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Calculating the Costs of the Technical Component of Operating Room in Selected Hospitals in Iran, 2019

Elham Ehsani-Chimeh[1], Zeinab Fakoorfard[2*], Alireza Olyaeemanesh[1], Mani Yousefvand[3], Saeed Ma'navi[3], Soheila Damiri[2], Maryam Radin Manesh[4], Ebrahim Hasanzadeh[5], Ali Akbari Sari[1], Mahmoudreza Mohaghegh Dolat Abadi[6], Rajabali Daroudi[2], Omid Barati[5]

[1]National Institute for Health Research, Tehran University of Medical Sciences, Tehran, Iran
[2]Department of Health Management, Policy and Economics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran
[3]Secretariat of the Supreme Health Insurance Council, Ministry of Health and Medical Education, Tehran, Iran
[4]Social Medicine Department, Faculty of Medicine, Jundishapur University of Medical Sciences, Ahvaz, Iran
[5]School of Management and Medical Information Sciences, Iran University of Medical Sciences, Tehran, Iran
[6]Anesthesiology Department, Shahid Hashemi Nejad Specialized Hospital, Faculty of Medicine, Iran University of Medical Sciences, Tehran, Iran

***Corresponding Author:** Zeinab Fakoorfard, Email: z-fakoorfard@farabi.tums.ac.ir

Abstract

Introduction: Considering that surgeries have a significant role in treating and improving patients' health, increasing the efficiency and optimizing the costs in the operating rooms are highly important. Thus, this study aimed to calculate the costs related to the technical component of the operating rooms in selected hospitals affiliated to Tehran and Iran Universities of Medical Sciences in 2019.

Methods: This research is a retrospective, descriptive, and analytical study, which is considered applied in terms of its objective. First, literature reviews and expert panel discussions were held, and calculating the methods and assumptions was defined, followed by performing a quantitative study and using traditional costing methods. Data were collected from forms, hospital documents, and the hospital information system and then recorded in Excel 2016. After performing calculations, cost analysis was conducted in two scenarios.

Results: In all the operating rooms of Tehran and Iran Universities of Medical Sciences, considering depreciation, the highest and lowest unit costs of the technical component were $3.54 and $1.68 based on USD purchasing power parity, respectively. Both values exceeded the technical component rate of $0.87 in 2019,, demonstrating a negative cost-to-revenue balance in all operating rooms. Even without considering depreciation, the unit cost of the technical component in all operating rooms (except one) was higher than the monetary coefficient of the technical component of $0.87 in 2019.

Conclusion: The significant difference between the unit cost of the technical component in the operating room and the technical component rate in 2019 led to increased costs for hospitals. Given the increasing trend of consumable costs, this cost imbalance is likely to widen further. Hospitals are forced to use their own revenues to cover these costs since they are not covered by insurance organizations or patients. Therefore, it is essential to take necessary measures to adjust the percentage of the technical component of the operating room and adopt policies to prevent problems in the continuity of service delivery in public hospitals.

Keywords: Technical component, Operating room, Unit costs, Hospital, Costing

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Introduction

Ensuring the health of individuals in society is a critical responsibility that differs in nature and urgency from the services provided by other organizations. Therefore, the effective functioning of healthcare services has a significant impact on public health (1). On the other hand, the substantial increase in hospital costs worldwide has prompted health economists to seek new methods to control these costs while maintaining service quality (2, 3). Nonetheless, efficient use of resources requires accurate cost information regarding the flow of resources (4). In this regard, some tools, such as costing and cost analysis, can provide essential data for managers (5). It can be mentioned that the analysis of hospital costs is one of the most important criteria for resource allocation in the healthcare sector (6). More precisely, cost analysis helps decision-makers compare the actual costs of services with what occurs in reality, allowing them to determine optimal strategies for achieving their goals (7). Additionally, information regarding costs and final prices can be effective in budget reform and tariff rates (8). On the other hand, unrealistic tariffs impose additional costs on the treatment sector (9) and can have harmful effects on the healthcare system (4). Therefore, understanding financial

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resources and identifying cost centers in hospitals are crucial for accurate decision-making (10).

Costing methods are generally categorized into traditional and modern costing types (11). In traditional methods, service delivery costs are divided into direct and indirect (overhead) types. The advantages of this method include its simplicity and speed in determining total costs (12). Moreover, modern methods have primarily developed over the past two decades. Activity-based costing is one of the modern methods, which was first introduced in 1978. It focuses on activities as the basis for cost objectives (13).

According to the Relative Value Units of Health Care Services book, relative value units indicate the difficulty of providing each service. These values were determined based on different indicators, such as the time required for service delivery, the risk to both the physician and the patient, the needed knowledge, experience, and skills, physical and mental efforts, and the legal risks associated with providing the service. In this book, three relative values units are mentioned for each service, representing the overall component, professional component, and technical component, respectively.

The technical component encompasses the costs of maintaining medical equipment and installation, physical space, facilities, providing necessary facilities and conditions, support services human resources (non-medical staff), depreciation costs, and capital gains for providing each service, and other costs are calculated separately. It is noteworthy that the physician's salary is not included in the technical component costs.

In 2015, agreements were settled between insurance organizations and treatment departments of medical universities. Based on these agreements and the mentioned book, in all services which is provided in the operating room only one relative value unit is indicated in the "relative value unit" column (no technical component is defined) and then the technical component is calculated as 40% and 25% for the public and private sectors, along with the final relative value unit. Accordingly, to determine the revenue of public hospital operating rooms, 40% of the relative value unit of each service provided in the operating room is multiplied by the monetary coefficient of the technical component (k).

According to Article (9) of the Permanent Provisions of the National Development Plan, the monetary coefficient of the technical component (k) is a fixed number that is annually announced before the start of the new year by the First Vice President. According to this law, the Supreme Health Insurance Council is obligated to review the relative value unit and determine the health service tariffs for all health, treatment, and diagnostic service providers in the country, including public, non-governmental, and private sectors. This should happen in the way that ensure the balance between resources and expenses and the actual price in order to promote appropriate health behaviors and create a uniform basis for calculations in competitive conditions. Moreover, this should be announced after approval by the Organization for Planning and Budget of the country and presented to the Cabinet for approval before the end of each year for the next year. In the Iranian healthcare system, some evaluate tariffs as realistic while others consider them unrealistic (14). The incentives in payment mechanisms will be adversely affected if the tariffs deviate significantly from actual values (15). Given these factors, the high costs and low revenues in public hospitals create a gap that prevents most public hospitals from reaching a breakeven point (16). This study aims to calculate the costs of operating rooms and compare them with the monetary coefficient of the technical component for 2019 to provide suitable measure for policymakers, whether these tariffs are realistic or not and weather existing situation may lead to financial losses for hospitals or not. It is hoped that the results of this study help health policymakers to make appropriate decisions regarding operating room costs based on reality.

Methods

The present study was designed to calculate the costs related to the technical component of the operating room and was conducted in 138 operating rooms from eight selected hospitals affiliated to Iran and Tehran Universities of Medical Sciences from September 2018 to February 2019.

First, a review of studies related to hospital costing was conducted to identify resource allocation methods and how to calculate overhead costs in hospitals. A working group was formed consisting of 12 faculty members (experts) in health management and economics and individuals who had relevant education and experience, as well as executive backgrounds in pricing, tariffs, insurance, and hospital costs. This group exchanged ideas during continuous meetings regarding various resource allocation methods and how to calculate costs. Based on the findings from the literature review and the experts' opinions, consensus was reached about evaluating and estimating resource allocation methods and costs, as well as calculating and defining calculation assumptions.

The sampling method was a census, including all operating room cost data from selected hospitals affiliated to Iran and Tehran Universities of Medical Sciences during the study duration. Overall, 138 operating rooms from eight hospitals were examined (Table 1), which were selected based on their ability to provide the necessary data and reporting them from the hospital information system.

It should be noted that the traditional costing method were applied in the present study. In this method, costs are divided into direct and indirect types. Direct costs include expenses that play a direct role in service delivery in the operating room, while indirect costs encompass expenses that indirectly affect the service delivery process in the operating room (e.g., costs related to the sterilization unit and laundry and the like).

According to the consensus, a significant portion of the sterilization unit's activities are related to the operating room; therefore, 90% of all costs associated with the

sterilization unit were considered in the operating room's costs. Additionally, the ratio of the operating room linen to the total hospital linen was used to allocate laundry costs to the operating room.

Total direct and indirect costs of the operating room = operating room costs + sterilization costs + laundry costs

The method for cost allocation is summarized in Table 2.

Based on the assumption, six cost headings were identified and calculated for each operating room cost. The calculation method of the costs in each heading is provided as follows:

Human Resources

The costs of human resources in hospitals include those for governmental (permanent), contractual, compulsory, and outsourced employees. Only the salaries and compensation costs of human resources paid from the hospital's internal revenues (not the governmental budget) during the study duration were calculated in this study. Thus, the salaries of governmental personnel working in the operating room, laundry, and sterilization units were excluded, while overtime, bonuses, salaries of outsourced employees, and other payments from hospital internal revenues were included in this investigation. The cost of human resources in the operating room was computed directly, and the cost of human resources in the laundry was also estimated and weighted based on the linen ratio. In the sterilization unit, human resource costs were multiplied by coefficient 0.9.

Energy Carriers

Energy costs included expenses for water, electricity, gas, internet, and telephone. Energy costs in the hospital were calculated for three units. Initially, the total energy cost of the hospital was computed, and the share of energy for the laundry, operating room, and sterilization unit was determined using the ratio of each unit's space (square meter) to the total hospital space. Subsequently, based on assumptions, the weight of energy consumption in the operating room was assigned a value of three due to the presence of high-energy-consuming equipment, while laundry and sterilization received a weight of two.

In the laundry unit, after determining the share of energy costs for the laundry from the total hospital and considering two coefficients, the resulting cost was multiplied by the linen ratio for the operating room to estimating the share of operating room energy costs from the laundry unit.

*** The share of operating room energy in laundry energy costs = total hospital energy costs * space ratio (square meter) * weight 2 * linen ratio coefficient***

In the sterilization unit, after measuring the share of energy costs for the sterilization unit from the total hospital and considering two coefficients, the resulting cost was multiplied by coefficient 0.9 to obtain the share of operating room energy costs from the sterilization unit.

*** The share of operating room energy in sterilization energy costs = total hospital energy costs * space ratio (square meter) * weight 2 * coefficient 0.9***

Consumables

The costs of consumables were examined in three groups:

1. *Operating Room Consumables:* The cost of all consumable items used in the operating room not included in the patient's bill was identified and calculated in the study.
2. *Laundry Consumables:* They include all consumable items utilized in the hospital's laundry unit. The consumables were identified, and the total cost was computed and multiplied by the linen ratio.
3. **Sterilization Consumables:* They encompass all consumable items employed in the sterilization unit. The consumables were identified, and the total cost was determined and multiplied by coefficient 0.9.

Table 1. Selected Hospitals

Tehran University of Medical Sciences			Iran University of Medical Sciences		
Hospital	**Type of Operating Room**	**Number of Operating Rooms**	**Hospital**	**Type of Operating Room**	**Number of Operating Rooms**
T1	Laparoscopy	3	I1	Total	32
T2	Open heart	3	I2	General	10
T3	Urology	3	I3	Total	6
T4	General	32	I4	Total	7
T5	General	18	I5	Total	6
T6	General	18			

Table 2. Cost Allocation Method

Type of Cost	Unit	Cost Allocation and Calculation Method
Direct	Operating room	Total costs of the operating room (personnel, consumables, energy, and the like)
Indirect	Laundry	Ratio of operating room clothing to total hospital clothing multiplied by laundry costs (personnel, consumables, energy, and the like)
	Sterilization	Overall, 90% of the total costs of the sterilization unit (personnel, consumables, energy, and the like)

Maintenance

The maintenance costs for capital equipment in the operating room were calculated. In the sterilization and laundry units, after computing the maintenance costs, a coefficient 0.9 was considered to the costs in the sterilization unit, and the linen ratio was multiplied by the laundry unit.

Depreciation

The depreciation costs of equipment and electrical and electronic devices were estimated based on their design lives. The following method was used to calculate depreciation:

$$^{**}\textit{Depreciation cost} = (\textit{cost accounting} - \textit{salvage value}) / \textit{design life (years)}^{**}$$

In the sterilization and laundry units, after computing the maintenance costs, a coefficient 0.9 was used for the costs in the sterilization unit, and the linen ratio was applied to the laundry unit.

Overheads

According to the consensus, 15% of the total costs for human resources, consumables, depreciation, maintenance, and energy in the three units (operating room, laundry, and sterilization) were considered overhead costs. Finally, the total operating room costs were divided by the total technical components for the surgeries performed; therefore, the cost per technical component for each operating room in different hospitals was calculated.

It should be noted that all costs, after being computed in rials, are to be converted into US dollars based on USD purchasing power parity, and the exchange rate is considered 129,180 rials per US dollar (1 USD = 129,180 rials)

Results

The present study calculated the unit costs of the technical component of the operating room from September 2018 to February 2019 in selected hospitals affiliated to Iran and Tehran Universities of Medical Sciences. The study was performed based on experts' opinions and consensus as study assumptions through two scenarios. In the first scenario, the total operating room costs were computed, including depreciation, and the unit cost of the technical component was determined accordingly. In the second scenario, the operating room costs were estimated without considering depreciation, and the unit cost of the technical component was obtained accordingly.

Table 3 provides the unit cost of the technical component broken down by each category. Based on the results, the average costs for consumables, maintenance, depreciation, overhead, and overall average were higher in Tehran University of Medical Sciences compared to Iran University of Medical Sciences.

Table 4 presents the unit cost of the technical component without calculating depreciation. The average unit cost of the technical component in Tehran University of Medical Sciences again was higher than that in Iran University of Medical Sciences.

As shown in Figure 1 , in all the operating rooms of Tehran and Iran Universities of Medical Sciences, considering depreciation, the highest and lowest unit costs of the technical component were $3.54 and $1.68, respectively, both of which exceed the monetary coefficient of the technical component for 2019 ($0.87). In other words, the cost and revenue balance in all operating rooms was negative. Even without considering depreciation, the unit cost of the technical component in all operating rooms (except one) was higher than the monetary coefficient of the technical component for 2019 ($0.87).

In the laparoscopic operating room T1 and urology T3, the unit cost of the technical component had the greatest difference with the monetary coefficient of the technical component. However, the lowest cost difference with

Table 3. Unit Cost of the Technical Component With Depreciation by Category ($)

Unit Cost of the Technical Component - Including Depreciation								
	Hospital	**Consumables**	**Human Resources**	**Maintenance**	**Energy**	**Depreciation**	**Overhead**	**Total**
Iran University of Medical Sciences	I1	0.41	0.72	0.18	0.08	0.60	0.20	2.20
	I2	0.39	0.59	0.13	0.09	0.45	0.17	1.82
	I3	0.15	0.38	0.22	0.03	0.75	0.15	1.68
	I4	0.30	0.94	0.15	0.03	0.60	0.20	2.22
	I5	0.21	0.78	0.26	0.00	0.91	0.22	2.37
	Average	0.29	0.68	0.19	0.05	0.66	0.19	2.06
Tehran University of Medical Sciences	T1	0.72	1.21	0.32	0.09	0.74	0.46	3.55
	T2	0.33	0.45	0.18	0.03	0.61	0.24	1.83
	T3	0.83	1.14	0.20	0.08	0.66	0.44	3.34
	T4	0.34	0.67	0.21	0.05	0.69	0.29	2.24
	T5	0.55	0.68	0.18	0.03	0.61	0.31	2.37
	T6	0.42	0.70	0.22	0.02	0.78	0.32	2.47
	Average	0.53	0.81	0.22	0.05	0.68	0.34	2.63

the monetary coefficient of the technical component was related to operating room I3. General operating rooms demonstrated similar differences in costs with the monetary coefficient of the technical component.

In this study, on average, the highest unit cost of the technical component was related to human resources, depreciation, consumables, maintenance, and energy, respectively. Table 5 presents the distribution of costs.

Discussion

This study calculated the operating room costs in six categories, including consumables, overhead, energy carriers, depreciation, maintenance, and human resources. The Secretariat of the Supreme Council of Health Insurance intended to examine income and cost data from 40% of the technical component of the operating room by aggregating in selected hospitals affiliated to Tehran and Iran medical universities. This measure was taken to inform decision-making based on the available data and evidence regarding the percentage of the technical component in operating rooms. The monetary coefficient of the technical component (k) is a fixed number that is annually announced by the First Vice-President before the beginning of the new year. According to the Permanent Provisions of the National Development Plan, the Supreme Council of Health Insurance should review

Table 4. Unit Cost of the Technical Component Without Considering Depreciation by Category ($)

	Unit Cost of the Technical Component - Without Depreciation							
	Hospital	**Consumables**	**Human Resources**	**Maintenance**	**Energy**	**Depreciation**	**Overhead**	**Total**
Iran University of Medical Sciences	I1	0.41	0.72	0.18	0.08	0.00	0.14	1.54
	I2	0.39	0.59	0.13	0.09	0.00	0.12	1.33
	I3	0.15	0.38	0.22	0.03	0.00	0.08	0.86
	I4	0.30	0.94	0.15	0.03	0.00	0.14	1.56
	I5	0.21	0.78	0.26	0.00	0.00	0.13	1.38
	Average	0.29	0.68	0.19	0.05	0.00	0.12	1.33
Tehran University of Medical Sciences	T1	0.72	1.21	0.32	0.09	0.00	0.35	2.70
	T2	0.33	0.45	0.18	0.03	0.00	0.15	1.14
	T3	0.83	1.14	0.20	0.08	0.00	0.34	2.59
	T4	0.34	0.67	0.21	0.05	0.00	0.19	1.44
	T5	0.55	0.68	0.18	0.03	0.00	0.22	1.66
	T6	0.42	0.70	0.22	0.02	0.00	0.20	1.57
	Average	0.53	0.81	0.22	0.05	0.00	0.24	1.85

Table 5. Share of Each Category of Total Cost by Two Scenarios (%)

Category	**Consumables (%)**	**Human Resources (%)**	**Maintenance (%)**	**Energy (%)**	**Depreciation (%)**	**Overhead (%)**	**Total (%)**
Scenario one	17.10	31.10	8.90	2.10	29.50	11.40	100.00
Scenario two	25.20	46.50	13.80	3.00	0.00	11.40	100.00

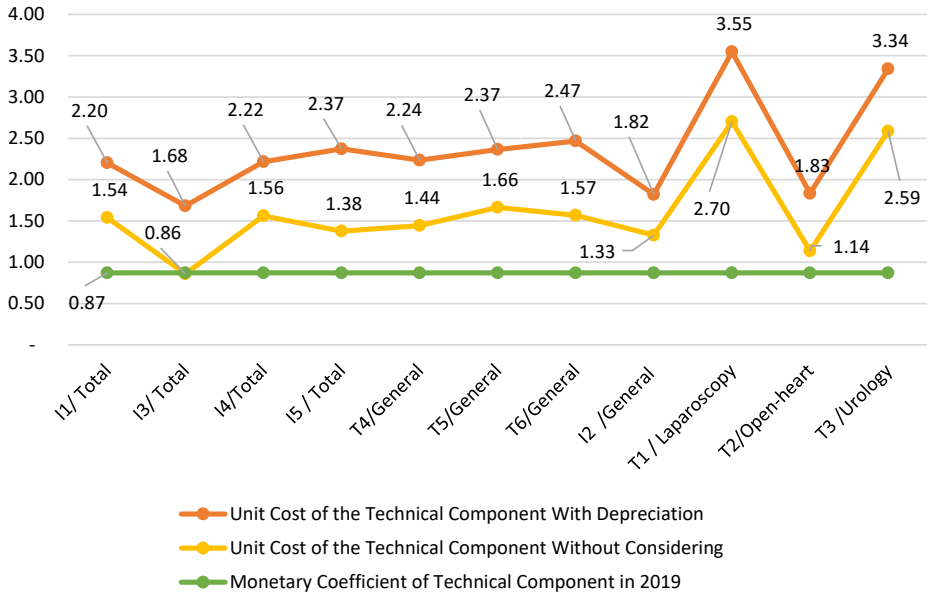


Figure 1. Comparison of the Unit Cost of the Technical Component With the Monetary Coefficient of the Technical Component ($)

the relative value units and determine the health service tariffs for all healthcare providers—whether public, non-public, or private—while ensuring balance between financial resources and expenses, as well as real prices, in order to promote appropriate health and treatment behaviors. After the approval of the National Budget and Planning Organization, these tariffs are announced before the end of each year for the following year. According to the Supreme Council of Health Insurance in 2019, the value of monetary coefficient of the technical component (k) was $0.87. Therefore, the income amount is obtained by multiplying 40% of the relative value units of services performed in the operating room (the technical component) by the monetary coefficient of the technical component.

The present study calculated the operating room unit cost of the technical component in selected hospitals in 2019. The study was analyzed based on two scenarios. In the first scenario, depreciation costs were computed, while in the second scenario, depreciation costs were not taken into consideration. The results of the study indicated that in both scenarios, the unit cost of the technical component in all the studied operating rooms (except for one general operating room) exceeded the technical component coefficient for 2019 ($0.87).

In this study, the human resource costs were the largest share of total costs in both scenarios. In the first scenario, the share of it was 31.1%, while in the second scenario, was 46.5%. A study by Alamshah also reported that the largest share of costs (66%) was related to salaries and benefits of staff (8). The results of the study by Rahmani et al indicated that human resources costs were 49% of the total costs (17). Moreover, Mehrolhassani et al concluded that personnel costs in the laboratory represented 74.2% of the total laboratory costs (18). In another studies were found that human resources constituted the largest share of costs (19,20). The findings of the study by Mobasheri et al in the lithotripsy unit of Ayatollah Kashani Hospital in Shahr-e-Kord indicated that the highest costs were related to human resources (86.1%) (6). Likewise, Mouseli et al showed that the share of human resources costs was 46.31%, which was one of the highest costs (21). Similarly, the results of the study performed by Beyranvand et al in the physiotherapy department of Sina Hospital revealed that the share of human resources costs was 48.4% of the total costs (22). In their study conducted in the radiology department of Golestan Hospital in Ahwaz, Torabi et al reported that the share of human resource costs was 43.35% of the total costs (23). It is noteworthy that differences in the calculated percentages are due to the services and the studied populations and including physicians' salaries or not.

The cost of consumables, after human resources and depreciation, had the highest unit cost of the technical component. In the first and second scenarios, the cost of consumables accounted for 17.1% and 25.2% of the total costs, respectively. Consumables are a significant factor influencing costs. Given the high prices of consumables, it is essential to manage their usage and prevent wastage. The findings of Mehralhassani et al revealed that consumables in the laboratory costed 21.1% of the total laboratory costs (18). Moreover, Rahmani et al found that consumables costed 45% of the total costs (17). Likewise, Mouseli et al reported that the share of laboratory consumables was 47.26% (21). In calculating the total costs in the surgical care cycle of patients who performed laparotomy using the activity-based costing method, it was shown that 68.5% of the total costs were related to drugs and medical consumables (24). Ebrahimi Pour et al computed the average cost of medical consumables to be 2.02% (25). Hadian et al also concluded the mentioned costs accounted for 2% of the total costs in Fatemieh Hospital in Semnan (26).

In this study, the costs of depreciation and maintenance was 38.4% of the total costs in the first scenario and 13.8% in the second one. Additionally, Alamshah et al observed that the share of equipment depreciation costs in the laboratory was 7% of the total costs (8). The results of the research by Beyranvand et al in the physiotherapy department of Sina Hospital indicated that the costs of equipment and building depreciation was 13.3% of the total costs (22). Similarly, Rahmani et al estimated equipment depreciation costs to be 5.5% in their study on laboratory service costs (17). Ebrahimi Pour et al also found that the depreciation cost was 6.7% in their analysis of hospital service costs in Fatemieh Hospital in Semnan (26). Eventually, Golmohammadi et al reported 3.2% for the cost of equipment depreciation in the physiotherapy department of Shafayehian Hospital (27).

The cost of different forms of energy had the lowest unit cost of the technical component in this study. It accounted for 2.1% and 3% of the total costs in the first and second scenarios, respectively. The costs of energy varied across different hospital sections based on their functionalities and the equipment used in this regard. In the operating room, due to the number of general and specialized equipment, the consumption of energy is significant. Using equipment that operates at optimal energy consumption levels can be a crucial step in reducing costs. Mehrolhassani et al also found that energy costs in the laboratory of Shafa Hospital in Kerman was 0.19% (18). The results of the study by Rahmani et al demonstrated that the share of energy costs was 0.5% of the total costs (17). Finally, the share of energy costs was 15% of the total costs in the study by Mohammadi et al at Shahid Sadoughi Hospital in Yazd (28).

Conclusion

In the present study, to estimate the operating room costs, the costs were analyzed in six categories and in two scenarios. The results revealed that in both scenarios, the unit cost of the technical component in all the studied hospitals (except for one hospital) exceeded the monetary coefficient of the technical component for 2019 ($0.87). There was a significant difference between the unit cost of the technical component in the operating

room with the monetary coefficient of the technical component for 2019, which was a high cost for hospitals. It should be noted that the ongoing trend of the rising costs of consumables will increases this gap in future. Considering that the difference between income and costs (the loss amount for the hospital) is not covered by insurance organizations or patients, hospitals are forced to cover these costs from their own revenues. Therefore, it is essential to conduct necessary reviews to adjust the technical component percentage of the operating room (40%) or the monetary coefficient of the technical component to align with actual costs and implement policies to ensure the continuity of services in public hospitals. In addition, the revenue from the technical component of the operating room should be in such way that hospitals do not face difficulties in maintaining quality service provision. If this situation continues and hospitals loss their revenues, not only the sustainability of hospital services and their quality will be threated, but there is also a risk that hospitals will add extra services to the patient's bill, which will be primarily paid directly by the patient, thereby increasing the informal payments of the patient's share.

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Authors' Contribution

Conceptualization: Alireza Olyaeemanesh, Saeed Manavi, Ali Akbari Sari, Mahmoudreza Mohaghegh Dolat Abadi
Data Curation: Saeed Manavi, Ebrahim Hasanzadeh, Omid Barati
Formal Analysis: Mani Yousefvand, Elham Ehsani-Chimeh, Zeinab Fakoorfard
Funding Acquisition:Mahmoudreza Mohaghegh Dolat Abadi
Investigation:Soheila Damiri, Maryam Radin Manesh
Methodology:Mani Yousefvand, Ali Akbari Sari, Rajabali Daroudi, Alireza Olyaeemanesh
Project Administration:Alireza Olyaeemanesh
Supervision: Elham Ehsani-Chimeh
Validation:Zeinab Fakoorfard
Visualization:Soheila Damiri
Writing–Original Draft: Zeinab Fakoorfard
Writing–Review & Editing: Elham Ehsani-Chimeh

Competing Interests

The authors declare that there is no conflict of interests related to this article.

Ethical Approval

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