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Original article

Development of unit cost for the health services offered at King FAHD Central hospital Jazan, Saudi Arabia



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ABSTRACT

Background: Efficiency remains one of the most important drivers of decision making in health care system. Fund allocators need to receive structured information about the cost healthcare services from hospitals for better decisions related to resource allocation and budgeting. The objective of the study was to estimate the unit cost for health services offered to inpatients in King Fahd Central hospital (KFCH) Jazan during the financial year 2018.

Methods: We applied a retrospective approach using a top-down costing method to estimate the cost of health care services. Clinical and Administrative departments divided into cost centres, and the unit cost was calculated by dividing the total cost of final care cost centres into the total number of patients discharged in one year. The average cost of inpatient services was calculated based on the average cost of each ward and the number of patients treated.

Results: The average cost per patient stayed in KFCH was SAR 19,034, with the highest cost of SAR 108,561 for patients in the Orthopedic ward. The average cost of the patient in the Surgery ward, Plastic surgery, Neurosurgery, Medical ward, Pediatric ward and Gynecology ward was SAR 33,033, SAR 29,425, SAR 23,444, SAR 20,450, SAR 9579 and SAR 8636 respectively.

Conclusion: This study provides necessary information about the cost of health care services in a tertiary care setting. This information can be used as a primary tool and reference for further studies in other regions of the country. Hence, this data can help to provide a better understanding of tertiary hospital costing in the region to achieve the privatization objective.

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1. Introduction

1.1. Background

Healthcare systems all over the world are continuously trying to reduce the cost of health care services along with improvement in quality and efficiency. Policymakers are working closely with Healthcare managers to understand better and monitor the cost

of healthcare services at the hospital, department, and patient level (Than et al., 2017). The World Health Organization (WHO) has also paid attention to this critical issue by developing the manuals that can help in the assessment of hospital costs (Mathauer and Carrin, 2010).

Cost estimations contribute to the regulation of efficiency for healthcare service delivery, the performance of resource monitoring, standardisation of healthcare service, and determination of reimbursement rates (Adam et al., 2003; Aboagye et al., 2010; Green et al., 2000; Conteh and Walker, 2004). These factors are also crucial for the improvement of the quality of the healthcare system.

Many developed and developing countries have executed the exercise of cost by using different methodologies. They categorised the methodologies into two main approaches, namely the bottom-up and top-down approach (Zafar et al., 2005). The bottom-up approach is also known as micro-costing, covers all resources used

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by a specific patient. Nevertheless, this approach requires extensive data and difficult to estimate due to inter-patient variation (Zafar et al., 2005). The top-down costing approach starts at the top with total expenditures. It then divides these by a measure of total output (patient visits, days, or admissions) to give an “average” cost per patient, per visit, day or admission (Creese and Parker, 1994). The top-down costing approach is relatively easy and more popular, as data can be collected from routine sources. The only limitation of this method is that adjustment may not account for individual differences in patient’s characteristics. (Barnum and Kutzin, 1993). Patient classification, famously known as diagnosis-related groups (DRG), can rectify this limitation (Medicare Cf, 2018).

Top-down costing is carried out into steps, starting from the study of the organisational chart that leads to defining and grouping into the Overhead, Intermediate, and Final care cost centres (Zafar et al., 2005). A cost centre is an accounting unit where all costs associated with a specific activity are recorded and allocated (Conteh and Walker, 2004). After defining the cost centres, the inputs of each cost centre are allocated and stepped down further. The cost of an overhead cost centre stepped down to intermediate and final care cost centres, and then the cost of the Intermediate cost centre stepped down to the final care cost centre (Zafar et al., 2005).

Saudi Arabia is the largest country in the Gulf region and has the biggest market of the health care consumer. Healthcare is the third largest sector in terms of Government spending and is increasing every year. The allocated percentage in the 2019 fiscal year was 15.6% of the total budget as compared to 15.4% in 2018 and 14.4% in 2017 (Ministry of Health, 2020). However, there was a need for a valid study exploring the budget allocation strategy and health care costing at a hospital, patient, or services level.

Saudi Arabia has made healthcare financing reforms through a national transformation program to enhance equity and accessibility to healthcare services. The privatisation of the healthcare sector is one of the critical initiatives of this transformational plan and Saudi Vision 2030 (Alharbi, 2018). For the privatisation of any healthcare sector, it is essential to estimate the costing of various services for the price-setting process, as the costing information can provide the base to identify the resource flow and its consumption during health service delivery (Bane, 2015). The costing information can provide a base for planning, allocation, and projection of budgeting in the future (Conteh and Walker, 2004).

Although the government is continuously trying to enhance the quality of healthcare services while maintaining the cost efficiency and productivity of this key sector. In Saudi Arabia, significant attention is not being paid to the issues of cost estimation and cost efficiency at the patient level in public hospitals, and there is no valid study available in this regard, especially in Jazan region. There are some studies available that only address the issues related to specific disease costing.

We envisioned this study to highlight the most overlooked health care costing related issues in King Fahd Central hospital (KFCH) Jazan, Southern region of Saudi Arabia. We conducted this study to estimate the cost of healthcare services provided to inpatients at the hospital during the 2018 calendar year.

2. Methodology

2.1. Study design

It was an economic study. We applied a cross-sectional retrospective approach to categorise the inpatients and then estimated the actual cost of different healthcare services provided to inpatients during one financial year. We divided the study into two

parts. In part 1, we collected clinical data of the patients. In part 2, by using financial and administrative data of the hospital, we estimated the cost of resources being consumed by each patient while staying at the hospital. We applied a top-down costing approach for cost estimation.

2.2. Study location and target population

We conducted this study in King Fahd Central Hospital, the only tertiary hospital in Jazan region, Kingdom of Saudi Arabia. Jazan region is one of the highest population density regions, located in the southern part of Saudi Arabia.

Each administrative governorate of Jazan region has one General Hospital affiliated with the Ministry of Health. There is only one Tertiary care hospital in the Jazan region. In total, there are twenty-one (Mills et al., 1993) general and specialized hospitals in the Jazan region and they are directly managed by the Ministry of health.

2.3. Sample size

Total available clinical, administrative, and financial data within the hospitals for one whole year was utilized in this analysis and no sampling or sample size calculation method need to be followed.

2.4. Study period

For data collection, we decided to collect data for one financial year. We considered data from January 2018 to December 2018 for the inpatients who were discharged from the hospital. We extracted the data in January 2019.

We decided to divide this study into two parts that enabled us to collect and analyse data in a better way. Part 1 was related to patient classification and related to patient clinical data. Part 2 was for clinical costing associated with the financial and administrative data of the hospital to estimate the cost of resources being consumed by each patient while staying at the hospital. The methodology used to collect and analyse data for both parts was different and described in the research framework (Fig. 1).

2.5. Data collection for patient classification

Patient classification groups the patients into different wards based on diagnosis and procedures. We developed checklists to extract and collect patient clinical data from the Electronic Health Record System of the hospitals. Focused group discussions were also conducted with the Quality Assurance Department of the hospitals to understand the organisational structure and flow of patients at the hospital.

2.6. Data collection for patient level costing

We followed the steps as demarcated in the research framework for patient-level costing data collection. We divided our study into following eight distinct steps based on the above framework. These steps provide more accurate patient-level unit costs 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 centres
4. Identify total cost of overhead, intermediate and final care cost centres
5. Allocate the costs of overhead cost centres to intermediate and final care cost centres

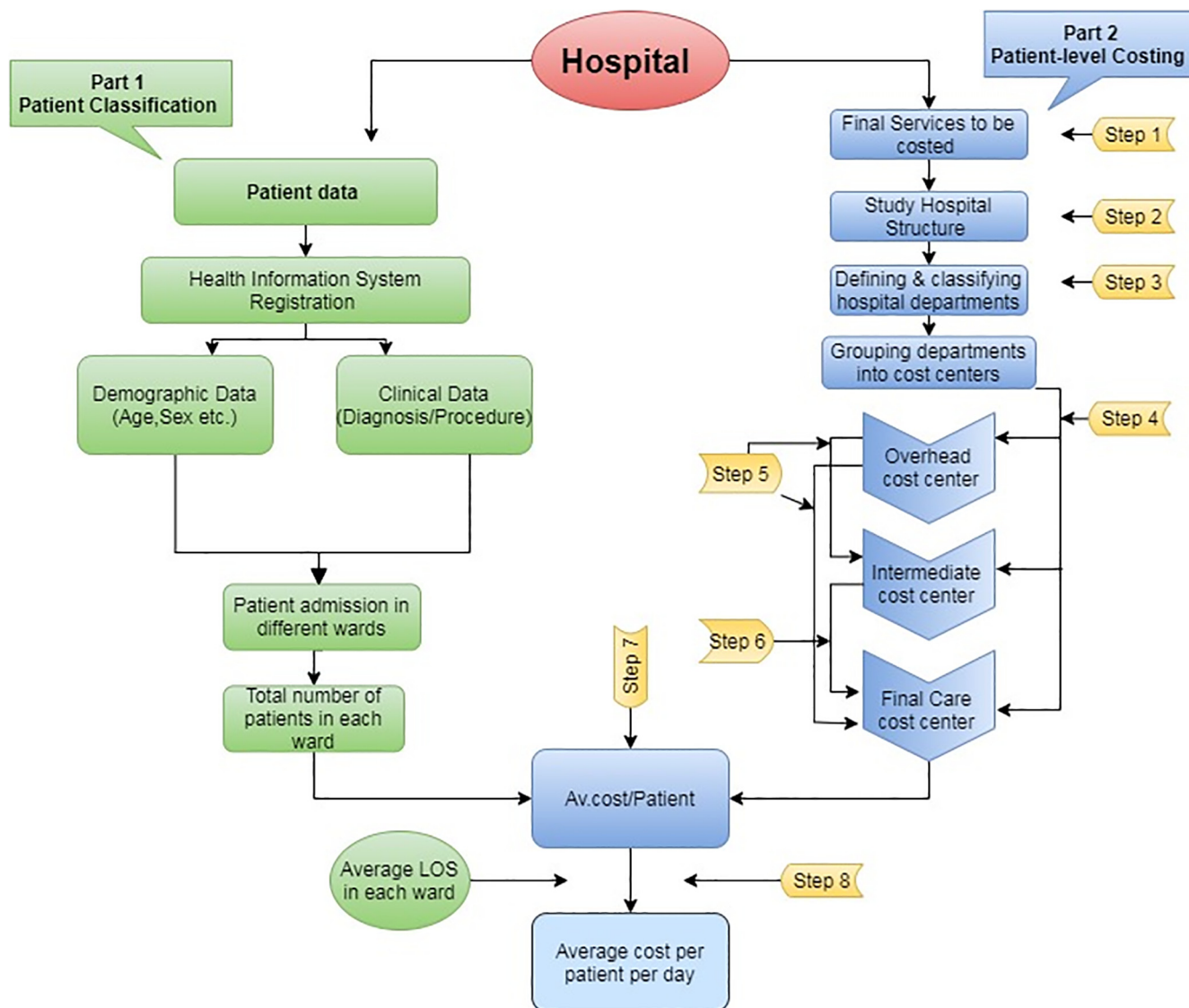


Fig. 1. Research framework.

- 6. Allocate the costs of intermediate to final care cost centres
- 7. Estimation of cost per patient
- 8. Estimation of cost per patient per day

2.6.1. Step 1: Define final services to be costed

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

2.6.2. Step 2: Study Organizations' chart and structure

Hospital structure helped us to identify how the resource flow happens in the hospital. It also helped to identify the cost centres. A cost centre is the basic unit of responsibility in a hospital, where we assign the cost, e.g., operation theatre, hospital ward, pharmacy, and radiological services. It is an accounting unit that records all costs associated with a specific activity.

2.6.3. Step 3: Classify hospital departments and define cost centres

We classified the administrative and clinical departments into the overhead, intermediate, and final care cost centres based on the functions they perform. We classified the overhead cost centre that includes the supporting department for other cost centres. Intermediate cost centre that represents the services indirectly

used by the other departments and services of the hospital. The final care cost centre is the hospital's final products and services that receive support and services from overhead and intermediate cost centres.

2.6.4. Step 4: Identify the total cost of overhead, intermediate and final care cost centres

We Identified the total cost (recurrent and capital costs) of the cost centres individually.

2.7. Identification of cost for overhead cost centre (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 and participating in health care delivery services and related operations of the hospital. We included all assets, including electronic equipment, computers, and furniture fixtures, regardless of purchased or donated. For all equipment and furniture, the price was obtained and multiplied by the depreciation rate to estimate the annual depreciation value.

2.8. Identification of cost for Intermediate Cost Centers (ICC)

Intermediate Cost Centers (ICC) that receive services from Overhead cost centre as well as provide services directly to patients and Final care Cost Centers. In this study, we did not include the total cost of medical supplies to the hospital. We considered patient-level data of pharmacy, laboratory, and Radiology services that contained the actual consumption of resources used by the patient. Patient data were extracted directly from the Electronic health information and administrative data collected from the administration office of the hospital.

2.9. Identification of cost for Final care cost centers

Final care cost centres (FCC) that receive services both from OCC and ICC but do not provide services back to these cost centres. FCC is involved directly in the management of the patients or the creation of services and includes inpatient wards and outpatient clinics. For Clinical staff, there was no fixed work placement, and providing services to both inpatient wards and outpatient clinics. To resolve this issue, we distributed the total salary of the clinical staff among inpatient and outpatient cost centres by using the universal allocation statistics, which was 75% and 25%, respectively.

2.9.1. Step 5: Allocate the costs of overhead cost centres to intermediate and final care cost centres

We applied an internationally acceptable methodology to allocate overhead costs to intermediate and final cost centres (Shepard et al., 2000). We distributed the total cost of overhead cost centres among intermediate and final care cost centres based on the allocation statistics used in other studies (Zafar et al., 2005; Shepard et al., 2000). For final care cost centre, we applied the universal allocation statistics (75% and 25% for Inpatients and Outpatients, respectively) to distribute the cost among inpatient wards and outpatient clinics. As inpatient consumes hospital resources three times more than the outpatients (Shepard et al., 2000, 1998).

2.9.2. Step 6: Allocate the costs of intermediate to final care cost centres

In this step, we allocated the total cost of the intermediate cost centre (having proportion from an overhead cost centre) to final care cost centres. We applied the same distribution approach for proportional values distribution among Inpatients and outpatients (75% for inpatients and 25% for outpatients). In this step, we finalised the stepped down costing process and allocated all costs to the final care cost centre.

2.9.3. Step 7: Estimation of cost for each patient

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

2.9.4. Step 8: Estimation of cost per patient per day

In this final step, we calculated the average length of stay in each ward and divided the average cost of each patient with an average length of stay in each ward. As a result, we had the average cost per patient per day for each ward.

3. Results

King Fahd Central Hospital (KFCH) is the only tertiary care hospital in the region with a capacity of 500 patient beds. The entire staff at the KFCH hospital was 1606. Out of these, 441 were physicians/surgeons, and 546 are nurses. The detail of the other staff is given in Table 1.

Table 1
Staff distribution among hospital.

Category	Total staff	Percentage
Administrative	153	9.5
Physicians	441	27.5
Nurses	546	34.0
Technicians	466	29.0
Total Staff	1606	

The total inpatient discharges for the calendar year 2018 were 12,979. Out of these maximum number of patients were observed in the Pediatric and gynaecology ward that were 32.72% and 28.38% respectively of the total patients. The detail of other wards is given in Table 2.

We considered only inpatients services for resource estimation. We studied the hospital structure in detail to identify the patient and resource flow in the hospital. We classified the administrative and clinical departments into the overhead, intermediate, and final care cost centres based on the functions they perform. We grouped the departments as listed in Table 3 and classified as an overhead cost centre.

We classified the intermediate cost centre by grouping the departments that are listed in Table 4.

We grouped all hospital inpatient wards and outpatient clinics and classified it as a final care cost centre (see Table 5).

The total operational cost of the hospital, including overhead, intermediate, and final care cost centres, was SAR 347,499,930. We found Human resource cost (SAR 166,655,388) as the maximum that was 48% of the total cost. The cost of equipment and maintenance (26%) was the second-highest. The cost centre that consumed the highest resources was the overhead cost centre that amounted to SAR 122,819,410 (1USD = 3.75 SAR) (35.34%). In contrast, the final care cost centre was the second-highest amounting to SAR 116,766,493 (33.60%), and the intermediate cost centre consumed SAR 107,914,027 (31.05%) of the total cost (Table 6).

In the over-head cost centre, the maximum resource consumption of the hospital were contractual services, including Cleaning/Maintenance, Food, and utilities that were 34.42%, 24.43%, and 12.89% respectively of the total cost of the overhead cost centres (Table 7).

By following the step-down costing, in the first step, the cost of the overhead cost centre was allocated to an intermediate and final care cost centre by using the allocation statistics. Intermediate cost centres (ICC) included the services given to patients while admitted in the hospital or as required by the outpatient during the visit. The maximum cost was of Pharmacy services, which were 25.63% of the Intermediate total cost, followed by Radiology and Laboratory, which was 21.49% and 19.07%, respectively (Table 8).

In the second step, we allocated the cost of the intermediate cost centre to the final Care cost centres (FCC) by using the allocation statistics. We observed that the maximum cost in the Male and Female Orthopedic ward (25.14%). The final cost of the Medical ward, Gynecology ward, Surgical ward, Neurosurgery ward, Pediatric ward and plastic surgery was 19.15%, 12.88%, 17.76%, 5.23%, 16.47%, and 3.38% respectively (Table 9).

We calculated the average cost of treatment per patient admitted in the wards and found that the cost of Orthopedic ward patients was highest with SAR 108,561 per patient. In contrast, the average cost of patients in the Medical ward, Gynecology ward, Surgery ward, Neurosurgery, Pediatric ward, and Plastic surgery was SAR 20,450, SAR 8636, SAR 33,033, SAR 23,444, SAR 9579 and SAR 29,425 respectively as shown in Table 10.

The average inpatient length of stay at the hospital was 12 days. The maximum stay was in Neurosurgery ward with 30 days. The average length of stay in other wards is shown in Table 11. We

Table 2
Patient distribution among different wards.

Wards	Male Patients	Female Patients	Total Patients	Percentage
M & F. Orthopaedic	408	164	572	4.41
M & F. Medical	1234	1079	2313	17.82
Gynaecology	–	3684	3684	28.38
M & F. Surgery	724	604	1328	10.34
Paediatric	2399	1848	4247	32.72
Plastic surgery/Burn Unit	170	114	284	2.19
Neurosurgery	425	126	551	4.25
Total	5015	6584	12,979	

Table 3
Overhead cost centre departments.

Overhead Cost Centre (OCC)		
<ul style="list-style-type: none"> • Hospital director office • Patient Registration • Administrative supervision • Preventive medicine • Home care • General and clinical Dietary • Infection control • E-Health, Medical record 	<ul style="list-style-type: none"> • Patient management, Coordination and referral • Quality & Patient safety, clinical audit • Central sterilisation • Academic affair & training • HR services • HR planning • Communication services 	<ul style="list-style-type: none"> • Housing management • Security department • Self-resource management • Family Management • Medical supply • Food supplies • Maintenance & cleaning • Utilities

Table 4
Intermediate cost centre departments.

Intermediate Cost Centre (ICC)		
<ul style="list-style-type: none"> • Anaesthesia • ICU • N. ICU Ward (Neonate) 	<ul style="list-style-type: none"> • P. ICU Ward • CCU • Physiotherapy 	<ul style="list-style-type: none"> • Laboratory • Radiology & imaging • Pharmacy

Table 5
Final care cost centre departments.

Final Cost Centre (FCC)		
<ul style="list-style-type: none"> • M & F Ortho ward • M & F Medical ward • Gynaecology ward 	<ul style="list-style-type: none"> • M & F Surgery ward • Neurosurgery • Pediatric ward 	<ul style="list-style-type: none"> • Plastic Surgery, Burns unit • Outpatient clinics

Table 6
Total operational cost for different cost centres.

Cost Centers	Total operational cost (SAR)	Percentage usage (%)
Overhead cost center	122,819,410	35.34
Intermediate cost center	107,914,027	31.05
Final care cost center	116,766,493	33.60
Total Cost	347,499,930	

divided the average cost per patient in the ward to the average length of stay at each ward to estimate the average cost per patient per day. The following Table 11 shows that the maximum average cost per patient per day was observed in Orthopedic ward with SAR 5428. The detail of other wards is given in Table 11.

Table 7
Cost distribution among Overhead cost centre.

Overhead Cost Center	Total cost (SAR)	Percentage Cost
Hospital director office	487,076	0.40
OPD reception	1,147,240	0.93
Public relation, Health media, Administrative supervision, communication services	2,995,460	2.44
Patient right and relation, patient management, Coordination & referral, follow up	2,300,528	1.87
Quality & Patient safety, clinical audit, safety management	668,956	0.54
E Health, Medical record	2,913,496	2.37
Housing management /Maintenance, rent, furnish	1,655,500	1.35
Security department	638,500	0.52
Self-resource management	1,033,660	0.84
Family Management	388,004	0.32
Preventive medicine	397,592	0.32
Home care	1,492,996	1.22
Rehabilitation, Social and psychological services	955,500	0.78
General Dietary, Clinical dietary, Nutritionist	1,216,092	0.99
Infection control	660,732	0.54
Inventory control	366,228	0.30
Central sterilization	1,019,508	0.83
Mobile blood donation unit Administrative supervision	541,608	0.44
Academic affair & training, Scholarship, conferences,	2,611,056	2.13
HR services	5,293,864	4.31
HR planning	5,916,432	4.82
Food supplies	30,009,955	24.43
Maintenance and cleaning	42,275,667	34.42
Utilities (Electricity, water, Telecom)	15,833,760	12.89
Total cost	122,819,410	

Table 8
Total cost of Intermediate cost centre including OCC percentage using Top-down approach.

Intermediate Cost Center	Total cost including percentage from OCC (SAR)	Percentage cost
Laboratory	31,680,018	19.07
Radiology & imaging	35,699,073	21.49
Pharmacy	42,569,190	25.63
Physiotherapy	10,485,120	6.31
Anesthesia /OR	9,874,270	5.94
ICU	12,543,567	7.55
Neonate ICU	17,498,870	10.53
Pediatric ICU	3,928,887	2.37
CCU	2,625,181	1.58
Total	166,904,176	

We observed that the maximum resources were consumed by human resource in term of salaries the detail of other resources with the maximum cost is given in Table 12.

Table 9

Total cost of Final cost centre (Inpatients) including OCC and ICC percentage using Top-down approach.

Final Cost Center (Inpatients)	Total cost including percentage from OCC and ICC (SAR)	Percentage allocation (%)
M&F. Orthopedic ward	62,096,980	25.14
M&F. Medical ward	47,301,317	19.15
Gynecology ward	31,814,248	12.88
M&F. Surgery ward	43,868,028	17.76
Neurosurgery ward	12,917,859	5.23
Pediatric ward	40,680,719	16.47
Plastic surgery & Burn Unit	8,356,787	3.38
Total cost	247,035,938	

Table 10

Average cost per patients in each ward.

Final care cost centre (Inpatients)	Total Patients	Average cost per patient (SAR)
M&F. Orthopedic ward	572	108,561
M&F. Medical ward	2313	20,450
Gynecology ward	3684	8636
M&F. Surgery ward	1328	33,033
Neurosurgery ward	551	23,444
Pediatric ward	4247	9579
Plastic surgery + Burn Unit	284	29,425

Table 11

Average cost per patient per day in each ward.

Final care cost centre (Inpatients)	Average LOS	Average cost per patient per day (SAR)
M&F. Orthopedic ward	20	5428
M&F. Medical ward	8	2556
Gynecology ward	5	1727
M&F. Surgery ward	9	3670
Neurosurgery ward	30	781
Pediatric ward	8	1197
Plastic surgery + Burn Unit	14	2102

Table 12

Resources with maximum cost.

Cost Resources	Total cost	Percentage
Human Resource (Salaries)	166,655,388	48.02
Machinery/Equipment	47,396,650	13.63
Maintenance	42,275,667	12.17
Food Supplies	30,009,955	9.00
Pharmacy	27,523,654	8.03

4. Discussion

To our best knowledge, we conducted this study first time on unit costs of healthcare services at tertiary care hospitals in Saudi Arabia and especially in the Jazan region. The unit costs of the hospital services fluctuate depending on the available resources used by each cost centre and utilisation of hospital services. Unit cost estimation studies done in developing countries found the human resource cost as the most significant component of the total cost (Olukoga, 2007; Tsilaajav, 2009; Flessa and Dung, 2004; Minh et al., 2010). We observed similarly in this study that is about 48% of the total cost. The studies conducted in Malawi (Mills et al., 1993) and Myanmar (Than et al., 2017) also found the same results regarding human resource cost. In our study, this finding was probably due to less local workforce, as about 70% of the clinical staff is expatriate working in this hospital. Another study showed that higher human resource costs could be associated with

better performance of the hospital (Stock et al., 2014). Human resource costs can be linked with the capital budget allocation based on the output and demand pattern.

In our study, the cost of equipment was 13.63% of the total cost. That was also a significant component of the total cost of the hospital. Studies from India (Chatterjee et al., 2013) and Myanmar (Than et al., 2017) also showed comparable results related to the cost of equipment and machinery. In a tertiary hospital setting, to improve the performance and utilisation of services, higher investment is required for equipment. If the health sector planned and executed the capital budget wisely, then a higher cost of equipment maintenance and their depreciation cost can be avoided. (Pena and Ndiaye, 2002) We observed that maintenance and cleaning services of the hospital outsourced to the contractors that had a critical impact on the budget and quality of services.

The findings of the intermediate cost centres showed that medicines and medical supplies were the most significant component of the total cost, which is about 25.50% of the total cost of an intermediate cost centre. In comparison, it is only about 8% of the total cost. Variation in medicine cost could be due to different factors related to hospital policy, Physician's prescribing trends, and facility of free-of-charge medicines to the patients who are visiting the hospital or admitted at the hospital. Studies conducted in Pakistan and Vietnam also reported similar results regarding the cost of medicines and medical supplies and found the second most abundant component of the hospital budget (Green et al., 2001; Flessa and Dung, 2004). As the pharmacy and medical supplies contribute with higher cost effects in health services provision, it is imperative to explore the usage of these medicines to know either patient consumed these dispensed medicines efficiently and effectively, or not (Mehmood et al., 2019).

Hospitals had a higher number of laboratory tests that contribute about 6% of the total cost as compared to radiological services that are much lesser in number but contribute about 7% of the total cost. The higher cost of radiology services could be due to the expensive equipment used in the radiological department as compared to the laboratory.

The resources generated by the hospitals have limited capacity to contribute in terms of budgeting support. Studies in India and South Africa also reported similar findings in the variation of unit cost depending on the volume of services (Olukoga, 2007; Chatterjee et al., 2013). However, the unit costs of healthcare services at a hospital understudy was higher compared to the unit cost at the 400-bed district hospital and 778-bed central hospital in India and the 170-bed district hospital and 980-bed central hospital in Vietnam (Flessa and Dung, 2004; Chatterjee et al., 2013). The study period, location, and pattern of resource utilisation can have an impact on the difference in healthcare services cost, as observed in the above studies.

The unit costs of the speciality units for inpatients were highest due to expensive equipment and fewer patients, like the Orthopedic ward that had the highest cost and a smaller number of patients. The same is the case with Neurosurgery and Plastic surgery ward. We found the second-highest unit cost for the Surgical ward. The Plastic surgery ward and Neurosurgery ward had the third-highest unit cost. The higher cost of the Orthopedic ward could also be as a result of the ongoing cross border conflict, and the hospital is the only tertiary care hospital in this region. All inpatient wards consume more resources in terms of medicines and equipment.

5. Study limitation

The study has some limitations. First, we included one tertiary care hospital in this study and thus not able to compare the cost

with others. Secondly, we considered only inpatient data for cost estimation, and the average cost of patient stay at the hospital was calculated irrespective of the disease and procedure performed. Third, the cost of some variables in different departments was underestimated because some of the inpatient records were incomplete, and resources were untraceable.

6. Conclusion

This study is the first costing exercise conducted in the region, so it provides the necessary information about the cost of health care services. We calculated the unit cost of inpatient services, and results showed that the cost of human resource was maximum among all resources in terms of salaries. The cost of overhead cost centres was highest among all cost centres, that is important to note, and actions must be taken to manage the overhead resources. The retrospective top-down costing approach applied in this study can be used as a primary tool and reference for further studies in other regions of the country. It also complements the Saudi vision 2030 in which the privatisation plan of hospitals is on priority. Hence, this data can help to provide a better understanding of the tertiary hospital costing in the region to achieve the privatisation objective. It can help the policymakers and administrators to better understand the planning and budget allocation, especially in a tertiary care setting.

7. Recommendations

Hospitals had incomplete records of the medical and surgical equipment being used during surgical procedures. Therefore, assigning the surgical resources to each patient, used by each cost centre was challenging. Similarly, there was also no proper differentiation between the delivery of medical supplies to inpatients and outpatients. Hospitals should also develop a robust information management system with more reliable and precise information which can provide a clear image and allow for practical evaluation of resource usage. In this research, we calculated only the average cost of an inpatient stay at the hospital, so we suggest further analysis to estimate the diagnostic cost of each patient being treated at the hospital as well as the outpatient cost calculation.

8. Ethics approval and consent to participate

The ethical committee of Jazan University, Saudi Arabia, and Jazan Research Ethics Committee, Directorate of Health Affairs Jazan region, approved this study. We explained the objectives of the study to clinical and administrative staff before the commencement of the study.

9. Consent for publication

Not Applicable

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Authors contributions

KG identified the problem and idea of the study; ZA, KG, AM was responsible for study design. AM, FK, AN conducted data collection. ZA, AM did data analysis. AM, KF, AMJ, JA drafted the manuscript, and all authors commented on and refined the draft. ZA, KG was general supervision, ZA, KG edited the final version. All authors read and approved the final manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- Aboagye, A., Degboe, A., Obuobi, A., 2010. Estimating the cost of healthcare delivery in three hospitals in Southern Ghana. *Ghana Med. J.* 44 (3).
- Adam, T., Evans, D.B., Murray, C.J., 2003. Econometric estimation of country-specific hospital costs. *Cost Effect. Resour. Alloc.* 1 (1), 3.
- Alharbi, M.F., 2018. An analysis of the Saudi health-care system's readiness to change in the context of the Saudi National Health-care Plan in vision 2030. *Int. J. Health Sci.* 12 (3), 83.
- Bane, F., 2015. Introduction to the Price Setting Process for Admitted Patients. In: Executive HS, editor. *Healthcare Pricing Office*; 2015.
- Barnum, H., Kutzin, J., 1993. *Public Hospitals in Developing Countries: Resource Use, Cost, Financing*. Johns Hopkins University Press.
- Chatterjee, S., Levin, C., Laxminarayan, R., 2013. Unit cost of medical services at different hospitals in India. *PLoS ONE* 8, (7) e69728.
- Conteh, L., Walker, D., 2004. Cost and unit cost calculations using step-down accounting. *Health Policy Plann.* 19 (2), 127–135.
- Creese, A., Parker, D., 1994. *Cost Analysis in Primary Health Care. A Training Manual for Programme Managers*. ERIC.
- Flessa, S., Dung, N.T., 2004. Costing of services of Vietnamese hospitals: identifying costs in one central, two provincial and two district hospitals using a standard methodology. *Int. J. Health Plann. Manage.* 19 (1), 63–77.
- Green, A., Ali, B., Naeem, A., Ross, D., 2000. Resource allocation and budgetary mechanisms for decentralized health systems: experiences from Balochistan, Pakistan. *Bull. World Health Organ.* 78, 1024–1035.
- Green, A., Ali, B., Naeem, A., Vassall, A., 2001. Using costing as a district planning and management tool in Balochistan, Pakistan. *Health Policy Plann.* 16 (2), 180–186.
- Mathauer, I., Carrin, G., 2010. OASIS user manual. A tool for health financing e Performance assessment e Options for improvement. WHO, Department of Health Systems Financing, Geneva.
- Medicare Cf, Services M. 2018. Design and development of the diagnosis related group (DRG).
- Mehmood, A., Adnan, S., Khan, M., Karunamoorthi, K., Azeez, F.K., 2019. Prevalence and Practice of Self-medication among University Students in Pakistan through Online Resources. *Asian J. Res. Med. Pharm. Sci.*, 1–9
- Mills, A.J., Kapalamula, J., Chisimbi, S., 1993. The cost of the district hospital: a case study in Malawi. *Bull. World Health Organ.* 71 (3–4), 329.
- Minh, H.V., Giang, K.B., Huong, D.L., Huong, L.T., Huong, N.T., Giang, P.N., et al., 2010. Costing of clinical services in rural district hospitals in northern Vietnam. *Int. J. Health Plann. Manage.* 25 (1), 63–73.
- Ministry of Health, S.A., 2020. Ministry of Health, Saudi Arabia-Budget Saudi Arabia: Ministry of Health; 2020 [cited 2020 15-03-2020]. Available from: <https://www.moh.gov.sa/en/Ministry/About/Pages/Budget.aspx>.
- Olukoga, A., 2007. Unit costs on inpatient days in district hospitals in South Africa. *Singapore Med. J.* 48 (2), 143.
- Pena, A.D., Ndiaye, M., 2002. Developing hospital efficiency-cost control measures. *World Hospitals Health Serv.* 38 (3), 2–9.
- Shepard, D.S., Hodgkin, D., Anthony, Y.E., 2000. Analysis of hospital costs: a manual for managers. World Health Organization.

- Shepard, D.S., Hodgkin, D., Anthony, Y., 1998. Analysis of Hospital Costs: A Manual for Manager. World Health Organization, Geneva.
- Stock, G.N., McDermott, C., McDermott, M., 2014. The effects of capital and human resource investments on hospital performance. *Hospital Top.* 92 (1), 14–19.
- Than, T.M., Saw, Y.M., Khaing, M., Win, E.M., Cho, S.M., Kariya, T., et al., 2017. Unit cost of healthcare services at 200-bed public hospitals in Myanmar: what plays an important role of hospital budgeting? *BMC Health Serv. Res.* 17 (1), 669.
- Tsilajav, T., 2009. Costing study for selected hospitals in the Philippines. Health Sector Policy Support Programme in the Philippines, Manila, Philippines.
- Zafar, A.S.B.S., Amrizal, M.N., Rohaizat, B.Y., Aljunid, Syed, 2005. The development of cost centres for case-mix costing in a teaching hospital in Malaysia. *Malaysian J. Public Health Med.* 5 (2), 5.
- Zafar, A.S.B.S., Amrizal, M.N., Rohaizat, B.Y., Aljunid, Syed, 2005. The development of cost centres for case-mix costing in a teaching hospital in Malaysia. *Malaysian J. Public Health Med.* 5, 2.