



# Patient-Level Cost Estimation for Health Services at Secondary Hospital, Saudi Arabia

Asim Mehmood<sup>1\*</sup>, Zafar Ahmed<sup>2,4</sup>, Fahad Khan Azeez<sup>1</sup>, Sohail Akhtar<sup>3</sup>, Wajiha Rehman<sup>1</sup>, Sumaira Idrees<sup>1</sup>

<sup>1</sup>Department of Health Informatics, College of Public Health and Tropical Medicine, Jazan University, Jazan, Saudi Arabia; <sup>2</sup>Faculty of Medicine and Health Sciences, University Malaysia Sarawak, Kota Samarahan, Malaysia; <sup>3</sup>Department of Health Informatics, College of Public Health and Health Informatics, Qassim University, Buraydah, Saudi Arabia; <sup>4</sup>Department of Social Work Education and Community Wellbeing, Northumbria University, Newcastle upon Tyne, UK

## Abstract

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**\*Correspondence:** Asim Mehmood, Department of Health Informatics, Faculty of Public Health and Tropical Medicine, Jazan University, Saudi Arabia. E-mail: [assimrza@gmail.com](mailto:assimrza@gmail.com)

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**BACKGROUND:** Cost information can help improve the quality of medical care budgeting and can also improve the efficient allocation of resources and patient outcomes.

**AIM:** This study aimed to estimate the inpatient unit cost of health services in a secondary hospital in Saudi Arabia. Cost information can help improve the quality of medical care budgeting and can also improve the efficient allocation of resources and patient outcomes. This study aimed to estimate the inpatient unit cost of health services in a secondary hospital in Saudi Arabia.

**METHODOLOGY:** A cross-sectional retrospective approach was applied to categorize the inpatients discharged from the hospital from January to December 2018. A top-down costing method for cost estimation was used.

**RESULTS:** We found that the overhead cost center represents 40.17% of the total hospital cost and the intermediate and final care cost centers consumed 25.50% and 34.33%, respectively. Among the inpatient wards, the surgical ward had the highest operational cost (39.27%). Human resources consumed the hospital's highest resources (75%) on salaries.

**CONCLUSION:** The hospital's cost structure was not remarkable and needed revolutionary changes to adopt the new payment mechanism envisioned in the 2030 Saudi vision.

## Introduction

Cost knowledge helps administrators and policymakers improve the quality of medical care and make cost projections. Hospital costing information support improving the effective distribution of resources and patient performance [1]. It also offers basic information on setting user fees for the community with quality [2]. Hospitals are vital and critical for the healthcare system and are considered the most extensive and expensive operational units that consume a large proportion of the health sector's budget. They provide primary health services and accept referral cases for complicated diseases.

Cost analysis studies in recent years have increased awareness of hospital cost structures that are important to improve the efficiency and quality of healthcare services [3]. The World Health Organization (WHO) also introduced different projects in member states to provide cost information to policymakers to effectively distribute health expenditures [4]. Many developed and developing countries have performed costing exercises for different purposes. South Africa,

Myanmar, Ghana, Palestine, and India, where hospital service demand is growing and the health system needs to be strengthened, have conducted cost estimation studies [5], [6], [7], [8].

In Saudi Arabia, the Ministry of Health (MOH) is the primary provider and covers almost 60% of health services. It supervises and regulates 244 hospitals and 2037 primary health-care centers throughout the Kingdom through its 20 regional health directorates [9]. The annual Government budget directly funds the MOH, and the regions are allocated lump-sum budgets distributed among hospitals per capacity and requirement [10]. In Saudi Arabia, the third largest sector of government spending in the fiscal year 2019 was healthcare and social services, accounting for 15.6% of the total budget, a slight increase from 15.4% and 14.4% of the total budget in 2018 and 2017, respectively [11]. This increase reflects that healthcare costs will probably increase in the coming years. However, allocations in the health care sector were traditionally allocated based on the figures of the previous year without performing costing exercises at the patient or service level. Recently, a costing exercise was performed in a tertiary hospital [1]. There is a need

for a study exploring the budget allocation strategy and health care costs at the hospital, patient, or service level. Saudi Arabia is in a phase of implementing healthcare financing reforms through a national transformation plan and the Saudi Vision 2030. One of the critical initiatives is the privatization of the health-care sector. To privatize any healthcare sector, it is essential to estimate the cost of various services for the price-setting process. The cost information can provide the base to identify the resource flow and its consumption during health service delivery [1].

Once the government has an accurate picture of the consumption of resources at different levels, it can be reflected in future planning, budget allocation, and the projection process [12].

This study was carried out in a secondary hospital. The goal was to estimate the patient-level unit cost of healthcare services in the secondary level hospital to provide basic cost information for the resources consumed by each patient during their stay at the hospital.

## Methodology

It was an economic study, and a cross-sectional retrospective approach was applied to categorize the inpatients. We conducted this study at Abu-Aresh General Hospital, a secondary hospital in the Jazan region, Saudi Arabia.

We consider data for 1 financial year from January 2018 to December 2018. We applied a top-down costing approach for cost estimation, as it is less time-consuming, cheaper, and, at the same time, provides an accurate method for regular hospital costing exercises.

There is no universally accepted appropriate methodology for patient-level costing of health services or hospital services cost, and it depends on the nature and scope of the study. As in this study, we calculated the cost at the patient level for inpatients. For this purpose, we followed the top-down costing methodology adopted by Zafar in his research on patient-level costing [13]. The principal methodology for top-down costing follows numerous steps to allocate total hospital costs to cost centers and patient-level services [14].

Based on the above costing approach, we followed a patient-level costing sequence framework adopted by Ghilan *et al.* [1]. Figure 1 illustrates the steps and flow of patient-level hospital services costing.

We adopted the above framework and methodology followed by Ghailan *et al.* and Zafar [1], [13] and divided our study into eight steps. These steps provide more accurate unit costs at the patient level by identifying all cost components.

1. Define final services to be costed
2. Study Organizations' Chart and structure
3. Classify hospital departments and define cost centers
4. Identify the total cost of overhead, intermediate, and final care cost centers.
5. Allocate the costs of overhead cost centers to intermediate and final care cost centers.
6. Allocate the costs of intermediate to final care cost centers
7. Cost estimation per patient
8. Cost estimation per patient per day

### Step 1: Define final services to be costed

In this study, we included inpatients for the patient-level costing process.

### Step 2: Study organizations' charts and structure

The hospital structure is a fundamental part of the costing process. Studying the hospital structure helped to identify the resource flow in the hospital, and it also helped to determine the cost centers. A cost center is the basic unit of responsibility in a hospital, where we assign costs, for example, operation theatre, hospital ward, pharmacy, and radiological services.

### Step 3: Classify hospital departments and define cost centers

After reviewing the structure critically, we classified the administrative and clinical departments into the overhead cost center (OCC), intermediate cost center (ICC), and final care cost centers (FCC) based on the functions they perform. We classified the OCC center which includes the supporting department for other ICC and FCC. The list of OCC departments is given below.

**Table 1: The list of OCC departments**

Medical records	Human resource services	Inventory Control
Administrative Services	Human resource planning	Administrative communication
Administrative communication	Internal communication	Cleaning and maintenance contract services
Technical and administrative follow-up	Academic affair and training	Food Contract Services
Nutrition department	Equipment maintenance	Public health
Hospital director office	Security and Safety	OPD registration
Quality and Safety Department	Financial and Administrative	Hospital Misc. Supplies
E-health	Medical supply and warehouse	Utilities

We classified the ICC as representing services indirectly used by other departments and hospital services. The following are the departments identified during the study.

**Table 2: Departments identified during the study**

ICU	Laboratory	Radiology
Pharmacy	Physical therapy	Anesthesia
		NICU

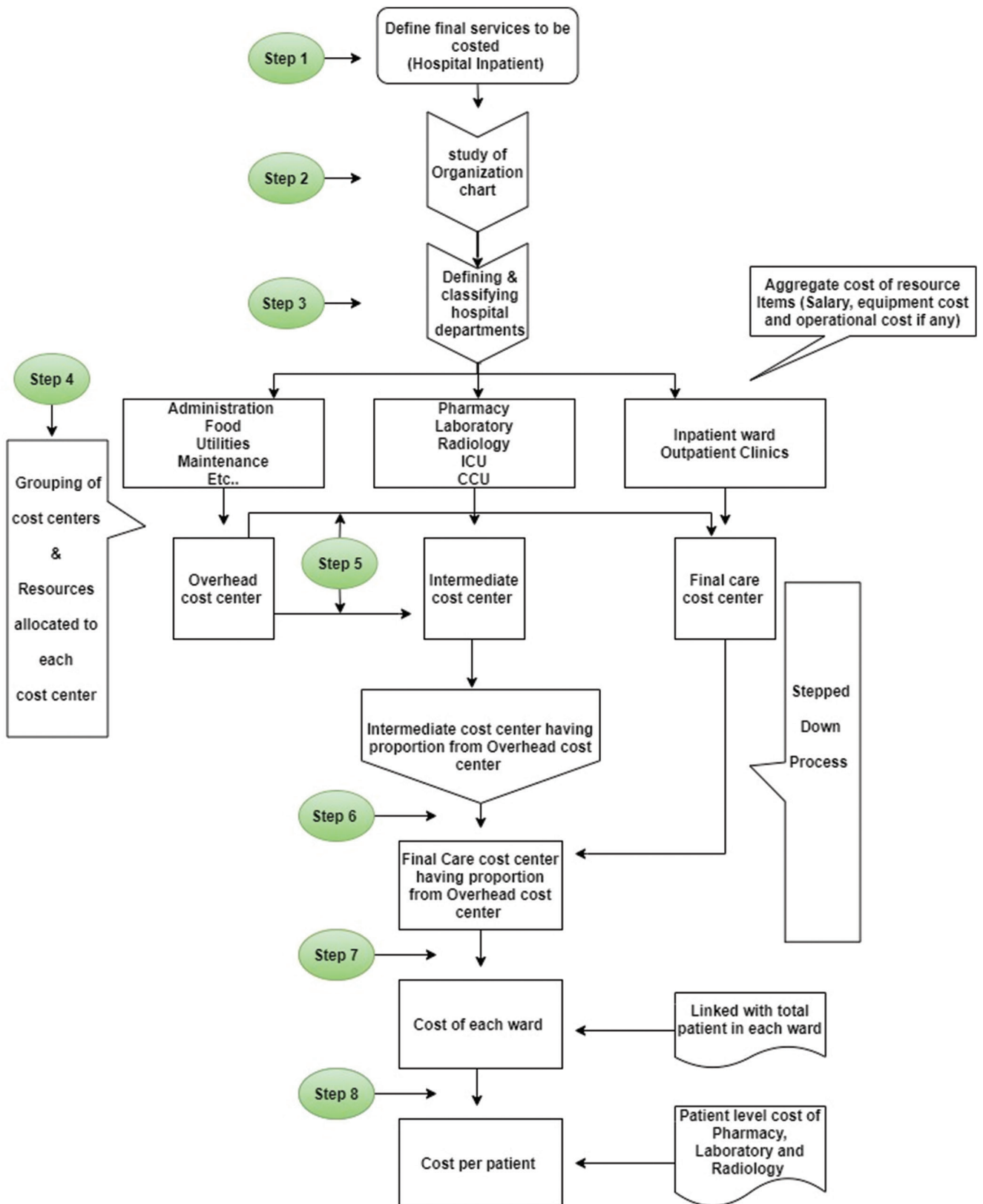


Figure 1: Framework for the costing of health services at the patient level

FCC is the hospital's final product, and the services receive the support of OCC and ICC. It includes the wards and outpatient clinics.

**Step 4: Identify the total cost of OCC, ICC, and FCC**

We included the total cost of each cost center or department and calculated capital cost (equipment and machinery) and recurrent cost (salary and recurrent cost except salary).

Table 3: Included the wards and outpatient clinics

Surgical ward	Pediatric ward	Orthopedic ward
Medical ward	Gynecology ward	Plastic Surgery/Burn Unit

### Identification of the cost for OCC

We estimated the operational cost of OCC by calculating the staff salary, operational expenses, and cost of assets. We counted all staff who were regular, part-time, casual, and contractual employees participating in health-care delivery services and related operations of the hospital. We included all assets, including electronic equipment, computers, and furniture fixtures, whether purchased or donated.

### Identification of cost for ICC

ICC receives services from OCC and provides services directly to patients and FCC. We estimated the operational cost of the intermediate cost center by calculating the staff salary, cost of machines and equipment, and other operational expenses of the departments. Patient data were extracted directly from electronic health information and administrative data collected from the hospital administration office.

### Identification of cost for FCC

FCC receives services from OCC and ICC but does not provide services back to these cost centers. FCC is also known as a patient care cost center that consists of patient wards. We estimate the operational cost of the FCC by calculating the expenses and equipment or machinery used on the wards.

### Step 5: Allocate the costs of OCC to ICC and FCC

We applied an internationally acceptable methodology to allocate overhead costs to intermediate and final cost centers [14]. We distributed the total cost of overhead cost centers among intermediate and final care cost centers based on the allocation statistics used in other studies [13], [14]. We allocated the proportional values for intermediate and final care cost centers from the overhead cost center, and then further distributed them among the departments of each cost center. For FCC, we applied universal allocation statistics (75% and 25% for inpatient and outpatient, respectively) to distribute the proportional value among inpatient wards and outpatient clinics as an inpatient consume hospital resources 3 times more than outpatients [14].

### Step 6: Allocate the costs of ICC to the FCC

In this step, we allocate the total cost of the ICC (having proportion from OCC) to FCC. We finalized the stepped-down costing process and assigned all costs to the FCC in this step.

### Step 7: Estimation of the cost per patient

In the above step, we had the final cost for each inpatient ward. Then we link the total number of patients in each ward with the cost of the ward. We divided the total cost of each ward by the total number of patients to get the cost per patient per stays in the hospital.

### Step 8: Estimation of cost per patient per day

As mentioned in Step 4, we did not consider the total cost of medical supplies for this study; instead, we calculated the patient-level consumption of pharmacy, laboratory, and radiological services and their cost. We linked the patient cost of pharmacy laboratory and radiology with an already estimated cost per patient to get the final cost of each patient in the hospital.

## Results

### Steps 1 and 2

The bed occupancy rate of Abu-Aresh General Hospital was 83.35%. The total number of staff during the study period was 972. Of these, 242 were physicians/surgeons and 455 were nurses. The detail of other staff is shown in Figure 2.

The total number of patients discharged from the hospital during the study period was 8310, of which 2731 were male and 5578 were female patients. We had the list of patients discharged from each ward as shown in Table 4.

### Steps 3 and 4

The overhead cost center includes the hospital's supporting departments holds 40.17% (SAR60,748,939) of the total hospital cost. Among the supporting departments, equipment maintenance

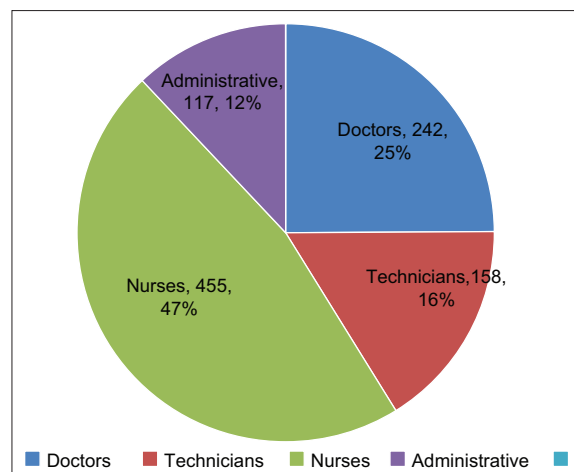


Figure 2: Staff distribution among Hospitals

**Table 4: Distribution of patient discharge among different departments**

Wards	Male patients	Female patients	Total patients	Percentage
Surgical ward	634	518	1152	13.86
Medical ward	707	769	1476	17.76
Pediatric ward	850	726	1576	18.97
Gynecology ward		3370	3370	40.55
Orthopedic ward	531	186	717	8.63
Burn unit	10	9	19	0.23
Total	2732	5578	8310	

cost was the highest at SAR10,990,467, and general maintenance and cleaning contract services were the second highest at SAR8,704,703. The cost of the other supportive services is given in Table 5.

ICC consumed 25.50% of the total hospital operation cost. Laboratory services had the highest operational cost among the ICC departments, with SAR 8,914,298. The operational cost of other departments of the ICC is shown in Table 6.

The FCC, which consumed 34.33% of the total hospital operational cost, had two major divisions; inpatients and outpatients. Among the inpatient wards, the surgical ward had the highest operational cost SAR15,334,874 (39.27%), while the second highest operational cost (26.89%) belongs to the medical ward. The operational cost of other wards is given in Table 7.

### Steps 5 and 6

We stepped down the OCC and ICC costs to FCC and summed up the operational cost of inpatient wards as given in Table 8.

### Step 7

In this step, we calculated the total average cost of inpatients treated in different wards at the hospital, as shown in Table 9.

### Step 8

In the last step, we calculated the average cost per patient per day using the average length of stay of the patients in each ward as shown in Table 10.

The center that consumes the highest 75% of hospital resources (SAR107,005,008) was human resources in terms of salaries. The other centers that consumed most of the hospital resources are shown in Figure 3.

Out of the 75% of resources consumed by human resources in terms of salaries, physicians/surgeons had the highest (57%) portion. The detail of human resource cost is categorized in Figure 4.

## Discussion

This study was a series of studies conducted on the unit costs of health-care services in secondary and tertiary hospitals in Saudi Arabia, especially in the Jazan region. Unit costs were observed to fluctuate significantly based on the use of hospital services, the resources available in the cost centers, and the type of medical intervention. The highest number of patients (40.55%) was treated in the gynecology ward. This is because one of the referral hospitals in the region is equipped with gynecological services compared to other secondary hospitals.

OCC, which accounted for 40.17% of total hospital costs, spent the most on machinery and equipment (18.09%), followed by maintenance and cleaning services (14.33%), which were outsourced and contracted. This was also noted in research carried out at several hospitals in India, which had higher

**Table 5: Cost distribution among overhead cost center**

OCC	Operational cost (without salary) (SAR)	Annual staff salary (SAR)	Total equipment cost after depreciation (SAR)	Total cost (SAR)	Percentage
Medical records		2,012,592	16,450	2,029,042	3.34
Administrative services	208,000	4,008,000	20,650	4,236,650	6.97
Administrative communication	400,000	546,000	19,800	965,800	1.59
Technical and administrative follow-up		468,000	12,150	480,150	0.79
Nutrition department		3,576,864	11,800	3,588,664	5.91
Hospital director office	75,000	1,014,000	21,300	1,110,300	1.83
Quality and safety department		375,432	15,450	390,882	0.64
Follow up		234,000	11,800	245,800	0.40
E-health		390,000	18,600	408,600	0.67
Human resource services	3,589,000	546,000	18,450	4,153,450	6.84
Human resource planning	1,842,000	312,000	14,800	2,168,800	3.57
Internal communication		312,000	11,800	323,800	0.53
Academic affair and training	112,000	234,000	17,800	363,800	0.60
Equipment maintenance	10,666,667	312,000	11,800	10,990,467	18.09
Security and safety		624,000	11,800	635,800	1.05
Financial and administrative	922,000	156,000	22,800	1,100,800	1.81
Medical supply and warehouse		424,296	27,100	451,396	0.74
Inventory control		312,000	18,950	330,950	0.54
Administrative communication	737,000	546,000	23,950	1,306,950	2.15
Cleaning and maintenance contract services	8,380,553	312,000	12,150	8,704,703	14.33
Food contract services	4,985,445	156,000	11,800	5,153,245	8.48
Public health	369,000	877,752	11,800	1,258,552	2.07
OPD registration		4,884,000	25,650	4,909,650	8.08
Hospital miscellaneous supplies	2,140,688		0	2,140,688	3.52
Utilities	3,300,000		0	3,300,000	5.43
Total				60,748,939	

OCC: Overhead cost center, OPD: Outpatient department.

**Table 6: Total operating cost of the intermediate cost center**

ICC	Annual staff salary (SAR)	Total equipment cost after depreciation (SAR)	Total operational cost (SAR)	Percentage
ICU	3,729,264	650,425	4,379,689	11.35
Pharmacy	3,313,800	78,650	3,392,450	8.80
Laboratory	8,329,848	584,450	8,914,298	23.11
Physical therapy	6,515,952	211,400	6,727,352	17.44
Radiology	5,329,488	1,409,925	6,739,413	17.47
Anesthesia	5,319,288	827,350	6,146,638	15.94
NICU	1,593,936	678,500	2,272,436	5.89
Total			38,572,276	

ICC: Intermediate cost center, ICU: Intensive care unit, NICU: Neonatal ICU.

equipment costs in tertiary hospitals and significantly lower equipment costs in secondary district hospitals [6].

**Table 7: Total cost of final care cost center (inpatient)**

FCC (inpatient)	Annual staff salary (SAR)	Total equipment cost after depreciation (SAR)	Total operational cost (SAR)	Percentage
Surgical ward	14,930,424	404,450	15,334,874	39.36
Medical ward	10,413,216	63,025	10,476,241	26.89
Pediatric ward	2,848,848	214,975	3,063,823	7.86
Gynecology ward	5,746,560	291,475	6,038,035	15.50
Orthopedic ward	2,699,280	170,725	2,870,005	7.37
Burns unit	1,007,832	169,975	1,177,807	3.02
Total			38,960,785	

FCC: Final care cost center.

This was discovered to be attributable to the enhanced health services provided in tertiary care hospitals as opposed to secondary hospitals. If capital budgeting is erroneous, immense maintenance and depreciation expenditures can become an unavoidable financial burden [15]. Therefore, higher maintenance costs must be addressed when planning the hospital's capital budget.

**Table 8: Total cost of final care cost center (inpatients) including overhead cost center and intermediate cost center percentage using a top-down approach**

FCC (inpatient)	Operational cost (SAR)	The proportion of OCC (SAR)	The proportion of ICC patients (SAR)	The total cost of FCC (SAR)
Surgical ward	15,334,874	10,289,175	21,135,102	46,759,150
Medical ward	10,476,241	7,029,198	14,438,750	31,944,190
Pediatrics	3,063,823	2,055,720	4,222,676	9,342,220
Gynecology	6,038,035	4,051,314	8,321,848	18,411,197
Ortho	2,870,005	1,925,675	3,955,549	8,751,229
Burns unit	1,177,807	790,268	1,623,298	3,591,373
Total	38,960,785	26,141,350	53,697,223	118,799,358

OCC: Overhead cost center, FCC: Final care cost center, ICC: Intermediate cost center.

ICC was the second-highest cost center which consumed about 25.50% of the hospital resources. Among this cost center laboratory services had the highest spending 23.11% followed by radiology at 17.47% and physical therapy at 17.44%. The cost of the pharmacy was quite low compared to other studies [3], [16].

**Table 9: Average cost per patient in each ward**

FCCs (inpatient)	Total patient	Total cost (SAR)	Average cost per patient (SAR)
Surgical ward	1152	46,759,150	40,590
Medical ward	1476	31,944,190	21,642
Pediatric ward	1576	9,342,220	5928
Gynecology ward	3370	18,411,197	5463
Orthopedic ward	717	8,751,229	12,205
Burns unit	19	3,591,373	189,020
Total	8310	118,799,359	14,296

FCCs: Final care cost centers.

The pharmacy cost was considered the highest in any hospital setting but due to the unavailability of pharmacy data in a hospital, and the central supply of pharmaceutical and surgical supplies from a regional depot, the data were scattered at different locations and difficult to reconcile. The hospital information system contained patient-level pharmacy data that were

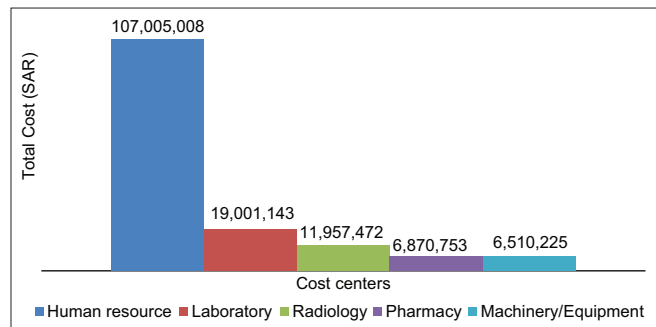


Figure 3: Cost centers with maximum cost

consumed during a patient's stay, but surgical supplies data for the specific surgery and patient was missing. This is in line with studies from Pakistan and Vietnam, which also reported that drugs and medical supplies represented the second largest component [3], [16].

**Table 10: Average cost per patient per day**

FCCs (inpatient)	Average LOS (days)	Average cost per patient per day (SAR)
Surgical ward	7	5696
Medical ward	6	3401
Pediatric ward	8	738
Gynecology ward	5	1174
Orthopedic ward	13	935
Burns unit	2	79,808

FCCs: Final care cost centers.

The FCC had two major divisions and consumed 34.33% of the total hospital operational cost. Inpatients represented 75.04% of the total final care cost center, while outpatients accounted for 24.96%. Among the specialty wards, the surgical ward had the highest operational cost (39.36%), while the second highest (26.89%) was the medical ward. Although the gynecological ward had the highest number of treated patients compared to the surgical and medical wards, it only consumed 15.50% of the cost of FCC. This is due to the specialized equipment and machines used during surgery and interventions in surgical and medical wards. These findings indicated that it is important to consider capital budget allocation based on demand and output. The surgery unit consumed the second highest cost because the cost of equipment, medicines, and medical supplies used by the surgery unit was very high.

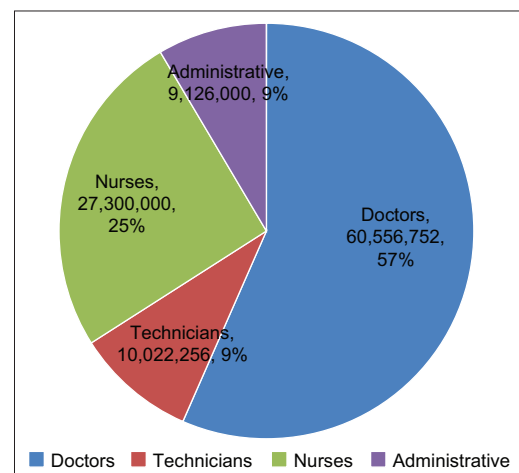


Figure 4: Resources with maximum cost

The maximum cost per patient was recorded in Burns units due to a limited number of patients with a high severity level. The surgical ward had the second highest cost per patient. This is consistent with research conducted in India, where the total unit cost of the tertiary hospital under consideration was more than that of the district hospital [6]. The most significant variations were identified in specialized care, laboratory investigations, and interventional procedures. Even though the number of admission cases was higher.

The study findings can also be compared to hospital costing studies in India and South Africa. According to these investigations, the variation in the unit cost was determined by the number of services [5], [6]. However, the unit cost of healthcare services in the hospital under investigation was higher than the unit cost in India's 400-bed secondary hospital and 778-bed tertiary hospital, Vietnam's 170-bed secondary hospital, and a 980-bed tertiary hospital [6], [16]. This could be due to differences in the study year, economic situations, resource allocation at these hospitals, and demand behavior of health-care services in respective countries.

Human resources absorbed most of the hospital's resources (75%), with physicians and surgeons accounting for the highest percentage of resource consumption. According to hospital unit cost studies from developing economies, human resources were the most expensive component of the entire cost of a hospital [5], [16], [17], [18], [19]. This finding is also consistent with a hospital cost study in Malawi, which found that salaries and benefits were the highest component of hospital spending [20]. Another study found that more investments in human resources, such as more staffing or higher pay, were connected with better performance but not higher healthcare costs [21].

### Limitations

The study has limitations related to the partial availability of records on medication utilization during surgery and surgical instruments. For this reason, certain variable costs in each department were underestimated.

### Conclusions

The hospital per patient cost was persuaded by the services utilized by the inpatients, efficiency, types of services intervened, and availability of the specialty services. We concluded that the hospital's cost structure was not remarkable and needs revolutionary changes to adopt the new payment mechanism envisioned in the Saudi 2030 vision. The methodology adopted in this study to estimate the cost of health services can be the benchmark for further studies in other hospitals and regions of the country.

This study has the scope to be followed to develop an efficient hospital budget of the same size and promote health-care policies.

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