on the frequency of the procedures or services at the final service departments. Data were collected by screening activity registers available at the intermediate and final service departments. The number of cases by patient category and diagnosis were extracted from the activity registers for the 12 months prior to September 1991. These data were not consistently and thoroughly recorded by the departments, and therefore may be the weakest link in this analysis. Reliable information on the number of emergency cases has been particularly difficult to collect. Data on the number of cases by type in the emergency department were not available. In many cases, averages for all types of procedures were used to estimate total cost in emergency and several other departments.

4. 0 COST ANALYSIS AND FINDINGS

This section analyzes the findings of the cost study carried out at Embaba Hospital and presents them in a way most useful for setting fees for procedures and services. The findings are presented in two sections. In Section 4.1, the findings from the step-down accounting process are analyzed. The total monthly expenditures of Embaba Hospital are analyzed by functional departments and by cost categories. The analyses are presented for step-down allocation of the overhead departments costs to intermediate service and final service departments, intermediate service departments costs to final service departments, and final service departments cost to patient categories. Cost of individual procedures or services at the Laboratory and Radiology departments are also estimated and described in this section.

Section 4.2, presents cost estimations from a combination of step-down allocation of costs and resource use analysis at the procedure level. This section examines costs of resources used to produce a number of frequently provided inpatient, outpatient, and emergency services in the final service departments are examined. It provides information on resource use at the procedural level and can be most useful to compare cost of treatment of an episode of illness between departments within Embaba Hospital and between Embaba Hospital and other providers (whose rates of charges for medical procedures or services are known). Section 4.3 presents sensitivity analysis of cost by categories of patients based on assumed cost scenarios.

4. 1 ANALYSIS OF EXPENDITURES AT EMBABA HOSPITAL THROUGH STEP-DOWN ACCOUNTING METHOD

Forty-four functional departments were identified as cost centers at Embaba Hospital. Expenditure on materials used, personnel employed, and cost of equipment physically present in and used by the departments were collected in a straightforward manner. Costs of overhead equipment and buildings and expenditures on utilities were estimated for the whole hospital and allocated to each department in proportion to the area of the building space occupied by respective departments.

Total monthly cost by department of capital, personnel, and materials are presented in *Table 4-1*. These costs vary from LE 60,240 (almost 15 percent of total cost) in the operation theaters to LE 656 in the Purchasing department.⁸ The categories of overhead departments, intermediate service departments, and final service departments each account for 11, 41, and 48 percent, respectively, of the total hospital-wide cost. Cost of materials and supplies consumed by departments are the prime determinant of the sharp variation in cost by departments. Personnel cost also differs substantially across departments.

Five major categories of cost were examined to estimate the total expenditure incurred by the Embaba Hospital. These are: buildings and permanent structures, equipment, personnel, utilities, and materials and supplies.

The total monthly expenditure on all categories at Embaba Hospital is estimated at LE 372,102. Expenditures on material supplies account for almost 45 percent of total cost. Personnel cost and depreciation cost accounts for almost 40 percent and 16 percent of total cost, respectively. Cost of utilities is a negligible portion of total expenditure. Personnel cost as a proportion of total cost is substantially higher in the overhead department (60 percent) than in the intermediate service departments (6 percent) or the Final Service departments (5 percent). The cost categories by departments are illustrated in *Table 4-1* and discussed separately in the following text.

⁸ Does not include cost centers or departments that do not have any personnel assigned to them.

Building Costs: Embaba Hospital has a total area of approximately 6,300 square meters. Based on the current construction cost of LE 1,250 per square meters, the buildings are estimated to have a value of LE 7.84 million. The price of land has not been included in this estimation. Building costs (with no salvage value or economic adjustment for inflation) were depreciated over 25 years (300 months) to determine monthly depreciation cost. This amounted to LE 26,133. Building depreciation costs for individual departments was determined by the proportion of total building space each department occupies. Depreciated cost of common space was also allocated to departments based on the proportion of occupied space.

Cost of Equipment: Three categories of equipment and machinery, each with a different working life and use, were assessed. The depreciated costs of overhead equipment, such as elevators and generators, were assumed to have a working life of 25 years and were distributed to each department according to its proportion of occupied space. The other categories are physically located at the departments and their working life varies between one and ten years. The total cost of equipment at Embaba Hospital amounted to LE 5.38 million with a monthly depreciation cost of LE 45,002. No salvage value is attached to any equipment.

Personnel Costs: Embaba Hospital employs a total of 1,005 people, including 101 student nurses who are paid stipends and provided meals. Most of the staff (880 members including student nurses) are assigned to intermediate and final service departments, and 125 staff are assigned to overhead (administrative and support service) departments. Total monthly payment for personnel amounts to LE 148,312, of which 80 percent represents basic salaries and 20 percent fringe benefits and incentive payments.

The department of Obstetrics and Gynecology is the largest department with 92 employees. The Assistance and Support department is the largest overhead department with 48 employees. The breakdown of average monthly labor cost by departments is presented in *Table 4-2*.⁹

Utility Costs: This category includes electricity, gas, telephone, and oil. Total monthly cost for this account is LE 5,646.

⁹ A detailed breakdown of personnel costs is on file at the HFS Information Center.

**TABLE 4-1
COST BY CATEGORY AND FUNCTIONAL DEPARTMENT**

Cost Items	Total Cost of Equip/Furn By Dept L.E.	Monthly Depreciation Cost Equip L.E.	Total Bldg Cost By Dept @LE 1250/ Sq. Meter	Monthly Depreciation Cost Bldg L.E.	Monthly Personnel Cost L.E.	Monthly Utility Cost L.E.	Monthly Materials/Supplies Cost L.E.	Total Variable and Fixed Cost L.E.
A. Overhead Departments								
1 Assist. & Supp Serv	82,056	685	25,937	54	10,000	1,109	6,500	18,348
2 Maintenance	8,195	70	157,352	328	301		2,421	3,120
3 Director's secr.	25,490	281	143,519	299	984			1,564
4 Finance	12,876	114	100,290	209	2,244			2,567
5 Cashier	9,948	98	43,229	90	763			951
6 Telephone System	36,036	300	16,427	34				335
7 Personnel Affairs	12,771	110	86,457	180	3,059			3,349
8 Stores	11,896	99	198,851	414	1,253			1,766
9 Security/Police	2,437	22	25,937	54				76
10 Purchasing	6,619	57	86,457	180	419			656
11 Patients' Affairs	8,803	75	86,457	180	1,347			1,602
12 Soc. Serv & Stat	3,813	32	51,874	108	922			1,062
13 Wireless comm.	53,836	449	25,937	54				503
14 Resident Physicians	51,926	434	497,992	1,037				1,472
15 Nursing School	22,029	185	248,996	519	3,921			4,625
TOTAL	348,731	3,011	1,795,712	3,741	25,213	1,109	8,921	41,995
B. Intermediate Serv Depts								
16 Laboratory	162,521	1,354	69,166	144	6,040		3,996	11,534
17 Dental Laboratory	4,733	41	23,516	49	3,874		27	3,991
18 Radiology	166,746	1,404	69,166	144	2,451		3,703	7,701
19 Sterilization	525,237	4,377	91,299	190	262			4,829
20 Anaesthesiology	1,622	14	36,312	76	6,207			6,296
21 Operation Theaters	1,824,718	15,206	871,487	1,816	903		42,315	60,240
22 Inpatient Pharmacy	12,899	109	103,748	216	2,870		23,197	26,392
23 Kitchen	62,305	558	293,954	612	2,246		12,746	16,162
24 Laundry	259,521	2,163	328,537	684	468		838	4,153
25 Outpatient Pharmacy	5,934	51	71,932	150	(incl in inp)		12,051	12,252
26 Pharmacy Economic	3,622	30	34,583	72	pharmacy)			102
TOTAL	3,029,859	25,306	1,993,698	4,154	25,321	0	98,874	153,654
C. Direct Service Depts								
27 Surgery	61,327	514	568,022	1,183	16,797		2,579	21,074
28 Internal Medicine	107,117	898	62,941	131	16,096		3,299	20,424
29 Urology	30,432	257	57,062	119	3,463		5,164	9,002
30 Emergency incl emr lab	161,924	1,351	371,765	775	2,156		6,404	10,686
31 Dental	191,970	1,601	159,773	333	4,374		2,005	8,313
32 Family Planning	3,861	32	86,457	180				212
33 Renal Dialysis	458,977	3,825	285,308	594	2,101		16,552	23,072
34 Orthopaedics	55,136	463	259,371	540	4,411		1,452	6,866
35 Dermatology	2,680	22	34,583	72	3,053			3,147
36 Intensive Care Unit	263,544	2,199	207,497	432	4,280		3,198	10,110
37 Ear, Nose, & Throat	3,166	26	70,895	148	3,798		104	4,076
38 Ophthalmology	91,317	761	51,874	108	3,014		244	4,127
39 Physiotherapy	161,583	1,347	259,371	540	2,918		0	4,805
40 Pediatrics	168,641	1,405	34,583	72	7,946		2,748	12,172
41 Neurology & Psychiatry	1,544	13	34,583	72	1,468			1,553
42 Plastics & Burn	119,313	994	456,493	951	3,922		3,751	9,618
43 Outpatient	37,751	318	419,662	874			403	1,595
44 Obstetric & Gynecology	78,764	658	627,851	1,308	17,981		5,654	25,601
TOTAL	1,999,047	16,685	4,048,090	8,434	97,778	0	53,556	176,453
Total All Departments	5,377,637	45,002	7,837,500	16,328	148,312	1,109	161,351	372,102

TABLE 4-2
AVERAGE MONTHLY LABOR COST AT SERVICE DEPARTMENTS
BY PERSONNEL CATEGORY

Medical Departments	Numbers by Personnel Category	Monthly Cost	Hours Worked	Hourly Rate
Specialist & Members	11.00	471.85	63.00	7.49
Specialists	84.00	377.53	87.00	5.99
Special Assistance	81.00	276.25	115.00	4.38
Residents	131.00	199.19	165.00	3.16
Nurses	110.00	186.16	211.00	2.95
Workers	92.00	114.49	188.00	1.82
Clerks	22.00	117.55	129.00	1.87
Technicians	234.00	173.09	68.00	2.75
Chemists	4.00	169.97	154.80	2.70
Nursing School Head	1.00	392.28	154.80	6.23
Nursing Teachers	9.00	300.17	154.80	4.76
Nursing Students	101.00	7.05	154.80	0.11
Total Average All Personnel	880.00	232.13	137.10	3.68
Overhead Departments	Number of Staff by Department	Average Salary by Dept	Staff Hours Worked by Staff	Hourly Rate by Staff
Head Nursing Assistants	2.00	352.489	154.00	5.59
General Manager	1.00	60.23	154.00	15.24
External members of Mgmt.	2.00	11.75	154.00	0.19
Head Nursing	1.00	195.65	154.00	3.11
Adminis. & Finan. Manager	1.00	543.13	154.00	8.62
Personnel Affairs	18.00	169.95	154.00	2.70
Financial Affairs	13.00	172.63	154.00	2.74
Patients' Affairs	6.00	244.47	154.00	3.56
Social & Statistical	5.00	184.49	154.00	2.93
Stores	8.00	156.67	154.00	2.49
Purchasing	2.00	209.41	154.00	3.32
Maintenance	1.00	300.83	154.00	4.78
Support Services	48.00	208.34	154.00	3.31
Cashier	2.00	381.50	154.00	6.06
Kitchen	13.00	172.79	154.00	2.74
Laundry	2.00	234.16	154.00	3.72
Total Average all Personnel	125.00	279.90	154.00	4.44

Cost of Materials and Supplies: This category includes drugs and medical supplies provided by Embaba Hospital, stationery, cleaning supplies, and other consumables. Total monthly costs of drugs and supplies are estimated at LE 161,351, not including prescribed drugs that patients purchase outside of the hospital. A large portion of the drugs and supplies are consumed by the intermediate (ancillary) services departments, particularly the operation theaters.

In algebraic form, total expense of department i is estimated through the following equation:

$$TC_i = B_i PB + OE_i + \sum_{j=1}^n E_{ij} PE_{ij} + \sum_{j=1}^n L_{ij} W_{ij} + \sum_{j=1}^n C_{ij} PC_{ij} + U_i PU$$

Where

- TC_i = Total expenses at department i
- B_i = Total building space occupied by department i
- PB = Depreciated cost of building space
- OE_i = Share of overhead equipment depreciated cost allocated to department i
- E_{ij} = Number of equipment in category j at department i
- PE_{ij} = Depreciated cost of a unit of equipment j at department i
- L_{ij} = Number of personnel in category j at department i
- W_{ij} = Salary of personnel in category j at department i
- C_{ij} = Units of consumable j used by department i
- PC_{ij} = Unit price of consumable j
- U_i = Units of utility consumed by department i
- PU = Unit price of utility

4.1.1 Step-Down Allocation of Cost to Inpatient, Outpatient, and Emergency Medical Procedures and Services

The five major categories of costs at Embaba Hospital comprise the total cost of operating the hospital. These costs are assigned to overhead, intermediate service, and final service departments through direct distribution or step-down allocation. The unit of cost produced in this study will be determined through a series of step-down procedures to allocate costs to inpatient, outpatient, and emergency medical procedures and services.

Costs of the overhead departments are first allocated to intermediate service and final service departments. Total costs of the intermediate service department after allocation of overhead cost are then allocated to final service departments. Finally, costs at the final service departments are allocated to inpatient, outpatient, and emergency medical procedures and services.

Allocation of Overhead Departments Costs: Costs of overhead departments are allocated in a step-down fashion to intermediate service and final service departments, according to criteria and statistics developed for each department.¹⁰ *Table 4-3* illustrates the allocation statistics of overhead departments and total cost of intermediate service and final service departments after allocation of overhead departments costs. Approximately 37 percent of overhead departments costs were distributed among intermediate service and 51 percent to final service departments. The operation theaters (13 percent allocated) in the intermediate service group, and obstetric and gynecology department (7 percent allocated) in the final service group received the largest share of overhead department allocations. Cost of the Nursing school, which accounted for almost 12 percent of total overhead departments costs, was not distributed because it was believed that it had little contribution to the services of patients.¹¹

Allocation of Intermediate Service Departments to Final Service Departments: A sample of final department medical procedures and services was examined to assess the composition of a procedure or service. From this sample and the average number of intermediate service department procedures and services provided in final department procedures and services, the total number ordered by each department was estimated. The costs at the intermediate service departments were then distributed among the final service department according to the number of procedures or services used. The proportion of various intermediate (ancillary) service departments procedures and services used by final service departments and the amount of the cost distributed are shown in *Table 4-4*. The Surgery and Obstetrics and Gynecology departments are the two largest users of intermediate department services, each accounting for more than a quarter of those total expenditures.

Procedures and services in the intermediate service departments are not only provided to final service departments but potentially to patients directly. It was felt, therefore, that information on unit cost of procedures at some of the intermediate service departments would be useful. Unit costs of procedures and services in the Laboratory and Radiology departments were estimated by distributing total cost among the procedures and services provided by the departments according to the relative complexity of the procedures. The prices for a variety of radiology and laboratory procedures and services currently charged at Embaba Hospital and other private and public providers in the Embaba area were collected and used as proxy of the relative complexity between procedures. The unit comparison of costs of frequently performed procedures at Radiology and Laboratory departments with prices at other facilities are presented in *Table 4-5* and *Table 4-6*, respectively.¹²

¹⁰ See Appendix for discussion of methodology.

¹¹ Only a small fraction of the student nurses pursued their professional careers at Embaba Hospital.

¹² Estimates of unit cost of meals and laundry and of Laboratory and Radiology departments services are on file at the HFS Information Center.

**TABLE 4-3
ALLOCATION OF OVERHEAD AND SUPPORT SERVICE COST TO MEDICAL DEPARTMENT**

Cost Items	Assistance & Support services		Maintenance		Director's Secretary		Finance	
	Proport. of total cost	Allocated Amount LE	Proport. of total Cost	Allocated Amount LE	Proport. of total Cost	Allocated Amount LE	Proport. of total Cost	Allocated Amount LE
A. OVERHEAD DEPARTMENTS								
Assistance & Support Services	100.00%	18,348						
Maintenance	0.88%	162	100.00%	3,281				
Director's secretary	0.44%	81	0.45%	15	100%	1,660		
Finance	0.73%	133	0.73%	24	0.74%	12	100.00%	2,736
Cashier	0.27%	49	0.27%	9	0.27%	5	0.27%	8
Telephone System	0.09%	17	0.10%	3	0.10%	2	0.10%	3
Personnel Affairs	0.95%	174	0.96%	31	0.96%	16	0.97%	26
Stores	0.50%	92	0.50%	17	0.51%	8	0.51%	14
Security/Police	0.02%	4	0.02%	1	0.02%	0	0.02%	1
Purchasing	0.19%	34	0.19%	6	0.19%	3	0.19%	5
Patients' Affairs	0.45%	83	0.46%	15	0.46%	8	0.46%	13
Social Services & Statistics	0.30%	55	0.30%	10	0.30%	5	0.31%	8
Wireless communications	0.14%	26	0.14%	5	0.14%	2	0.15%	4
Resident Physicians	0.42%	76	0.42%	14	0.42%	7	0.42%	12
Nursing School	1.31%	240	1.32%	43	1.32%	22	1.33%	37
Total	6.68%	1,227	5.85%	192	5.43%	90	4.74%	129
B. INTERMEDIATE SERVICE DEPARTMENTS								
Laboratory	3.26%	598	3.29%	108	3.30%	55	3.33%	91
Dental Laboratory	1.13%	207	1.14%	37	1.14%	19	1.15%	32
Radiology	2.18%	399	2.20%	72	2.21%	37	2.22%	61
Sterilization	1.37%	250	1.38%	45	1.38%	23	1.39%	38
Anesthesiology	1.78%	327	1.80%	59	1.80%	30	1.82%	50
Operation Theaters	17.03%	3,125	17.18%	564	17.26%	286	17.39%	476
Inpatient Pharmacy	7.46%	1,369	7.53%	247	7.56%	126	7.62%	208
Kitchen	4.57%	838	4.61%	151	4.63%	77	4.66%	128
Laundry	1.17%	215	1.18%	39	1.19%	20	1.20%	33
Outpatient Pharmacy	3.46%	635	3.49%	115	3.51%	58	3.54%	97
Pharmacy Economic	0.03%	5	0.03%	1	0.03%	0	0.03%	1
Total	43.44%	7,970	43.82%	1,438	44.02%	731	44.34%	1,213
C. DIRECT SERVICE DEPARTMENTS								
Surgery	5.96%	1,093	6.01%	197	6.04%	100	6.08%	166
Internal Medicine	5.77%	1,059	5.82%	191	5.85%	97	5.89%	161
Urology	2.54%	467	2.57%	84	2.58%	43	2.60%	71
Emergency incl. emergency lab	3.02%	554	3.05%	100	3.06%	51	3.08%	84
Dental	2.35%	431	2.37%	78	2.38%	40	2.40%	66
Family Planning	0.06%	11	0.06%	2	0.06%	1	0.06%	2
Renal Dialysis	6.52%	1,197	6.58%	216	6.61%	110	6.66%	182
Orthopaedics	1.94%	356	1.96%	64	1.97%	33	1.98%	54
Dermatology	0.89%	163	0.90%	29	0.90%	15	0.91%	25
Intensive Care Unit	2.86%	524	2.88%	95	2.90%	48	2.92%	80
Ear, Nose, & Throat	1.15%	211	1.16%	38	1.17%	19	1.18%	32
Ophthalmology	1.17%	214	1.18%	39	1.18%	20	1.19%	33
Physiotherapy	1.36%	249	1.37%	45	1.38%	23	1.39%	38
Pediatrics	3.44%	631	3.47%	114	3.49%	58	3.51%	96
Neurology & Psychiatry	0.44%	81	0.44%	15	0.44%	7	0.45%	12
Plastics & Burn	2.72%	499	2.74%	90	2.76%	46	2.78%	76
Outpatient	0.45%	83	0.45%	15	0.46%	8	0.46%	13
Obstetric & Gynecology	7.24%	1,328	7.30%	240	7.33%	122	7.39%	202
Total	49.88%	9,152	50.32%	1,651	50.55%	839	650.92%	1,393
Total All Departments	100.00%	18,348	100.00%	3,281	100.00%	1,660	100.00%	2,736

Continued...

**TABLE 4-3
ALLOCATION OF OVERHEAD AND SUPPORT SERVICE COST TO MEDICAL DEPARTMENT**

Cost Items	Cashier		Telephone System		Personnel Affairs		Stores	
	Proport. of Total Cost	Allocated Amount LE	Proport. of Total #Tel.Set	Allocated Amount LE	Proport. of Total Cost	Allocated Amount LE	Proport. of Material Supplies	Allocated Amount LE
A. OVERHEAD DEPARTMENTS								
Assistance & Support Services								
Maintenance								
Director's secretary								
Finance								
Cashier	100.00%	1,021						
Telephone System	0.10%	1	100%	360				
Personnel Affairs	0.97%	10	4.00%	14	100.00%	3,621		
Stores	0.51%	5	0.00%	0	0.96%	35	100.00%	1,937
Security/Police	0.02%	0	4.00%	14	0.00%	0	0.00%	0
Purchasing	0.19%	2	4.00%	14	0.32%	12	0.00%	0
Patients' Affairs	0.46%	5	4.00%	14	1.03%	37	0.00%	0
Social Services & Statistics	0.31%	3	0.00%	0	0.70%	25	0.00%	0
Wireless communications	0.15%	1	0.00%	0	0.00%	0	0.00%	0
Resident Physicians	0.43%	4	4.00%	14	0.00%	0	0.00%	0
Nursing School	1.34%	14	4.00%	14	2.99%	108	0.00%	0
Total	4.47%	46	24.00%	86	6.00%	217	0.00%	
B. INTERMEDIATE SERVICE DEPARTMENTS								
Laboratory	3.34%	34	0.00%	0	4.61%	167	2.62%	51
Dental Laboratory	1.16%	12	4.00%	14	2.96%	107	0.02%	0
Radiology	2.23%	23	4.00%	14	1.87%	68	2.43%	47
Sterilization	1.40%	14	0.00%	0	0.20%	7	0.00%	0
Anesthesiology	1.82%	19	0.00%	0	4.74%	172	0.00%	0
Operation Theaters	17.43%	178	8.00%	29	0.69%	25	27.76%	538
Inpatient Pharmacy	7.64%	78	0.00%	0	2.19%	79	15.22%	295
Kitchen	4.68%	48	0.00%	0	1.72%	62	8.36%	162
Laundry	1.20%	12	0.00%	0	0.36%	13	0.55%	11
Outpatient Pharmacy	3.55%	36	0.00%	0	0.00%	0	7.91%	153
Pharmacy Economic	0.03%	0	8.00%	29	0.00%	0	0.00%	0
Total	44.47%	454	24.00%	86	19.33%	700	64.86%	1,256
C. DIRECT SERVICE DEPARTMENTS								
Surgery	6.10%	62	20.00%	72	12.83%	464	1.69%	33
Internal Medicine	5.91%	60	4.00%	14	12.29%	445	2.16%	42
Urology	2.61%	27	0.00%	0	2.64%	96	3.39%	66
Emergency incl. emergency lab	3.09%	32	4.00%	14	1.65%	60	4.20%	81
Dental	2.41%	25	4.00%	14	3.34%	121	1.32%	25
Family Planning	0.06%	1	0.00%	0	0.00%	0	0.00%	0
Renal Dialysis	6.68%	68	0.00%	0	1.60%	58	10.86%	210
Orthopaedics	1.99%	20	4.00%	14	3.37%	122	0.95%	18
Dermatology	0.91%	9	0.00%	0	2.33%	84	0.00%	0
Intensive Care Unit	2.93%	30	8.00%	29	3.27%	118	2.10%	41
Ear, Nose, & Throat	1.18%	12	0.00%	0	2.90%	105	0.07%	1
Ophthalmology	1.19%	12	0.00%	0	2.30%	83	0.16%	3
Physiotherapy	1.39%	14	0.00%	0	2.23%	81	0.00%	0
Pediatrics	3.52%	36	4.00%	14	6.07%	220	1.80%	35
Neurology & Psychiatry	0.45%	5	0.00%	0	1.12%	41	0.00%	0
Plastics & Burn	2.78%	28	0.00%	0	2.99%	108	2.46%	48
Outpatient	0.46%	5	0.00%	0	0.00%	0	0.26%	5
Obstetric & Gynecology	7.41%	76	4.00%	14	13.73%	497	3.71%	72
Total	51.06%	521	52.00%	187	74.66%	2,704	35.14%	680
Total All Departments	100.00%	1,021	100.00%	360	100.00%	3,621	100.00%	1,937

Continued...

**TABLE 4-3
ALLOCATION OF OVERHEAD AND SUPPORT SERVICE COST TO MEDICAL DEPARTMENT**

Cost Items	Security/Police		Purchasing		Patients' Affairs		Social Services & Stat.	
	Proport. of Floor Space	Allocated Amount LE	Proport. Equip. & Supplies	Allocated Amount LE	Proport. of total Patients	Allocated Amount LE	Proport. of Total Patients	Allocated Amount LE
A. OVERHEAD DEPARTMENTS								
Assistance & Support Services								
Maintenance								
Director's secretary								
Finance								
Cashier								
Telephone System								
Personnel Affairs								
Stores								
Security/Police	100.00%	96						
Purchasing	1.23%	1	100.00%	733				
Patients' Affairs	1.23%	1	0.47%	3	100.00%	1,781		
Social Services & Statistics	0.74%	1	0.31%	2	0.00%	0	100.00%	1,172
Wireless communications	0.37%	0	0.15%	1	0.00%	0	0.00%	0
Resident Physicians	7.07%	7	0.43%	3	0.00%	0	0.00%	0
Nursing School	3.54%	3	1.36%	10	0.00%	0	0.00%	0
Total	14.17%	14	2.73%	20	0.00%	0	0.00%	
B. INTERMEDIATE SERVICE DEPARTMENTS								
Laboratory	0.98%	1	3.40%	25	20.19%	360	20.19%	237
Dental Laboratory	0.33%	0	1.18%	9	0.10%	2	0.10%	1
Radiology	0.98%	1	2.27%	17	2.66%	47	2.66%	31
Sterilization	1.30%	1	1.42%	10	0.00%	0	0.00%	0
Anesthesiology	0.52%	0	1.86%	14	0.00%	0	0.00%	0
Operation Theaters	12.38%	12	17.75%	130	0.00%	0	0.00%	0
Inpatient Pharmacy	1.47%	1	7.78%	57	0.00%	0	0.00%	0
Kitchen	4.18%	4	4.76%	35	0.00%	0	0.00%	0
Laundry	4.67%	4	1.22%	9	0.00%	0	0.00%	0
Outpatient Pharmacy	1.02%	1	3.61%	26	0.00%	0	0.00%	0
Pharmacy Economic	0.49%	0	0.03%	0	0.00%	0	0.00%	0
Total	28.32%	27	45.28%	332	22.95%	409	22.95%	269
C. DIRECT SERVICE DEPARTMENTS								
Surgery	8.07%	8	6.21%	46	4.41%	79	4.41%	52
Internal Medicine	0.89%	1	6.02%	44	12.56%	224	12.56%	147
Urology	0.81%	1	2.65%	19	2.07%	37	2.07%	24
Emergency incl. emergency lab	5.28%	5	3.15%	23	20.50%	365	20.50%	240
Dental	2.27%	2	2.45%	18	3.05%	54	3.05%	36
Family Planning	1.23%	1	0.06%	0	0.00%	0	0.00%	0
Renal Dialysis	4.05%	4	6.80%	50	0.30%	5	0.30%	4
Orthopaedics	3.68%	4	2.02%	15	3.97%	71	3.97%	47
Dermatology	0.49%	0	0.93%	7	2.43%	43	2.43%	29
Intensive Care Unit	2.95%	3	2.98%	22	0.10%	2	0.10%	1
Ear, Nose, & Throat	1.01%	1	1.20%	9	8.18%	146	8.18%	96
Ophthalmology	0.74%	1	1.22%	9	3.35%	60	3.35%	39
Physiotherapy	3.68%	4	1.42%	10	0.18%	3	0.18%	2
Pediatrics	0.49%	0	3.59%	26	9.56%	170	9.56%	112
Neurology & Psychiatry	0.49%	0	0.46%	3	0.76%	14	0.76%	9
Plastics & Burn	6.48%	6	2.83%	21	0.26%	5	0.26%	3
Outpatient	5.96%	6	0.47%	3	0.00%	0	0.00%	0
Obstetric & Gynecology	8.92%	9	7.54%	55	5.35%	95	5.35%	63
Total	57.51%	521	51.99%	381	77.05%	1,373	77.05%	903
Total All Departments	100.00%	1,021	100.00%	733	100.00%	1,781	100.00%	1,172

Continued...

**TABLE 4-3
ALLOCATION OF OVERHEAD AND SUPPORT SERVICE COST TO MEDICAL DEPARTMENT**

Cost Items	Wireless Communications		Resident Physicians		Nursing School		Total Overhead Cost Allocated to Direct & Intermediate Serv Dept		Cost by Medical Depts. After O/H Allocation
	Proport. of Total Patients	Allocate Amount LE	Prop. of Total Patients	Allocate Amount LE	Cost Not Distributed	Allocated Amount LE	Percent Allocated	Amount LE	
A. OVERHEAD DEPARTMENTS									
Assistance & Support Services									
Maintenance									
Director's secretary									
Finance									
Cashier									
Telephone System									
Personnel Affairs									
Stores									
Security/Police									
Purchasing									
Patients' Affairs									
Social Services & Statistics									
Wireless communications	100.00%	543							
Resident Physicians	0.00%	0	100%	1,609					
Nursing School	0.00%	0	0.00%	0	100.00%	5,117	12,18%	5,117	5,117
Total	0.00%	0	0.00%	0	100.00%	5,117	12,18%	5,117	5,117
B. INTERMEDIATE SERVICE DEPARTMENTS									
Laboratory	20.19%	110	20.19	325					
Dental Laboratory	0.10%	1	0.10%	2					
Radiology	2.66%	14	2.66%	43					
Sterilization	0.00%	0	0.00%	0					
Anesthesiology	0.00%	0	0.00%	0					
Operation Theaters	0.00%	0	0.00%	0					
Inpatient Pharmacy	0.00%	0	0.00%	0					
Kitchen	0.00%	0	0.00%	0					
Laundry	0.00%	0	0.00%	0					
Outpatient Pharmacy	0.00%	0	0.00%	0					
Pharmacy Economic	0.00%	0	0.00%	0					
Total	22.95%	125	22.95%	369					
C. DIRECT SERVICE DEPARTMENTS									
Surgery	4.41%	24	4.41%	71	0.00%	0	5.87%	2,467	23,541
Internal Medicine	12.56%	68	12.56%	202	0.00%	0	6.56%	2,757	23,181
Urology	2.07%	11	2.07%	33	0.00%	0	2.33%	979	9,982
Emergency incl. emergency lab	20.50%	111	20.50%	330	0.00%	0	4.88%	2,051	12,737
Dental	3.05%	17	3.05%	49	0.00%	0	2.32%	976	9,289
Family Planning	0.00%	0	0.00%	0	0.00%	0	0.04%	18	230
Renal Dialysis	0.30%	2	0.30%	5	0.00%	0	5.02%	2,110	25,182
Orthopaedics	3.97%	22	3.97%	64	0.00%	0	2.15%	904	7,769
Dermatology	2.43%	13	2.43%	39	0.00%	0	1.09%	458	3,605
Intensive Care Unit	0.10%	1	0.10%	2	0.00%	0	2.37%	995	11,105
Ear, Nose, & Throat	8.18%	44	8.18%	132	0.00%	0	2.02%	847	4,922
Ophthalmology	3.35%	18	3.35%	54	0.00%	0	1.39%	584	4,711
Physiotherapy	0.18%	1	0.18%	3	0.00%	0	1.13%	473	5,278
Pediatrics	9.56%	52	9.56%	154	0.00%	0	4.09%	1,719	13,891
Neurology & Psychiatry	0.76%	4	0.76%	12	0.00%	0	0.48%	203	1,756
Plastics & Burn	0.26%	1	0.26%	4	0.00%	0	2.23%	935	10,553
Outpatient	0.00%	0	0.00%	0	0.00%	0	0.33%	137	1,731
Obstetric & Gynecology	5.35%	29	5.35%	86	0.00%	0	6.88%	2,888	28,488
Total	77.05%	418	77.05%	1,240	0.00%	0	51.19%	21,499	197,951
Total All Departments	100.00%	543	100.00%	1,609	100.00%	5,117	100.00%	41,995	372,102

TABLE 4.4
ALLOCATION OF INTERMEDIATE DEPARTMENT COSTS TO FINAL DEPARTMENTS
EMBABA HOSPITAL

Cost Items	DISTRIBUTION OF ANCILLARY COST AMONG FINAL SERVICE DEPARTMENTS							
	Laboratory		Radiology		Sterilization		Anaesth. & Oper.Th.	
	Prop. of Total Patients	Allocated Amount L.E.	Prop. of Total Patients	Allocated Amount L.E.	Prop. of Total Patients	Allocated Amount L.E.	Prop. of Total Patients	Allocated Amount L.E.
A. Overhead Departments								
1 Assist. & Supp Serv								
2 Maintenance								
3 Director's Secr.								
4 Finance								
5 Cashier								
6 Telephone System								
7 Personnel Affairs								
8 Stores								
9 Security/Police								
10 Purchasing								
11 Patients' Affairs								
12 Soc. Serv & Stat								
13 Wireless Comm.								
14 Resident Physicians								
15 Nursing School								
TOTAL								
B. Intermediate Serv Depts								
16 Laboratory								
17 Dental Laboratory	0.27%	37	0.27%	23	0.27%	14	0.00%	0
18 Radiology	(Dental Lab is treated as final service department)							
19 Sterilization								
20 Anaesthesiology								
21 Operation Theaters								
22 Inpatient Pharmacy								
23 Kitchen								
24 Laundry								
25 Outpatient Pharmacy								
26 Pharmacy Economic								
TOTAL	0	37	0	23	0	14	0	0
C. Direct Service Depts								
27 Surgery	5.57%	763	5.57%	478	5.57%	291	57.12%	41,448
28 Internal Medicine	4.14%	567	4.14%	355	4.14%	216	0.00%	0
29 Urology	2.34%	320	2.34%	200	2.34%	122	0.44%	320
30 Emergency incl emr lab	14.31%	1,960	14.31%	1,227	14.31%	747	10.74%	7,790
31 Dental	2.32%	318	2.32%	199	2.32%	121	0.00%	0
32 Family Planning	0.00%	0	0.00%	0	0.00%	0	0.00%	0
33 Renal Dialysis	0.90%	123	0.90%	77	0.90%	47	0.00%	0
34 Orthopaedics	2.01%	276	2.01%	173	2.01%	105	0.15%	106
35 Dermatology	0.64%	88	0.64%	55	0.64%	34	0.00%	0
36 Intensive Care Unit	16.02%	2,194	16.02%	1,364	16.02%	836	0.00%	0
37 Ear, Nose, & Throat	5.02%	687	5.02%	430	5.02%	262	7.33%	5,318
38 Ophthalmology	2.69%	369	2.69%	231	2.69%	141	6.46%	4,687
39 Physiotherapy	0.67%	92	0.67%	58	0.67%	35	0.00%	0
40 Pediatrics	6.00%	821	6.00%	514	6.00%	313	0.00%	0
41 Neurology & Psychiatry	1.92%	264	1.92%	165	1.92%	100	0.00%	0
42 Plastics & Burn	0.96%	131	0.96%	82	0.96%	50	0.21%	155
43 Outpatient	0.18%	25	0.18%	16	0.18%	10	0.00%	0
44 Obstetric & Gynecology	34.02%	4,659	34.02%	2,918	34.02%	1,776	17.56%	12,743
TOTAL	99.73%	13,658	99.73%	8,552	99.73%	5,205	100.00%	72,568
TOTAL ALL DEPARTMENTS	100.00%	13,695	100.00%	8,576	100.00%	5,219	100.00%	72,568

Continued...

TABLE 4.4

DISTRIBUTION OF ANCILLARY COST AMONG FINAL SERVICE DEPARTMENTS						
Cost Items	Pharmacy		Hotel Services		Total Ancillary Cost Allocation	Cost at Final Dept After all Allocation
	Prop. of Total Patients	Allocated Amount L.E.	Prop. of Total Patients	Allocated Amount L.E.		
A. Overhead Departments						
1 Assist. & Supp Serv						
2 Maintenance						
3 Director's Secr.						
4 Finance						
5 Cashier						
6 Telephone System						
7 Personnel Affairs						
8 Stores						
9 Security/Police						
10 Purchasing						
11 Patients' Affairs						
12 Soc. Serv & Stat						
13 Wireless Comm.						
14 Resident Physicians						
15 Nursing School						5,117
TOTAL						5,117
B. Intermediate Serv Depts						
16 Laboratory						
17 Dental Laboratory	0.27%	116	0.27%	61	252	4,685
18 Radiology						
19 Sterilization						
20 Anaesthesiology						
21 Operation Theaters						
22 Inpatient Pharmacy						
23 Kitchen						
24 Laundry						
25 Outpatient Pharmacy						
26 Pharmacy Economic						
TOTAL	0	116	0	61	252	4,685
C. Direct Service Depts						
27 Surgery	5.57%	2,360	5.57%	1,235	46,574	70,115
28 Internal Medicine	4.14%	1,753	4.14%	917	3,807	26,988
29 Urology	2.34%	990	2.34%	518	2,471	12,453
30 Emergency incl emr lab	14.31%	6,063	14.31%	3,174	20,962	33,699
31 Dental	2.32%	985	2.32%	515	2,139	11,427
32 Family Planning	0.00%	0	0.00%	0	0	230
33 Renal Dialysis	0.90%	381	0.90%	200	828	26,011
34 Orthopaedics	2.01%	853	2.01%	447	1,960	9,729
35 Dermatology	0.64%	272	0.64%	142	591	4,196
36 Intensive Care Unit	16.02%	6,788	16.02%	3,553	14,746	25,850
37 Ear, Nose, & Throat	5.02%	2,125	5.02%	1,112	9,935	14,858
38 Ophthalmology	2.69%	1,141	2.69%	597	7,165	11,876
39 Physiotherapy	0.67%	285	0.67%	149	620	5,898
40 Pediatrics	6.00%	2,541	6.00%	1,330	5,520	19,411
41 Neurology & Psychiatry	1.92%	815	1.92%	427	1,771	3,527
42 Plastics & Burn	0.96%	405	0.96%	212	1,035	11,588
43 Outpatient	0.18%	78	0.18%	41	170	1,901
44 Obstetric & Gynecology	34.02%	14,413	34.02%	7,544	44,054	72,542
TOTAL	99.73%	42,250	99.73%	22,115	164,348	362,300
TOTAL ALL DEPARTMENTS	100.00%	42,366	100.00%	22,176	164,600	372,102

TABLE 4-5
FREQUENCY OF SERVICES AT RADIOLOGY DEPARTMENT
BY PROCEDURES DURING (1991)

NAME	Frequency (Cases)	Fee Charged at EMBABA (L.E.)	Fee Charged at HIO (L.E.)	Fee Charged at CCO (L.E.)	Fee Charged at Market (L.E.)
1 Plain Urine X-ray	1,229	8-12	8	6-10	20
2 IVP X-ray	279	20-24	22	13-23	120
3 Plain Gallbladder X-ray	2	8	8	4-7	40
4 Contr Gallbladder X-ray	1	16	15	6-18	20
5 Plain Chest X-ray	2,778	8	8	5-9	20
6 Plain Skull X-ray	1,091	12	12	9-12	40
7 Plain vert/pelvis X-ray	543	16	8-12	6-14	30
8 Plain bones X-ray	7,367	4-8	8-12	5-9	20
9 Plain/contr uterus X-ray	143	8-16	8	11-18	40
TOTAL	13,433				

TABLE 4-6
FREQUENCY OF LABORATORY PROCEDURES
AND CURRENT CHARGES ADJUSTED (1991)

NAME	Frequency (Cases)	Fee Charged at EMBABA (L.E.)	Fee Charged at HIO (L.E.)	Fee Charged at CCO (L.E.)
1 Complete urine analysis	19,468	3	3	2
2 Partial urine analysis	16,224	1	3	2
3 Hemoglobin %	11,902	1	2	2
4 Blood sugar	8,671	2	2	2-3
5 Stool analysis	8,193	3	1.5-3.5	2-5
6 Others	37,424			
TOTAL	101,882			

Composition of Cost at the Final Service Departments: Distribution of cost at final service departments by major cost categories is presented in *Table 4-7*. Column five, cost of intermediate (ancillary) service department procedures and services and directly assigned cost of drugs (39 percent of total cost) and column three, medical personnel (28 percent) are the two largest cost items allocated to final service departments. There is, however, wide variations in the composition of costs by departments. The proportion of total cost accounted for by drugs and intermediate (ancillary) service department procedures or services range from 65 percent in the Surgery department to 4 percent in Renal Dialysis department. Ear, Nose, and Throat, Ophthalmology, Emergency, and Gynecology are final service departments where more than 50 percent of total cost was allocated from intermediate (ancillary) service department procedures and services. Cost of medical labor varies from 83 percent of total cost in the Dental Laboratory to 8 percent in the Renal Dialysis department. Cost of medical personnel in Internal Medicine, Dermatology, and Physiotherapy account for 50 percent or more of total cost. Overhead departments, plant and equipment, and hotel services¹³ each contribute 6 percent or more of total cost to the Final Service departments.

Allocation of Cost at Final Service Departments to Patient Categories: Based on information on the relative differences in resource use by patient category (see *Section 3.2*), estimates were made of the number of cases by patient category treated in final service departments in 1991, total cost at final service departments, and the average cost of inpatient, outpatient, and emergency cases. The average costs of inpatient, outpatient, and emergency cases in the final service departments are provided in *Table 4-8*.

There is substantial variation in inpatient cost by departments. The average cost of inpatient discharge varies from LE 599 at Intensive Care Unit (ALOS 7.9 days), to LE 31 (ALOS 1.1 days) Ear, Nose and, Throat (ENT) department, with a hospital-wide inpatient cost of LE 84 (ALOS 5.3). The median cost per discharge of inpatient care is about LE 45, implying that the high cost of a few procedures or services at some departments is balanced by low cost in many others.

Inpatient discharge costs for surgery cases across all departments have not been separately estimated at this level. The inpatient cost at the Surgery department is estimated at LE 90 (ALOS 3.8 days). The average cost of outpatient care at Embaba Hospital is LE 8.

The high cost at the Dialysis department has caused substantial upward bias to the average cost. The median cost of outpatient cases is LE 3.1. The average cost of emergency cases at Embaba is similar to median cost of outpatient care at LE 3.9.

It must be noted that costs in *Table 4-8* do not include the cost of prescribed drugs, medical materials, and ancillary procedures and services obtained by patients from sources other than Embaba Hospital. These costs (outside costs) make up a substantial portion of total expenditures incurred by Embaba patients. Those expenditures will be discussed in more detail in *Section 4.2*.

¹³ For presentation of costs by area of service in this table, hotel services were identified separately from overhead departments.

**TABLE 4-7
DISTRIBUTION OF COST BY COST CATEGORIES IN FINAL SERVICE DEPARTMENTS**

	Total Cost Month After All Allocations	Cost of Overhead Support		Cost of Medical Personnel		Cost of Plant and Equipment		Cost of Drugs ¹ and Ancillary Services		Cost of Medical Supplies		Cost of Hotel Services	
		LE	PC	LE	PC	LE	PC	LE	PC	LE	PC	LE	PC
1 Dental Laboratory	4,685	433	9%	3,874	83%	90	2%	191	4%	27	1%	61	1%
2 Surgery	70,115	2,467	4%	16,797	24%	1,698	2%	45,339	65%	2,579	4%	1,235	2%
3 Internal Medicine	26,988	2,757	10%	16,096	60%	1,029	4%	2,890	11%	3,299	12%	917	3%
4 Urology	12,453	979	8%	3,463	28%	376	3%	1,953	16%	5,164	41%	518	4%
5 Emergency (incl emr lab)	33,699	2,051	6%	2,156	6%	2,126	6%	17,788	53%	6,404	19%	3,174	9%
6 Dental	11,427	976	9%	4,374	38%	1,934	17%	1,623	14%	2,005	18%	515	5%
7 Family Planning	230	18	8%	0	0%	212	92%	0	0%	0	0%	0	0%
8 Renal Dialysis	26,011	2,110	8%	2,101	8%	4,419	17%	629	2%	16,552	64%	200	1%
9 Orthopaedics	9,729	904	9%	4,411	45%	1,003	10%	1,513	16%	1,452	15%	447	5%
10 Dermatology	4,196	458	11%	3,053	73%	94	2%	449	11%	0	0%	142	3%
11 Intensive Care Unit	25,850	995	4%	4,280	17%	2,632	10%	11,192	43%	3,198	12%	3,553	14%
12 Ear, Nose, & Throat	14,858	847	6%	3,798	26%	174	1%	8,823	59%	104	1%	1,112	7%
13 Ophthalmology	11,876	584	5%	3,014	25%	869	7%	6,568	55%	244	2%	597	5%
14 Physiotherapy	5,898	473	8%	2,918	49%	1,887	32%	471	8%	0	0%	149	3%
15 Pediatrics	19,411	1,719	9%	7,946	41%	1,477	8%	4,190	22%	2,748	14%	1,330	7%
16 Neurology & Psychiatry	3,527	203	6%	1,468	42%	85	2%	1,344	38%	0	0%	427	12%
17 Plastics & Burn	11,588	935	8%	3,922	34%	1,945	17%	823	7%	3,751	32%	212	2%
18 Outpatient	1,901	137	7%	0	0%	1,192	63%	129	7%	403	21%	41	2%
19 Obstetric & Gynecology	72,542	2,888	4%	17,981	25%	1,966	3%	36,509	50%	5,654	8%	7,544	10%
TOTAL	366,985	21,942	6%	101,652	28%	25,208	7%	142,424	39%	53,584	15%	22,176	6%

¹ Cost of drugs do not include prescribed drugs filled by outside pharmacies.

TABLE 4-8
BREAKDOWN OF COST BY PATIENT CATEGORIES IN FINAL SERVICE DEPARTMENTS (1990 DATA)
EMBABA HOSPITAL

Cost Items	Total Yearly Cost (LE) After all Allocation	DISTRIBUTION BETWEEN INPATIENT AND OUTPATIENT						
		INPATIENT				OUTPATIENT		
		Total Cost (LE)	Number Cases	ALOS	Cost/Dis- charge (LE)	Total Cost (LE)	Number Cases	Cost/ Visit(LE)
1 Dental Laboratory	56,513	0	0			56,513	503	
2 Surgery	845,764	342,236	3,822	3.77	89.54	503,528	18,428	27.32
3 Internal Medicine	325,541	131,729	1,304	3.91	101.02	193,812	62,066	3.12
4 Urology	150,215	60,784	464	14.00	131.00	89,431	9,995	8.95
5 Emergency	406,495					406,495	103,455	3.93
6 Dental	137,842	0	0			137,842	15,401	8.95
7 Renal Dialysis	313,753	0	0			313,753	1,510	207.78
8 Orthopaedics	117,360	47,489	600	2.27	79.15	69,871	19,448	3.59
9 Dermatology	50,619	0	0			50,619	12,286	4.12
10 Intensive Care Unit	311,818	311,818	521	7.90	598.50	0	0	
11 Ear, Nose, & Throat	179,221	72,521	2,317	1.09	31.30	106,700	38,959	2.74
12 Ophthalmology	143,258	57,969	227	5.00	255.37	85,289	16,666	5.12
13 Physiotherapy	71,144	0	0			71,144	907	78.44
14 Pediatrics	234,143	94,745	569	7.55	166.51	139,398	47,671	2.92
15 Neurology & Psychiatry	42,540	0	0			42,540	3,855	11.04
16 Plastics & Burn	139,781	56,562	348	1.98	162.53	83,219	955	87.14
17 Obstetrics & Gynecology	875,040	354,082	8,027	5.58	44.11	520,958	18,989	27.43
TOTAL	4,401,047	1,529,935	18,199	5.31	84.07	2,871,112	371,094	7.74

4. 2 COST OF RESOURCES USED IN FREQUENTLY PROVIDED PROCEDURES

A number of frequently performed inpatient, outpatient, and emergency procedures by final service departments were assessed for their use of resources. A summary of the number of procedures assessed in each final service department and the corresponding number of cases reported in 1991 is shown in *Table 4-9*.

The procedures represent almost two-thirds of all cases with almost equal representation from inpatient and outpatient categories but substantially lower representation for emergency cases. The procedures examined represent a major portion of the total patients registered in all departments except Internal Medicine and Psychiatry, which accounted for less than 25 and 20 percent of total patients registered, respectively.

4. 2. 1 Cost Analysis of All Patient Categories

A group of physicians from each final service department was interviewed to determine an estimate of the resources used to perform some of the frequently dispensed medical procedures in their respective departments. These resources include the amount of time required by medical personnel to perform a procedure or service, amount of drugs prescribed, time use of various equipment, number and types of diagnostic examinations performed, and other services. Cost of the estimated resources used in a procedure, along with assigned and allocated costs of overhead departments (explained in Section 3), plant and equipment, hotel services, and intermediate (ancillary) service departments represent total resource cost of a procedure.

The average cost of resources used in the procedures assessed is presented in *Table 4-10*. The procedures in each department are classified by patient category (inpatient discharge and outpatient visit). The emergency procedures are averaged under the Emergency department.¹⁴

Comparison of Cost of Procedures by Departments: There is considerable variation in average cost of procedures by departments, ranging from LE 645 in the Intensive Care Unit to LE 5 in the Orthopedic department. The proportion of inpatient to outpatient services, of surgical cases to other cases, and (ALOS) for inpatient cases are the major determinants of the large variation in cost between departments. In the Intensive Care Unit, all cases are inpatient cases and have high ALOS (7.9 days), compared with less than 3 percent inpatient cases and very few surgical procedures in the Orthopedics department. The cost of a procedure in the Surgery department, where inpatients comprise about 7 percent (*Table 4-9*) of all cases, is LE 32 (average cost of an inpatient procedure is LE 326, an outpatient procedure is LE 11).¹⁵

¹⁴ A detailed description of procedures assessed in each department is on file at the HFS Information Center.

¹⁵ The direct cost of services by procedure, including information on departments, number of cases, and estimated cost, is on file at the HFS Information Center.

TABLE 4-9
NUMBER OF CASES RECORDED IN FINAL SERVICE DEPARTMENT BY
BY PATIENT CATEGORIES (1990)

	OUTPATIENTS	INPATIENTS	TOTAL	TOTAL INPATIENT DAYS	AVERAGE LENGTH OF STAY
1 General Surgery	18,428	3,822	22,250	14,409	3.77
2 Urology	9,995	464	10,459	6,496	14.00
3 Orthopaedics	19,448	600	20,048	1,362	2.27
4 Ear, Nose & Throat	38,959	2,317	41,276	2,526	1.09
5 Obstetrics & Gynecology	18,989	8,027	27,016	44,791	5.58
6 Internal Medicine	62,066	1,304	63,370	5,099	3.91
7 Pediatrics	47,671	569	48,240	4,296	7.55
8 Burns & Plastic	955	348	1,303	689	1.98
9 Ophthalmology	16,666	227	16,893	1,135	5.00
10 Intensive Care Unit		521	521	4,116	7.90
11 Physiotherapy	907		907		
12 Dermatology	12,286		12,286		
13 Neurology & Psychology	3,855		3,855		
14 Dentistry	15,401		15,401		
15 Dental Lab	503		503		
16 Renal Dialysis	1,510		1,510		
17 Emergency Patients	103,455		103,455		
TOTAL PATIENTS	371,094	18,199	389,293	96,637	5.31

TABLE 4-10

COMPOSITION OF COST FOR ALL PATIENT CATEGORIES BY FINAL SERVICE DEPARTMENT

	(Average of all procedures, in L.E.)								
	Average Cost of Procedure	Personnel Cost		Cost of Drugs & & Medical Supplies		Fixed Cost			Ancillary Services
		Physician	Others	EMBABA	Outside	Plant & Equipment	Overhead Support	Hotel Services	
Dental Laboratory	18.77	3.22	1.92	0.86	(0.00)	2.20	10.57	1.64	0.11
Surgery	32.38	1.64	0.73	3.51	0.41	0.96	1.24	1.07	22.81
Internal Medicine	7.16	0.47	0.15	0.60	4.48	0.25	0.49	0.28	0.46
Urology	53.45	1.72	0.72	8.08	34.06	0.46	1.08	1.15	6.19
Emergency/incl emr lab	6.35	0.80	0.49	2.13	2.38	0.25	0.20	0.02	0.09
Dental	12.50	1.28	0.15	2.23	6.53	1.56	0.75	0.16	0.09
Family Planning									
Renal Dialysis	189.77	4.14	1.49	132.89	0.00	35.17	16.08	0.05	0.00
Orthopaedics	5.00	0.12	0.83	0.83	1.32	0.65	0.49	0.36	0.41
Dermatology	12.12	0.47	0.02	0.06	11.02	0.14	0.41	0.11	0.03
Intensive Care Unit	645.32	150.74	140.04	200.04	15.96	60.60	21.83	31.41	24.69
Ear, Nose, & Throat	7.45	0.97	0.18	1.82	1.23	0.10	0.22	0.31	2.63
Ophthalmology	16.14	1.17	0.33	1.04	8.74	0.67	0.38	0.37	3.44
Physiotherapy	60.63	6.93	0.09	0.02	12.51	25.02	5.69	2.00	8.38
Pediatrics	7.82	0.82	0.36	0.99	4.17	0.42	0.40	0.42	0.25
Neurology & Psychiatry	13.94	3.97	0.75	0.02	6.79	0.32	0.58	0.51	1.00
Plastics & Burn	39.29	2.63	0.62	15.26	5.50	8.28	3.61	0.67	2.72
Outpatient									
Obstetric & Gynecology	69.10	7.45	4.45	9.27	30.88	0.90	0.34	6.32	9.48
TOTAL	19.66	1.63	0.82	3.23	7.82	0.85	0.65	1.03	3.64

Continued...

TABLE 4-10

(Average of all procedures in L.E.)

	Average	Personnel Cost		Cost of Drugs & Medical Supplies		Fixed Cost			Ancillary Services
	Cost of					Plant &	Overhead	Hotel	
	Procedure	Physician	Others	EMBABA	Outside	Equipment	Support	Services	
Dental Laboratory									
Surgery	100%	5%	2%	11%	1%	3%	4%	3%	70%
Internal Medicine	100%	7%	2%	8%	63%	3%	7%	4%	6%
Urology	100%	3%	1%	15%	64%	1%	2%	2%	12%
Emergency incl emr lab									
Dental	102%	10%	1%	18%	52%	12%	6%	1%	1%
Family Planning									
Renal Dialysis	100%	2%	1%	70%	0%	19%	8%	0%	0%
Orthopaedics	100%	2%	17%	17%	26%	13%	10%	7%	8%
Dermatology	101%	4%	0%	0%	91%	1%	3%	1%	0%
Intensive Care Unit	100%	23%	22%	31%	2%	9%	3%	5%	4%
Ear, Nose, & Throat	100%	13%	2%	24%	16%	1%	3%	4%	35%
Ophthalmology	100%	7%	2%	6%	54%	4%	2%	2%	21%
Physiotherapy	100%	11%	0%	0%	21%	41%	9%	3%	14%
Pediatrics	100%	10%	5%	13%	53%	5%	5%	5%	3%
Neurology & Psychiatry	100%	28%	5%	0%	49%	2%	4%	4%	7%
Plastics & Burn	100%	7%	2%	39%	14%	21%	9%	2%	7%
Outpatient									
Obstetric & Gynecology	100%	11%	6%	13%	45%	1%	0%	9%	14%
TOTAL	100%	8%	4%	16%	40%	4%	3%	5%	19%

Abscess, goiter, hemorrhoidectomy, lipoma, and circumcision are some of the most common outpatient procedures performed at the Surgery department. The average cost of these cases range from LE 4 to LE 68.

Among the more frequently performed inpatient surgical procedures are hernia (447 cases, average cost of LE 280), piles (203 cases, average cost of LE 247), appendectomy (546 cases, average cost of LE 212), and cholecystectomy (88 cases, average cost of LE 648). The Obstetrics and Gynecology department provides the largest number of procedures and services at Embaba Hospital. Average cost of a procedure in the Obstetrics and Gynecology department is LE 69 (inpatient cost is LE 142, outpatient cost is LE 38). The cost of normal delivery (generally a day case) is LE 36, whereas a caesarian section (ALOS eight days) costs about LE 297. The average cost of a procedure at the Internal Medicine department is LE 7 (inpatient cost is LE 64, outpatient cost is LE 6), ranging from LE 1 for a simple gastroenteritis case (outpatient) to LE 168 for a serious heart failure case with 10 days, ALOS.

Composition of Cost of Procedures by Final Departments: A detailed breakdown of average cost of final service departments procedures for each category of patients is presented in the top part of *Table 4-10*. The bottom part of the table shows the proportion of personnel, drugs, and medical supplies, plant and equipment, overhead departments, hotel services, and intermediate (ancillary) service department costs to total cost. Cost of drugs and medical supplies (56 percent) and intermediate (ancillary) service departments procedures and services (19 percent) are the largest portion of total cost.

Personnel time used in an average procedure represents 12 percent of cost total resources used. Procedures in the departments of Neurology, Intensive Care, and Orthopedics use relatively more labor (33, 44, and 19 percent respectively) than other departments. Departments of Urology, Renal Dialysis, and Dermatology use the least amount of labor (less than 4 percent in each department) relative to other resources in the delivery of procedures and services.

4. 2. 2 Cost Analysis by Patient Category

This section describes the cost of resources used in the medical procedures assessed by patient category. The average cost of resources used in each patient category was estimated by dividing the sum of the cost of the resources used by the total number of cases in the patient category. *Table 4-11* summarizes the average cost of resources used by patient category. The amount of time various categories of medical and non-medical personnel spend in direct contact with patients in final service departments, is presented in the bottom half of *Table 4-11*.¹⁶

Cost of All Procedures: The average hospital-wide cost of treatment at Embaba Hospital is estimated to be LE 19.66 (*Table 4-11*). As expected, the cost of inpatient discharge is substantially higher than the average cost of outpatient or emergency procedure. The cost of an outpatient visit is about twice that of an emergency case.

Because Embaba Hospital provides their patients with only a fraction of the drugs and medicine necessary for treatment, the cost of drugs obtained by patients from sources other than the hospital constitute the largest single account of cost for an episode of treatment protocol, representing almost 40 percent (*Table 4-11*) of total cost. Embaba pharmacy provides only 20 percent of all prescribed drugs. The major cost items after outside drugs are intermediate (ancillary) service department procedures and services, including hotel services representing 21 percent and personnel representing 15 percent of cost. Capital costs and cost of overhead departments are responsible for about 7 percent of cost. Average cost of inputs used to provide final service departments medical procedures or services measured by an episode of treatment is shown in the top part of *Table 4-12*.

Cost of Inpatient Discharge: A total of 80 inpatient procedures representing 13, 556 cases were assessed for resource use. The average cost of an inpatient discharge (ALOS 5.3 days), was LE 152.7 (*Table 4-11*, top). The

¹⁶ A more detailed breakdown of cost by departments for all inpatient, outpatient, and emergency procedures assessed is on file at the HFS Information Center.

cost of an inpatient day at Embaba Hospital is estimated to be LE 29. Intermediate (ancillary) service departments procedures and services (30 percent of total discharge cost) account for the largest share of total cost of inpatient discharge, followed by drugs and supplies (19 percent) and personnel (20 percent). Hotel service costs, which include laundry and meals, and capital and overhead department costs represent 12 and 6 percent of total costs respectively. The remaining 13 percent relates to the cost of drugs purchased outside Embaba Hospital.

An average Embaba patient receives about 43 minutes of final service department attention from medical and non-medical personnel, and an inpatient case receives over nine hours of personnel services over the five-day period (*Table 4-11*, bottom). Almost half of the personnel time spent on an inpatient case is provided by nurses and 30 percent is provided by resident physicians. The breakdown of cost of inpatient procedure by departments is presented in *Table 4-12*.

Cost of Outpatient Visit: Outpatient cases represent almost 69 percent of all patients at Embaba. About 112 outpatient procedures, representing more than half of the total cases, were studied to estimate outpatient visit cost of resources used. The average cost of the procedures studied was found to be about LE 12 (*Table 4-12*, bottom). About 60 percent of the cost is accounted for by drugs bought by the patients from facilities outside Embaba Hospital. Embaba provides only about 7 percent of the drugs (representing 4 percent of total cost) required for outpatient cases. Compared to inpatient cases, significantly fewer diagnostic tests and examinations are conducted for outpatient cases. Outpatient ancillary procedures and services represent about 11 percent of total outpatient cost. This is also true for the consulting/care time of physicians. An outpatient case receives less than 11 minutes of physician time, and the cost of personnel time contributes to less than seven percent of total cost. A breakdown of cost of outpatient procedures by department is presented in *Table 4-13*.

Cost of Emergency Procedure: A total of 20 emergency procedures were examined to determine the cost of resources used. The number of cases for each procedure was not determined because of a dearth of information. Therefore, the cost of a procedure for emergency cases is an average of the procedures examined. Average cost of an emergency procedure was LE 6 (*Table 4-11*, top). Like the outpatient cases, drugs and medical supplies comprise the largest share of total cost of emergency cases (71 percent). A higher percentage of drugs, however, is provided by the hospital in emergency cases than outpatient cases. Significantly more personnel time is also spent on emergency cases (26 minutes compared to 15 minutes for outpatients).

TABLE 4-11
HOSPITAL-WIDE DISTRIBUTION OF AVERAGE COSTS BY PATIENT
CATEGORIES (AVERAGE OF ALL PROCEDURES, IN L.E.)

	Average Cost of All Procedure	Average Cost In-patient Discharge	Average Cost Out-patient Visit	Average Cost Emergency Procedure
Physician Time	1.63	18.81	0.68	0.79
Other Personnel Time	0.82	12.34	0.18	0.52
Drugs from Embaba	1.57	20.40	0.54	1.39
Drugs from Outside	7.82	18.74	7.22	2.39
Medical Supplies	1.65	9.93	1.19	0.74
Ancillary Services	3.64	45.40	1.33	0.09
Hotel Services	1.03	17.96	0.09	0.02
Bldg. & Equip. Depr.	0.85	4.99	0.62	0.25
Overhead Support	0.65	4.19	0.45	0.20
TOTAL	19.66	152.76	12.30	6.39

TABLE 4-12
COMPOSITION OF INPATIENT COST BY FINAL SERVICE DEPARTMENT

(Average of all procedures, in L.E.)									
	Average Cost of Procedure	Personnel Cost		Cost of Drugs & & Medical Supplies		Fixed Cost			Ancillary Services
		Physician	Others	EMBABA	Outside	Plant & Equipment	Overhead Support	Hotel Services	
Dental Laboratory									
Surgery	325.52	15.40	7.36	46.20	6.11	8.80	11.92	15.06	214.67
Internal Medicine	63.63	8.33	3.25	17.41	3.60	3.51	8.73	15.29	3.68
Urology	357.87	47.84	17.03	140.25	12.30	10.56	26.03	57.05	46.83
Emergency incl emr lab									
Dental									
Family Planning									
Renal Dialysis									
Orthopaedics	104.01	4.49	2.48	17.62	49.70	3.95	3.17	9.17	13.42
Dermatology									
Intensive Care Unit	645.32	150.74	140.04	200.04	15.96	60.60	21.83	31.41	24.69
Ear, Nose, & Throat	43.03	5.29	2.92	0.39	2.56	0.48	1.77	4.48	25.16
Ophthalmology	448.27	24.32	8.48	79.37	30.60	13.22	8.06	21.15	263.07
Physiotherapy									
Pediatrics	177.77	21.39	26.52	50.99	8.29	15.21	16.25	30.05	9.07
Neurology & Psychiatry									
Plastics & Burn	352.19	16.80	4.64	109.97	121.95	56.22	24.63	11.74	6.25
Outpatient									
Obstetric & Gynecology	142.16	22.17	14.53	28.61	23.25	2.68	0.93	21.16	28.83
TOTAL	152.74	18.81	12.34	30.33	18.74	4.99	4.19	17.96	45.40

Continued...

TABLE 4-12 - COMPOSITION OF INPATIENT COST BY FINAL SERVICE DEPARTMENT

(Average of all procedures, in L.E.)									
	Average Cost of Procedure	Personnel Cost		Cost of Drugs & & Medical Supplies		Fixed Cost			Ancillary Services
		Physician	Others	EMBABA	Outside	Plant & Equipment	Overhead Support	Hotel Services	
Dental Laboratory									
Surgery	100%	5%	2%	14%	2%	3%	4%	5%	66%
Internal Medicine	100%	13%	5%	27%	6%	6%	14%	24%	6%
Urology	100%	13%	5%	39%	3%	3%	7%	16%	13%
Emergency/inc.emr lab									
Dental									
Family Planning									
Renal Dialysis									
Orthopaedics	100%	4%	2%	17%	48%	4%	3%	9%	13%
Dermatology									
Intensive Care Unit	100%	23%	22%	31%	2%	9%	3%	5%	4%
Ear, Nose, & Throat	100%	12%	7%	1%	6%	1%	4%	10%	58%
Ophthalmology	100%	5%	2%	18%	7%	3%	2%	5%	59%
Physiotherapy									
Pediatrics	100%	12%	15%	29%	5%	9%	9%	17%	5%
Neurology & Psychiatry									
Plastics & Burn	100%	5%	1%	31%	35%	16%	7%	3%	2%
Outpatient									
Obstetric & Gynecology	100%	16%	10%	20%	16%	2%	1%	15%	20%
TOTAL	100%	12%	8%	20%	12%	3%	3%	12%	30%

TABLE 4-13

COMPOSITION OF OUTPATIENT COST BY FINAL SERVICE DEPARTMENT

(Average of all procedures, in L.E.)

	Average	Personnel Cost		Cost of Drugs & Medical Supplies		Fixed Cost			Ancillary
	Cost of					Plant &	Overhead	Hotel	
	Procedure	Physician	Others	Embaba	Outside	Equipment	Support	Services	Services
Dental Laboratory	18.77	3.22	1.92	0.86	(0.00)	2.20	10.57	1.64	0.11
Surgery	11.41	0.65	0.26	0.46	0.00	0.40	0.48	0.14	9.03
Internal Medicine	6.29	0.35	0.10	0.34	4.49	0.20	0.36	0.05	0.41
Urology	48.02	0.89	0.43	5.72	34.45	0.27	0.63	0.15	5.47
Emergency/inc.emr lab	6.35	0.80	0.49	2.13	2.38	0.25	0.20	0.02	0.09
Dental	12.50	1.28	0.15	2.23	6.53	1.56	0.75	0.16	0.09
Family Planning									
Renal Dialysis	189.77	4.14	1.49	132.89	0.00	35.17	16.08	0.05	0.00
Orthopaedics	2.31	0.00	0.79	0.37	0.00	0.56	0.41	0.12	0.05
Dermatology	12.12	0.47	0.02	0.06	11.02	0.14	0.41	0.11	0.03
Intensive Care Unit									
Ear, Nose, & Throat	5.44	0.73	0.02	1.90	1.15	0.08	0.13	0.07	1.36
Ophthalmology	11.12	0.91	0.24	0.13	8.48	0.52	0.29	0.13	0.42
Physiotherapy	60.63	6.93	0.09	0.02	12.51	25.02	5.69	2.00	8.38
Pediatrics	5.80	0.57	0.05	0.39	4.12	0.24	0.21	0.07	0.14
Neurology & Psychiatry	13.94	3.97	0.75	0.02	6.79	0.32	0.58	0.51	1.00
Plastics & Burn	39.29	2.63	0.62	15.26	5.50	8.28	3.61	0.67	2.72
Outpatient									
Obstetric & Gynecology	38.21	1.23	0.19	1.09	34.11	0.15	0.09	0.05	1.30
TOTAL	12.31	0.68	0.18	1.73	7.22	0.62	0.45	0.09	133

Continued...

TABLE 4-13 - COMPOSITION OF OUTPATIENT COST BY FINAL SERVICE DEPARTMENT

(Average of all procedures, P.C. of average cost)									
	Average Cost of Procedure	Personnel Cost		Cost of Drugs & & Medical Supplies		Fixed Cost			Ancillary Services
		Physician	Others	EMBABA	Outside	Plant & Equipment	Overhead Support	Hotel Services	
Dental Laboratory									
Surgery	100%	6%	2%	4%	0%	4%	4%	1%	79%
Internal Medicine	100%	6%	2%	5%	71%	3%	6%	1%	6%
Urology	100%	2%	1%	12%	72%	1%	1%	0%	11%
Emergency/inc.emr lab									
Dental									
Family Planning									
Renal Dialysis									
Orthopaedics	100%	0%	34%	16%	0%	24%	18%	5%	2%
Dermatology									
Intensive Care Unit									
Ear, Nose, & Throat	100%	13%	0%	35%	21%	2%	2%	1%	25%
Ophthalmology	100%	8%	2%	1%	76%	5%	3%	1%	4%
Physiotherapy									
Pediatrics	100%	10%	1%	7%	71%	4%	4%	1%	2%
Neurology & Psychiatry									
Plastics & Burn	100%	7%	2%	39%	14%	21%	9%	2%	7%
Outpatient									
Obstetric & Gynecology	100%	3%	1%	3%	89%	0%	0%	0%	3%
TOTAL	100%	5%	1%	14%	59%	5%	4%	1%	11%

Total Cost of Procedures and Services at Embaba Hospital: The average cost of procedures for inpatient, outpatient, and emergency cases multiplied by the corresponding frequency of cases should technically translate into total cost of resources used in the hospital. It must be noted, however, that the procedures assessed were identified by the physicians of the hospital, and as such there could be a bias toward listing procedures with more significant treatment protocol. Therefore, the mean of estimated resources used for the sample procedures is expected to be higher than the mean of the population. The cost of resources used for treatment and other medical procedures and services at Embaba Hospital is presented by patient category in *Table 4-14*.

Total cost of all procedures at Embaba, estimated through the resource use method, amounted to LE 6.7 million. Of this total, resources of LE 4.2 million, representing about 62 percent of total cost, came from sources within Embaba Hospital.¹⁷ The remaining resources, LE 2.5 million or 37 percent of total cost, were obtained by the patients from sources outside of the hospital. The proportion of cost resulting from outside expenses is more significant in the case of outpatient procedures and services. Materials from outside sources were primarily drugs, medical supplies, and specialized ancillary procedures and services such as CAT (computerized axial tomography) scan that were not available at Embaba Hospital.

Total medical personnel time used directly in the production of procedures and services is shown in the bottom half of *Table 4-14*. A comparison of total time spent in final service consultation with patients and total time available (total paid hours) indicates either that medical personnel spent a considerable amount of time preparing for cases or on administrative duties within the department, or that the hospital has excess capacity in terms of personnel time.

It is estimated that annually there are 543,996 hours of medical labor time¹⁸ available in the final services departments. Only 52 percent of that time was spent in final service contact with patients (*Table 4-14*, bottom). The difference between total paid time and time spent on final service patient care is most significant in the case of assistant specialists who spent only about a quarter of their available time with patients. Nurses also spent less than half their paid time on final service patient care. But on the high end, the physician residents spent almost three-quarters of their available time on final service patient care.

¹⁷ This is comparable with the total expenditure of L.E. 4.3 million estimated for Embaba-Hospital through the step-down process (see *Table 4-1*).

¹⁸ This figure includes paid time of specialists, consultants, assistant specialists, resident, physicians, and nurses.

TABLE 4-14
HOSPITAL-WIDE DISTRIBUTION OF TOTAL COSTS BY PATIENT CATEGORY
(TOTAL FOR ALL PROCEDURES IN L.E.)

	Total Cost of All Procedure	Total Cost Inpatient Discharge	Total Cost Outpatient Visit	Total Cost Emergency Procedure
Physician Time	606,047.16	342,323.19	181,994.52	81,729.45
Other Personnel Time	326,547.28	224,575.66	48,175.02	53,796.60
Drugs from EMBABA	659,587.11	371,259.60	144,525.06	143,802.45
Drugs from Outside	2,520,660.29	341,049.26	1,932,353.58	247,257.45
Medical Supplies	575,763.18	180,716.07	318,490.41	76,556.70
Ancillary Services	1,191,505.42	826,234.60	355,959.87	9,310.95
Hotel Services	353,010.65	326,854.04	24,087.51	2,069.10
Bldg & Equip. Depr	282,612.94	90,813.01	165,936.18	25,863.75
Overhead Support	217,382.36	76,253.81	120,437.55	20,691.00
TOTAL	6,733,116.39	2,780,079.24	3,291,959.70	661,077.45

4. 3 SENSITIVITY ANALYSIS

The preceding analysis determined the average cost of producing various procedures and services at Embaba Hospital in the current cost environment. Average cost is a good pricing index if changes in quantity of procedures or services has no impact on incremental cost. The implicit assumptions behind using average cost as a valid measure of cost of incremental procedures and services are that (1) there is a constant return to scale; (2) all costs are variable, implying ability to purchase additional resources of all inputs in the level of units used; and (3) there is no excess capacity in any of the inputs used. These are quite limiting assumptions, but in the absence of data required to estimate marginal cost for health care services, average cost is often used as a pricing mechanism.

In this section, the impact of changes in demand conditions on the average cost of patient procedures and services are examined for different resource use scenarios (described below). The objective is to demonstrate how the methodology could be used to estimate average cost¹⁹ (and thereby price) of a case when resource use patterns change in anticipation of improvement in quality of procedures and services, under various demand scenarios.

The first scenario shows the effect of an increase of 10 percent in patient load on the average cost of patient procedures or services at Embaba Hospital presented in *Table 4-15*. Earlier analysis showed that medical personnel spend only 60 percent of their paid time in final service consultation with patients. Assuming that the medical personnel spend 30 percent of their time on administrative chores, medical personnel would still have time to see an additional patient load without any increase in personnel cost. Assuming excess capacity also exists in equipment, medical personnel, and overhead departments, a 10 percent rise in the patient load will lead to about a two percent drop in the average cost (see the first column of *Table 4-15*).

The second scenario, noted in the second column of *Table 4-15*, shows the effect on the average cost for a similar increase in inpatient load, resulting from perceived improvements of quality by increasing capital equipment use by 25 percent and overhead and medical personnel time by 10 percent. This will result in an increase of about 3 percent in total average cost.

In the third scenario, noted in the third column of *Table 4-15*, a drop in the cost of drugs and medical supplies and an increase in demand will result in a fall of the average cost by about 6 percent.

As can be seen from *Table 4-15*, increases in costs of medical personnel and capital inputs do not result in significant increases in average cost if demand increases relatively. On the other hand, if Embaba can lower the cost of drugs and medical supplies by improving internal capacity and bulk purchases, the average cost of procedures and services drops considerably if demand rises substantially.

¹⁹ Price based on average cost of the product is among the most frequently used pricing methodology for public goods.

TABLE 4-15
AVERAGE PATIENT CONTACT TIME BY PERSONNEL CATEGORY
(MINUTES PER CASE BY PATIENT CATEGORY)

	Average Time of all Procedure	Average Time Inpatient Discharge	Average Time Outpatient Visit	Average Time Emergency Procedure
Specialists	4.13	72.26	1.66	0.52
Assistant Specialists	2.66	34.81	1.43	1.42
Residents	18.00	171.65	7.61	12.21
Nurses	14.78	227.74	2.10	7.35
Technicians	1.05	0.10	1.40	0.31
Others	2.88	37.64	0.46	4.39
TOTAL	43.50	544.20	14.66	26.20

5.0 CONCLUSION

Public hospitals in developing countries usually are not organized to maintain elaborate cost accounting and monitoring systems within their facilities. Their accounting system is primarily designed to maintain proper records of expenditures for government institutions such as the MOH. Cost accounting for productivity management and pricing strategy is not relevant here.

On the other hand, in a competitive environment, success and financial subsistence of a facility like a hospital is critically dependent on its ability to produce procedures and services efficiently and to price them effectively. Reliable information on cost and productivity is therefore indispensable for production strategy and effective pricing. This study provides a process to collect and organize data on productivity of hospital services and applies it to Embaba Hospital. It is a one-time process to collect information on productivity and cost that otherwise should be collected and processed by the hospital on a continuous basis through an integrated accounting and productivity monitoring information system.

The study developed an easily replicable methodology to assess cost of resources used to produce hospital services. The study employs a step-down process to allocate joint costs and analyze the cost of the inputs used directly at the point of delivery of a procedure or service. The value of personnel time, equipment time, and material supplies used in diagnostic and treatment procedures and services are estimated from a sample of inpatient, outpatient, and emergency cases. This provides a useful data base on cost for the decisionmakers at Embaba Hospital.

Like most of the MOH hospitals in Egypt, Embaba Hospital provides primarily free inpatient and outpatient care to the population in the vicinity of the hospital. Limited user fees imposed on some cases, however, raise almost 20 percent of the total revenue for Embaba Hospital. User fees are not the only out-of-pocket expense for many of the patients. On average, Embaba patients incur out-of-pocket costs of LE 7.8 (representing about 40 percent of the cost of diagnosis and treatment per case, see *Table 4-11*) for drugs purchased from outside pharmacies. The proportion of outside cost to total cost is even higher for outpatient cases. Prescribed drugs obtained from outside sources account for almost 60 percent of total cost of an outpatient visit.

Embaba Hospital Board of Directors and management should explore the advantages and disadvantages of providing drugs from internal sources against having patients buy drugs at retail price from outside. To the extent Embaba can organize itself to supply prescribed drugs at a cost lower than the retail market price, it can reduce the cost of medical care at the hospital dramatically, and at the same time, improve perceived quality.

Most of Embaba Hospital's expenditures go to materials and supplies. Almost half of total costs is accounted for by cost of drugs, medical materials, and other medical and non-medical supplies. Medical and non-medical supplies at the operation theaters account for more than 25 percent of the cost of medical and other materials.

It also appears, from comparison of charges at other facilities, that the cost of operating theaters at Embaba is one of the very few services at the hospital that is higher than other hospitals. Therefore, a more thorough examination of the use of medical materials, especially in the operating theaters, would provide useful information for efficiency and cost control decisions.

Fixed salary, fringe, and other incentive payments to Embaba staff account for more than 40 percent of total expenditure at the hospital. Expenditure on personnel at intermediate and final service departments amounts to slightly more than 85 percent of personnel cost, while salaries of personnel at overhead departments represent 15 percent of total cost of labor.

An examination of the resource content of the final procedures and services shows that the cost of medical labor constitutes only about 15 percent (excluding the cost of drugs purchased from outside Embaba) of total cost.

Also, a comparison of total paid time of medical staff at final departments and total time actually spent on final service contact with the patients reveal that medical personnel spend only about 52 percent of their paid time on final service contact with the patients.

The difference is more remarkable in the outpatient cases than among the inpatient cases. This discrepancy between labor time available and labor time actually used on final service patient care suggests either that medical personnel at the service departments spend a substantial amount of their time on administrative and other managerial tasks, or that there is considerable excess capacity of medical labor. Further examination of this situation should provide valuable insight into cost management and productivity increases.

The cost of ancillary procedures and services account for less than 15 percent of total cost. As expected, it is substantially higher among the inpatient cases (approximately 30 percent of inpatient total costs) than among the outpatient or emergency cases (approximately 10 and 2 percent, respectively). As explained earlier, high cost of the use of the operating theaters contributes positively to increase the cost of ancillary procedures and services.

The high cost of procedures and services at the Renal Dialysis unit and the Plastics and Burn units should be independently considered for any rate setting strategy. The uniqueness of their procedures and services and difference in their structure of cost sets them apart from procedures and services at the other departments at Embaba Hospital. The inclusion of procedures and services provided by these two departments with other departments will inflate the general rate.

Although it is not the purpose of this study to provide recommendations for pricing strategy but to provide cost information to the decision makers, an important observation can be made based on the findings. Considering the large number of procedures and services at comparatively low cost provided by the Obstetric and Gynecology department, a small number of very expensive procedures and services at Plastic and Burn, Renal Dialysis, and Ophthalmology departments, and high cost but comparatively frequently provided surgical procedures at the Surgery department, different prices should be considered for each of these categories by inpatient and outpatient cases.

The methodology developed here to study cost has worked reasonably well. A small team of researchers was able to collect a substantial amount of useful information over a relatively short time. Valuable experience was gained from this study both in respect to the logistics and administration of undertaking such a project, and in ways to improve the model itself.

Shortcomings experienced in the methodology were easily remedied to make the methodology a more cost-effective way to collect and analyze cost data for hospitals going through conversion into a cost recovery mode of operation. First, an important element in the costing exercise was the collection of reliable and complete data on the number of cases and on procedures and services for each of the patient categories (inpatient, outpatient, and emergency). The difficulty of collecting reliable information on volume by type of procedure and service was not fully appreciated before undertaking data collection at Embaba Hospital. Considering the importance of this data element, the difficulty of collecting such data due to unreliable medical records, and the short period of time within which the task needed to be carried out, it is now felt that more intensive effort should have been given to the organization and execution of this effort. This kind of effort should be carried out over a longer period of time, and temporary investigators employed to collect this data should be more closely supervised.

Second, the sequence of activities to collect information on resources used in final procedures and the number of cases by procedure provided by departments should have been organized differently. The data on the number of patient cases by procedures should be collected prior to determining the frequency of procedures and the collection of data on resources used. When physicians were interviewed to identify the most frequent procedures performed in their respective departments, they often responded with the name of the most frequently performed significant procedures. This question would not have been necessary in the interviews, and more reliable data could have been obtained if the list of the most frequently provided procedures were obtained. The investigators then could have specified the procedures to the physicians who were asked to provide information on resources used.

APPENDIX

DETAILED METHODOLOGY OF THE COST STUDY

This appendix describes the cost study design and the data collection methodology employed in the cost study at Embaba hospital. The purpose of this appendix is to enable researchers to employ the methodology, modified for data sources and variability, in conducting cost analysis at other hospitals joining the cost recovery program.

The study was developed primarily to assist Embaba hospital establish fees for procedures and services once it is converted to a cost recovery system. It was therefore necessary not only to understand the cost of procedures and services at the current operating system, but also provide some understanding of how resources could be used to provide a desired level of procedure and service at competitive fees.

Analyses were conducted at four stages to describe costs at Embaba hospital. In the first stage, the indirect costs of supporting medical activities at the hospital were estimated. In the second stage, unit costs of intermediate services were determined. In the third stage, final service costs of resources used to produce medical procedures²⁰ at the medical departments were estimated. At the final stage, the unit of analysis is the cost of procedures at the level of inpatient, outpatient, or emergency cases. For inpatient cases, cost of both inpatient stays (admission to discharge) and inpatient day were estimated.

A.1 METHODOLOGY FOR ESTIMATING COST OF PROCEDURE AND SERVICE

The study employs a combination of resource use and accounting methods to determine unit costs of procedures and services at Embaba Hospital. It follows the accounting approach to examine cost of support services often termed as indirect service costs or overhead cost. Indirect service costs are measured by aggregating all fixed and variable costs incurred by the support departments. This was done through a combination of physical verification and examination of records from various indirect service and administration departments.

The indirect service cost is then distributed to the overhead, intermediate, and final service departments through a step-down method, according to allocation criteria devised to resemble as closely as possible the actual use of overhead resources by each of the departments. The step-down method is a more advanced cost-finding technique because it involves the distribution of costs from overhead departments to other overhead departments and finally to final medical service departments. The term "step-down" is used because the format in which the distribution of costs is made. The costs of an overhead department serving the most departments are distributed first, the overhead department serving the second largest number of departments is distributed next, and so on until all overhead department costs are distributed to final medical departments.

The costs of procedures and services at the intermediate department²¹ are also measured through a step-down accounting method. First, total final service expenses incurred by the intermediate departments are measured and aggregated with the overhead cost allocated to these departments. The total final service cost by intermediate departments is then divided among the various procedures and services performed within the departments according to the number of procedures and services and complexity of the procedure and service performed. The relative prices currently charged at Embaba Hospital and several other Health Insurance Organization (HIO), Curative Care

²⁰ In our analysis, a procedure is defined as a medical intervention that include diagnosis and diagnostic tests, treatment protocol and other services provided during one episode of illness. For inpatient it is analogous to services in an inpatient stay, and for outpatient and emergency visit, it pertains to services in one visit.

²¹Intermediate departments are those departments which offer services both to patients directly and to other medical departments. The intermediate departments generally include laboratory, pharmacy, radiology, etc. In our analysis, kitchen and laundry departments were also included in the intermediate category because cost in these centers were estimated and distributed similar to other intermediate departments.

Organization (CCO), and private hospitals in the area were used as proxies of the complexity factor of the identified procedures and services.

The final service cost of resources used to produce procedures and services offered at Embaba Hospital by the various final service medical service departments are measured through a combination of interviews, physical verification, and examination of medical records. The main focus of these activities is to determine the value of goods and final procedures and services directly received by the patients. Added to the final service costs are the costs of intermediate services received and the indirect cost of the support services provided by the overhead departments and passed on to the patients.

Costs related to the top two boxes are overhead costs that are distributed among the final service and intermediate service departments shown in the third tier. These overhead costs, together with costs of personnel time and materials provided directly to individual patients at the final service departments and the cost of intermediate services provided to individual patients (shown in the third tier), become the costs of a unit of medical procedure and service received by inpatient, outpatient, or emergency patients.

The following sub-sections are organized to describe each of the four stages of analysis followed in this study. The sections are structured to present the conceptual approach to the analysis, a step-by-step description with equations for estimating relevant medical procedure and service unit costs of procedures.

A.1.1 Costs to Be Allocated among all Departments

Fixed cost items 1, 2, 3, and 4 and operating cost item 5 are the total costs to be allocated to the overhead, intermediate service, and final service departments according to the proportion of support, materials, units of equipment, and procedures and services consumed by each department. Cost elements included in operating cost item 5 are variable costs only from the perspective of the overhead departments. For intermediate service and final service departments, however, they are fixed costs since they do not change with the number of procedures and services provided.

Fixed Costs: The fixed cost items are used for a long period of time (conventionally for more than one year) and therefore their costing poses two possible complications. The first is the concern of using historical cost versus replacement cost. The second involves choosing the base years for the depreciation period.

The historical cost is the price of the relevant item at the time of purchase. The replacement value is the cost of the item if it were to be replaced at the current market price. This study uses replacement cost for fixed cost items for various reasons, a dearth of historical data being the chief one.

The cost of buildings and units of equipment are depreciated according to the unified accounting method currently practiced in Egypt. There are two categories of cost: buildings and permanent structures and equipment and durable goods. The first includes those items that are used by all departments (buildings and permanent structures). Depreciated costs of these items are allocated to all departments according to the proportional use. The proportion of square meters of building space a department occupies compared to total building space was used as a proxy for cost allocation.

The second category, depreciated cost of units of equipment and durable goods that are exclusively used by specific departments are assigned and allocated fully to the respective departments. The cost of financing capital investments, if any, would be included in these costs. These include:

1. Cost of buildings and other permanent structures.
2. Cost of equipment and other durable goods including transportation equipment that can be specifically assigned and allocated to a department.
3. Cost of medical equipment that can be specifically assigned and allocated to a department.
4. Cost of overhead equipment, such as generators, elevators, incinerators, and other equipment that cannot be specifically assigned and allocated by departments.

Operating (Variable) Costs: Three categories were included in the operating cost (or recurrent cost) group: personnel working for each department, utilities (excluding electricity and water supply cost), and materials and supplies consumed by the department. Contracted services provided to the hospital (excluding consultants for medical procedures and services) are included in the Maintenance department. Cost of utilities are assigned to the Assist and Support Services department. These include:

5. Recurrent cost of operating each department. These are the costs of running the department including personnel, small equipment, supplies, material, electricity, fuel, general transportation (not ambulance), and other recurrent costs attributed to the department.

In algebraic form, total expenses of final service department i , can be estimated through the following equation:

$$TC_i = B_i PB + OE_i + \sum_{j=1}^n E_{ij} PE_{ij} + \sum_{j=1}^n L_{ij} W_{ij} + \sum_{j=1}^n C_{ij} PC_{ij} + U_i PU$$

Where

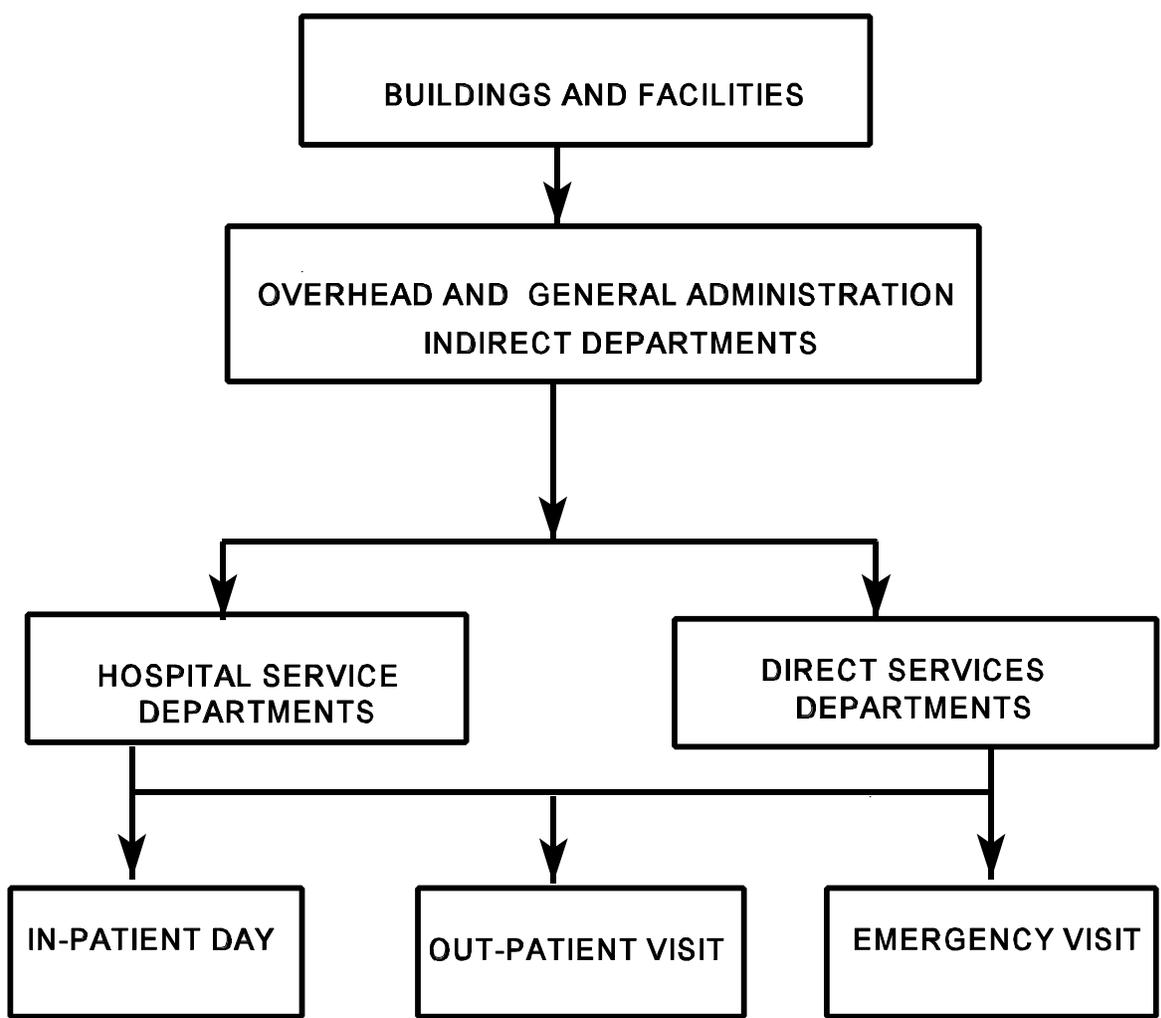
TC_i	=	Total expenses of department i
B_i	=	Total building space occupied by department i
PB	=	Depreciated cost of building space
OE_i	=	Share of depreciated overhead equipment cost allocated to department i
E_{ij}	=	Units of equipment in category j at department i
PE_{ij}	=	Depreciated cost of a unit of equipment j at department i
L_{ij}	=	Personnel in category j at department i
W_{ij}	=	Salary of personnel in category j at department i
C_{ij}	=	Units of consumable j used by department i
PC_{ij}	=	Unit price of consumable j
U_i	=	Units of utility consumed by department i
PU	=	Unit price of utility

Total cost is estimated for each of the final service departments. The estimated cost of each overhead department is then distributed among the other overhead service, intermediate, and final service departments according to criteria developed for each department (through the step-down methodology). These criteria are designed to reflect as close an approximation as possible of the proportion of procedures and services of the relevant departments that the final service departments consume. The step-down allocation criteria for distributing intermediate and final service department costs among departments are shown in *Table A-1*. The actual estimated statistics can only be developed after final service costs of all procedures are determined.

A.1.2 Overhead Departments' Costs to Be Allocated among All Departments

Support, administrative, and business services are provided by overhead departments. The costs associated with these departments are often termed overhead costs. Overhead costs are measured by aggregating all fixed and variable costs incurred by these departments. This was done through a combination of physical verification and examination of records from various support and administrative departments.

TABLE 3-2
DISTRIBUTION OF COST



Costs of the overhead departments comprise fixed and operating costs described above. The fixed cost items 6, 7, and 8, and operating (variable) cost item 9 are the total costs to be allocated among the overhead, intermediate service, and final service departments.

Fixed Costs:

6. Share of depreciation cost of buildings and other permanent structures.
7. Share of depreciation cost of equipment and other durable goods including transportation equipment that can be specifically assigned and allocated to a department.
8. Share of depreciation cost of overhead equipment, such as generators, elevators, incinerators, and other equipment that cannot be specifically assigned and allocated by department.

Operating (Variable) Costs:

9. Recurrent cost of operating each overhead department. These are the costs of running the department including personnel, small equipment, supplies, material, electricity, fuel, general transportation (not ambulance), and other recurrent costs attributed to the department.

The total estimated cost of each overhead department are then distributed among overhead, intermediate service, and final service departments according to criteria developed for each department (through the step-down methodology). These criteria are designed to reflect as close an approximation as possible of the proportion of cost that the departments consume. After step-down there are no costs in the overhead departments.

In algebraic form, the cost of an overhead department allocated to department i can be estimated through the following equations:

- a. Assist and Support Department

$$ASD_i = ASS * D_i / \sum_{i=1}^{44} D_i$$

Where

ASD_i = Amount of Assist and Support Service department cost allocated to department i

ASS = Total cost of Assist and Support Service department

D_i = Total cost of department i.

- b. Maintenance Department

$$MDC = SD_i / \sum_{i=1}^{43} SD_i$$

Where

MD_i = Amount of Maintenance Service department cost allocated to department i

MD = Total cost of Maintenance Service department

SD_i = Surface area (square meters) of department i

- c. Director's Secretariat

$$DS_i = DS * D_i / \sum_{i=1}^{42} D_i$$

Where

DS_i = Amount of Director's Secretariat cost allocated to department i

DS = Total cost of Director's Secretariat

D_i = Total cost of department i (exclusive of the prior two overhead departments)

d. Finance Department

$$FD_i = FD * D_i / \sum_{i=1}^{41} D_i$$

Where

FD_i = Amount of the Finance department cost allocated to department i

FD = Total cost of the Finance department

D_i = Total cost of department i (exclusive of the prior three overhead departments)

e. Cashier Department

$$CD_i = CD * D_i / \sum_{i=1}^{40} D_i$$

Where

CD_i = Amount of the Cashier department cost allocated to department i

CD = Total cost of the Cashier Department

D_i = Total cost of department i (exclusive of the prior four overhead departments)

f. Telephone System Department

$$TD_i = TD * D_i / \sum_{i=1}^{39} D_i$$

Where

TD_i = Amount of the Telephone System department cost allocated to department i

TD = Total cost of the Telephone System Department

D_i = Number of telephone sets at department i (exclusive of the prior five overhead departments)

g. Personnel Affairs Department

$$PAD_i = PAD * D_i / \sum_{i=1}^{38} D_i$$

Where

PAD_i = Amount of the Personnel Affairs department cost allocated to department i

PAD = Total cost of the Personnel Affairs department

D_i = Total cost of personnel at department i (exclusive of the prior six overhead departments)

h. Stores Department

$$SD_i = SD * D_i / \sum_{i=1}^{37} D_i$$

Where

SD_i = Amount of the Stores department cost allocated to department i

SD = Total cost of the Stores Department

D_i = Total cost of materials of department i (exclusive of the prior seven overhead departments)

i. Security and Police Department

$$SPD_i = SPD * D_i / \sum_{i=1}^{36} D_i$$

Where

SPD_i = Amount of the Security/Police department cost allocated to department i

SPD = Total cost of the Security/Police department

D_i = Surface area (square meters) of department i (exclusive of the prior eight overhead departments)

j. Purchase Department

$$PD_i = PD * D_i / \sum_{i=1}^{35} D_i$$

Where

PD_i = Amount of the Purchase department cost allocated to department i

PD = Total cost of the Purchase department

D_i = Total cost of materials and equipment of department i (exclusive of the prior nine overhead departments)

k. Patient Affairs Department

$$Pat_i = Pat * D_i / \sum_{i=1}^{29} D_i$$

Where

Pat_i = Amount of the Patient Affairs department cost allocated to department i

Pat = Total cost of the Patient Affairs department

D_i = Number of patients provide service in department i

l. Social Service and Statistics Department

$$SSS_i = SSS * D_i / \sum_{i=1}^{29} D_i$$

Where

SSS_i = Amount of the Social Service and Statistics department cost allocated to department i

SSS = Total cost of the Social Service and Statistics department

D_i = Number of patients provided service in department i

m. Wireless Communication Department

$$WC_i = WC * D_i / \sum_{i=1}^{29} D_i$$

Where

WC_i = Amount of the Wireless Communication department cost allocated to department i

WC = Total cost of the Wireless Communication Department

D_i = Number of patients provided service in department i

n. Physician Residence

$$PR_i = PR * D_i / \sum_{i=1}^{29} D_i$$

Where

PR_i = Amount of the Physician Residence cost allocated to department i

PR = Total cost of Physician Residents

D_i = Number of resident physicians at department i

A.1.3 Intermediate Service Departments' Costs to Be Allocated among Final Service Departments

The cost of intermediate service departments procedures and services are estimated through a two-step process. First, total final service costs of each of the intermediate service departments are estimated by a method similar to that used to determine direct overhead departments costs. To this estimated direct cost, the costs allocated from the overhead departments are added to determine the total costs of each intermediate service department. The total estimated costs of the intermediate service departments are then distributed to the procedures and services provided by each department according to the number of cases and a complexity factor.²²

The complexity factor varies by the type of intermediate service department procedures and services. For radiology and laboratory departments, relative prices charged at private facilities for these procedures and services are used as a proxy for the complexity factor. The complexity factor for anesthesiology, operation theater, and sterilization department costs is the amount of personnel time used in the medical procedures that require these intermediate procedures and services.

²² The relative prices charged for corresponding laboratory and radiological services by local private providers are used to measure the complexity factor.

The total cost of each intermediate service department is composed of the following:

Fixed Costs:

10. Share of depreciation cost of buildings and other permanent structures.
11. Share of depreciation cost of equipment and other durable goods including transportation equipment that can be specifically assigned and allocated to a department.
12. Share of depreciation cost of overhead equipment, such as generators, elevators, incinerators, and other equipment that cannot be specifically allocated by department.
13. Depreciation cost of the various equipment used to perform medical procedures and services in the relevant final service department.

Operating (Variable) Costs:

14. Overhead department costs allocated to the intermediate service departments.
15. Recurrent cost of operating each intermediate service department. These are the costs of running the department, including personnel, small equipment, supplies, material, electricity, fuel, general transportation (not ambulance), and other recurrent costs attributed to the department.

Items 10, 11, 12, 13, and 15 are costs attributed and allocated directly to intermediate service departments. Item 14 comprises costs allocated from overhead departments to intermediate service departments.

In algebraic form, total expenses of intermediate department i can be estimated through the following equation:

$$TCI_i = B_i PB + OE_i \sum_{j=1}^n E_{ij} PE_{ij} + \sum_{j=1}^n L_{ij} W_{ij} + \sum_{j=1}^n C_{ij} PC_{ij} + OH_i$$

Where

- TCI_i = Total cost of intermediate department i;
- B_i = Total building space (square meters) occupied by department i
- PB = Depreciated cost of building space
- OE_i = Share of depreciated overhead equipment cost allocated to department i
- E_{ij} = Units of equipment in category j at department i
- PE_{ij} = Depreciated cost of a unit of equipment j at department i
- L_{ij} = Number of personnel in category j at department i
- W_{ij} = Salary and benefits of personnel in category j at department i
- C_{ij} = Units of consumable j used by department i
- PC_{ij} = Unit price of consumable j at department i
- OH_i = Proportion of overhead department cost allocated to intermediate department i

Total costs of each of the intermediate departments are estimated using the above approach. Unit cost of a procedure and service at the intermediate departments is estimated by distributing the intermediate department total costs among the procedures and services provided by the department according to the relative complexity of the procedure. The unit cost of a procedure and service are estimated through the following formula:

$$APR_i = TCI_i / \sum_{j=1}^n PR_{ij} FR_{ij}$$

Where

APR _{ij}	=	Average cost of procedure and service j at intermediate department i
TCI _i	=	Total cost of intermediate department i
PR _{ij}	=	Complexity weight assigned to procedure and service j at department i
FR _{ij}	=	Number of procedure and service j performed at department i

The complexity factor varies by the type of intermediate service products. For radiology and laboratory departments, relative prices charged by private facilities for these procedures and services are used as a proxy for complexity factor. The complexity factor for anesthesiology, operation theater, and sterilization department costs is the amount of personnel time used in the medical procedures that require these intermediate services.

A.1.4 Cost of Resources Used to Produce a Unit of Medical Procedure and Service

The cost of resources used for a unit of medical procedure and service are estimated from costs allocated to the final service departments. First, the costs of building and facilities, equipment, supplies, and overhead and intermediate service department costs allocated to the final service department is distributed among all procedures and services performed. This distribution is done according to the intensity factor of the resources used in the procedure. The intensity of the procedure was measured by the amount of personnel time applied to the procedure compared with the total personnel time of the department. To determine the final costs, the cost distributed to individual procedures is added to the direct cost of personnel and material resources, equipment time, and the allocated cost of ancillary (intermediate service department) procedures and services required for the procedures. The cost elements in a final service department procedure and service are described below:

Fixed Costs:

16. Share of depreciation cost of buildings and other permanent structures.
17. Share of depreciation cost of equipment and other durable goods including transportation equipment that can be specifically assigned and allocated to a department.
18. Share of depreciation cost of overhead equipment, such as generators, elevators, incinerators, and other equipment that cannot be specifically allocated by departments.
19. Depreciation cost of the various equipment used to perform medical procedures and services in the relevant final service department.

Operating (Variable) Costs:

20. Overhead department costs allocated to the final service departments.
21. Recurrent costs of operating each final service department. These are the costs of running the department, including small equipment, non-medical supplies, non-medical material, electricity, fuel, general transportation (not ambulance), and other recurrent costs attributed to the department.
22. Cost of time by each category of personnel to perform a specific medical procedure and service offered in the relevant final service department.
23. Cost of drugs and medical materials used in a specific medical procedure and service offered in the relevant final service department.
24. Cost of prescribed drugs for an episode involving a specific final service department procedure and service.
25. Cost of intermediate service department procedures and services used in an episode of a specific final service department medical procedure and service.

Items 19, 22, 23, and 24 constitute the cost of resources consumed by the final service department to perform a unit of medical procedure and service. Item 25 is the allocated cost of procedures and services provided by intermediate service departments during the treatment protocol. Item 20 constitutes the allocated overhead departments costs of a medical procedure and service. Items 16, 17, 18 and 21 are costs assigned or allocated to the final service department. The total of items 16 through 25 for all final service departments determine the total cost to the hospital to provide medical procedures and services.

In algebraic form, the cost of a medical procedure and service i can be estimated through the following equation:

$$MC_{ij} = B_{ij} + OE_{ij} + OH_{ij} + \sum_{k=1}^n L_{kj} W_k + E_{ij} + C_{ij} + \sum_{k=1}^n DM_{kj} CDM_k + IS_j$$

Where

MC_{ij}	=	Cost of a medical procedure and service j at department i
B_{ij}	=	Share of the building cost allocated to department i and attributed to procedure and service j
OE_{ij}	=	Share of the equipment cost allocated to department i and attributed to procedure and service j
OH_{ij}	=	Share of the overhead departments cost allocated to department i and attributed to procedure and service j
L_{kj}	=	Amount of time spent by personnel category k to provide procedure and service j at department i
W_k	=	Salary and benefits cost of personnel of category k
E_{ij}	=	Share of the equipment cost directly attributed to department i attributed to procedure and service j
C_{ij}	=	Share of the cost of consumable at department i attributed to procedure and service j
DM_{kj}	=	Amount of drugs and medicine k prescribed and provided for procedure and service j
CDM_k	=	Price of drugs and medicine of category k
IS_j	=	Cost of services provided by intermediate service departments to a patient receiving procedure j

B_{ij} is determined by dividing the total building cost allocated to department i by the number of procedures performed by the department and weighted by personnel time spent for each procedure and service and then multiplying it by personnel time spent for procedure and service j. OE_{ij} , OH_{ij} , and C_{ij} are estimated similarly. By dividing the department i equipment cost, allocated overhead departments cost, and consumable cost, respectively, by the number of procedures performed by the department and weighted by personnel time spent for each procedure and service and then multiplying it by personnel time spent for procedure and service j. These consumable costs are in addition to the cost of prescribed drugs.

In each of the above cases, the personnel time is used as proxy for complicity and time (and therefore resources) consumed in the performance of the procedure and service. Cost of intermediate services (IS_j) for any medical procedure and service varies by the type of intermediate service. For radiology, laboratory, and hotel services, the cost is determined by the unit of their services consumed in the performance of the medical procedure and service. For example, an episode for kidney stone removal (a procedure in our analysis), requires four X-rays, four laboratory tests, and 14 days of hotel service. Cost of sterilization services are allocated across all procedures and services in all departments according to the amount of personnel time spent on the procedures/service. The cost of the operating theater and anesthesiology departments are distributed only among the procedures involving surgery and according to the amount of personnel time spent on surgical procedures.

A.1.5 Costing Inpatient Stay, Inpatient Day, Outpatient and Emergency Visit

The following are descriptions and equations for estimating the unit cost of inpatient, outpatient, and emergency patient procedures and services.

Cost of Inpatient Stay (CIS): The average cost of all inpatient medical procedures and services, including overhead, intermediate service, and final service departments costs weighted by their frequencies, constitutes the cost of an inpatient stay. CIS can be estimated by the following equation:

$$CIS = \frac{\sum_{i=1}^n \sum_{j=1}^m F_{ij} MC_{ij}}{\sum_{i=1}^n \sum_{j=1}^m F_{ij}}$$

Where

F_{ij} = Number of inpatient procedure and service j performed at final service department i
 MC_{ij} = Cost of inpatient procedure and service j at final service department i

Cost of Inpatient Day (CID): The cost of an inpatient stay (CIS) factored for the average length of stay (ALOS) of patients in the hospital will determine the cost of an inpatient day. The formula is quite simple and thus an equation is not required.

Cost of Outpatient Visit: The weighted average cost of all outpatient procedures will constitute the cost of an outpatient visit. The equation and procedure for estimating the CIS can be applied here.

$$CIS_o = \frac{\sum_{i=1}^n \sum_{j=1}^m F_{o_{ij}} MC_{o_{ij}}}{\sum_{i=1}^n \sum_{j=1}^m F_{o_{ij}}}$$

Where

$F_{o_{ij}}$ = Number of outpatient procedure and service j performed at final service department i
 $MC_{o_{ij}}$ = Cost of outpatient procedure and service j at final service department i

Cost of Emergency Case:

The weighted average cost of emergency procedures will constitute the cost of an emergency case. The equation and procedure for estimating CIS can be applied here.

$$CIS_e = \frac{\sum_{i=1}^n \sum_{j=1}^m F_{e_{ij}} MC_{e_{ij}}}{\sum_{i=1}^n \sum_{j=1}^m F_{e_{ij}}}$$

Where

$F_{e_{ij}}$ = Number of emergency procedure and service j performed at final service department i
 $MC_{e_{ij}}$ = Cost of emergency procedure and service j at final service department i

A.2. PROCEDURES FOR DATA COLLECTION

A thorough understanding of the organizational structure of the hospital under study is the first step in effective data collection. An examination of the accounting practice of the hospital and its organization is helpful in identifying the cost centers (departments) under which expenses are aggregated.

The departments are usually classified by functional categories into overhead, intermediate service, and final service departments²³. Once the cost centers (departments) are identified, cost items/elements within the cost centers are identified and measured. The following provides guidelines for identifying and measuring department costs.

A.2.1. Estimating Costs to Be Allocated to Overhead, Intermediate Service, and Final Service Departments

Fixed Costs:

1. Collect data on the area of land used by the hospital. This information may be available at the Engineering department of CRHP.
2. Collect data on floor space (square meters) for the entire facility, including annexes, garages, workshops, and other buildings. This information will then be separated by department and function. This information will be available at the Engineering department of the CRHP. The Engineering department also will be able to provide estimates of current construction costs. These should be estimated on the basis of square meters.
3. Conduct an inventory of overhead equipment in all areas of the hospital. This includes generators used to provide service to the entire facility or a major portion of it and equipment whose services cannot be separated by department or allocated to a specific department. Do not include medical or other equipments used exclusively by any particular department. This information will be collected from the Equipment department of the CRHP after appropriate categorization.
4. Collect information on current replacement costs of the units of equipment identified above. The Equipment department of the CRHP will be able to provide a close estimates of the prices of the equipment. Also obtain information on the working life and salvage value of the equipment from the Equipment department.
5. Conduct an inventory of equipment and durable appliances and goods, including furniture available at each of the intermediate and final service departments. This information can be obtained from appropriate support departments at the CRHP. Care must be taken to classify each item in the appropriate department categories.
6. Collect information on current replacement costs and the useful life of equipment and their useful life from the Equipment department of the CRHP.

Variable Costs:

7. Obtain the number of staff by appropriate positions employed in each of the departments.
8. Obtain data on salary and other monetary and non-monetary benefits related to the staff. The Personnel or Finance departments of the hospital can provide this information.
9. Obtain data on the cost of utilities, such as electricity, telephone services, fuel, sewer, water, and other services. The Finance department of the hospital can provide this information.

²³ Intermediate service and direct service departments are often referred to as medical departments.

10. Record expenditure data on consumable supplies used by each department. This should not include supplies that are specifically assigned for use by intermediate and final service departments. This would be specially true in the case of the pharmacy and the Medical Supplies department. The Stores department can provide this information.
11. Obtain data on the cost of spare parts for equipment, appliances, and vehicles. The Stores or Finance department can provide this information.
12. Collect data on other recurrent and operating costs attributed to the final service departments. This information can be obtained from the Finance, Stores, Administration, and other departments.

A.2.2. Estimating Cost of Hotel Services

Fixed Costs:

1. Conduct inventory of equipment and other durable appliances at the kitchen and laundry departments.
2. Obtain price information on the units of equipment and appliances used at the kitchen and the laundry departments from the Equipment department of the CRHP.
3. Obtain information on the useful life of equipment and appliances used in the kitchen and the laundry departments.

Variable Costs:

4. Prepare a list of the staff working in the kitchen and laundry departments by position/category, salary, and compensation data from the Personnel department.
5. Obtain information on the quantity and cost of food supplies used by the kitchen for a period of six months. This information should be available in the kitchen records. The number of meals served during the same period should also be obtained.
6. Record the amount of cleaning materials and other supplies used by the laundry department for a period of six months. Also, obtain the number of cleaned linens supplied to each department during this period. The information should be available from department records.

A.2.3. Estimate Cost of Resources Used to Produce a Unit of Medical Procedure and Service

Fixed Costs:

1. Review inventory of equipment and major durable appliances in each department. The equipment department of CRHP should be able to update this information.
2. Review activity log in each department and obtain the type and number of procedures and services performed for a period of six months. The information should be obtained and recorded by procedure and service to inpatient, outpatient and emergency patients.²⁴ If the information is not available, then discuss with the department Chief and various department physicians how to estimate proportion of each type of procedure and service provided to each of the three groups.

²⁴ Data on emergency patient was not available.

Variable Costs:

3. Review the list of the personnel by category and total number for each department.
4. Review the list of procedures and services with the each department chief (and if possible with various department physicians) and identify the major procedures and services offered by the department.
5. Prepare a medical protocol for each procedure and service performed by the department. This can be accomplished through interviews with various physicians at each department. The protocol will include time required by each category of physicians to prepare and perform the protocol/service, the physician's estimate of the degree of difficulty in providing the procedure and service, supervision time required, nurse and technician time required, materials (drugs and supplies) consumed, time used of major equipments, and other items. For an inpatient procedure also estimate the average number of days a patient will be in the hospital before discharge.
6. Observe and record the results of a small sample of patients in the inpatient and outpatient areas to determine the amount of time devoted to them by various categories of personnel and the amount of materials used to provide them with medical procedures and services. This will involve measuring the time required by the various categories of personnel in preparing for and performing the procedure and service; the time of equipment usage; and drugs and supplies provided or prescribed. Review the results with the various department physicians and adjust accordingly.
7. Review the personnel list and gather from the Personnel department information about salaries and other benefits (monetary and non-monetary) offered to the categories of personnel observed.
8. Contact the Supply department, the pharmacy, and outside vendors/suppliers to obtain prices of all the drugs and materials identified in the observation.