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Research Article

Actual Costs of Residency Training in Teaching Hospitals: A Case of Iran

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Abstract

Background: There was a challenge for teaching hospitals to accept residents for educational goals due to their training costs.

Objectives: The present study aimed to estimate the actual costs of residency training in hospitals for policymaking, budgetary impact, and negotiation.

Methods: This retrospective study was performed in eight teaching hospitals affiliated with the Iran University of Medical Sciences, Tehran, Iran, in 2018. Two scenarios were designed to estimate the costs of education per resident. All of the resources used by residents in the hospitals were identified. Cost items attributed to the training goals were allocated to the internal medicine and surgical fields; however, for cost items that were used for treatment and education, such as disposables and consumables and equipment, the cost drivers were used. Therefore, the difference between the scenarios was related to the cost drivers.

Results: Overall, the selected hospitals had spent $ 586,720.35 and $ 572,358.10 based on scenarios 1 and 2, respectively. The residency training per surgical resident in the hospitals was about 1.2 times higher than an internal medicine resident. Surgery, neurology, urology, and anesthesiology were the fields with the highest costs in the hospitals.

Conclusion: Although residency training accounts for a large proportion of hospital costs, employing residents reduces the costs of human resources. Monitoring and controlling costs, as well as resource quotas for resident training, can be a way to reduce educational course costs in hospitals. Universities can cover some parts of the educational costs to motivate hospitals to make an appropriate setting for residents.

Keywords: Cost Analyses, Academic Medical Centers, Internship and Residency

Background

Health care funding is the most controversial issue that encourages policymakers worldwide to think about it and provide cost control strategies. Aging, chronic diseases, expensive treatments, and education are some factors that raise the costs of health sectors (1). In the 1700s, Adam Smith who was one of the earliest references for medical education costs pointed out the expense of medical education costs (2). Although education increases the costs of hospitals, it can provide the required specialized human resources in hospitals (1).

Training in the health sector is one of the human resources information system dimension that if carried out correctly and comprehensively, it can economically avoid expenses for the health sector in the one hand and increase the quality of life of the population on the other

hand (3, 4); furthermore, this will be more evident in the training of medical students, especially residents. Due to diversity and challenging populations, general practice skills do not meet the needs; then, it seems that specialized clinical knowledge has more value for the health economy than generalist medical expertise (5).

A portion of medical education that leads to experience and skill is the residency training program that takes 4 to 7 years based on the field (6). Much of this course is spent in hospitals. Residents require spending long hours in hospitals and clinics to gain training and experiments and need some facilities, such as food, during the period of training bearing costs for hospitals (7, 8). However, the question is that how much does it cost to train residents in teaching hospitals, and how should the costs be financed? What portion of the costs of residents training is borne by the government, universities, or teaching hospitals?

Several studies addressed the costs of education in teaching hospitals (9-12) that have been estimated more than 80 billion euros per year globally for education and training in 2015 (13). The total costs of education were $US 9,042,400. Moreover, the total costs of per resident and per fellow were $US 35,164 and $US 31,363 for the School of Medicine, University of Pittsburgh, United States, in 2003, respectively. The cost items were included as administrative office expens, fellowship and residency training expense, program leaders, Residency Review Committee (RRC) subspecialty coordinators, and Additional teaching cost. (14). The hidden costs of medical education were estimated at the Sydney Medical School, Australia, about $US 56,250 per student in 2010, also including the infrastructure costs. The total costs paid by the university were about $US 56,000, and the costs that were not paid by the university were annually about $US 34,000 per student (15). Although there were no published papers on the costs of residency training in Iran, several studies addressed the costs of university student educational services (16, 17).

The education costs of nursing, health education, and environmental health were $US 4662, $US 3305, and $US 3906 in MSc per student in 2017, respectively. The education costs of laboratory sciences were $US 2373 (17). The education costs of PhD, MSc, and BSc students were $US 3380, $US 2191, and $US 1208 in 2013, respectively (16).

Iran Ministry of Health and Medical Education is also in charge of educating medical students and residents. The residents do not have any payment for their training course, and all of the costs were paid by medical universities and hospitals, although the cost portion of hospitals is lower than the universities. Due to the imposition of costs on hospitals and the financial priorities, there was a challenge for teaching hospitals to accept residents for educational goals. Although admissions are compulsory, the challenge will be solved by sharing the costs between the university and the hospitals and receiving more financial supports from the university for hospitals due to education; nevertheless, how much of the costs should be covered by the university and paid to the hospitals?

Objectives

The present study aimed to estimate the financial burden of residents' training in teaching hospitals affiliated with Iran University of Medical Sciences, Tehran, Iran, for policymaking, budgetary impact, and negotiation.

Methods

It was a mixed-method study. A retrospective evaluation and analysis of training cost per medical resident at all teaching hospitals affiliated to the Iran University of Medical Science were performed to address the challenges in cost management between the university and teaching hospitals and negotiation as well. Iran University of Medical Sciences is one of the major medical centers in Iran that supports nine colleges, 18 teaching hospitals, and 27 research centers and residency fields.

This study aimed to estimate the instructional and program-specific administrative actual costs of residency training in internal medicine and surgical fields in all the teaching hospitals affiliated with the Iran University of Medical. The total costs of residency training for an academic year per field, the costs of residency training per resident on average, and the percentage of educational costs from the full costs of hospitals were the outputs of the present study.

All of the teaching hospitals that support residency courses were considered in this study. Accordingly, eight teaching hospitals were included in the present study. The hospitals were marked in English letters from A to H to maintain confidentiality. No sampling was required, and all the members of the hospitals that provided residency courses were considered. The residency rotation and failed residents were considered separate samples in each hospital because the resources used by them were different in each one.

The costs of all the resources were taken from the accounting, staffing, and medical equipment departments. All units had their information systems and made the information available on the required items. All the data were entered in a researcher-made form.

Costing Perspective

The costs were estimated by "hospital perspective". Accordingly, all of the cost items in the hospitals as direct costs and overhead costs that attributed to the education were considered. Accordingly, the cost items that were paid by the university were not considered. Unlike other medical students who have two semesters a year, residents spend one academic year on educational courses in hospitals and the university. Therefore, the time duration of the present study was an academic year. Costs items were considered for the fiscal year 2018.

For the estimation of residency training costs, qualitative and quantitative phases were defined as follows:

First, the resources used by residents in the hospitals were identified; accordingly, a 14-item survey was designed based on process mapping. The research team tried to visualize connections and feedback loops to

provide a baseline understanding of the costs of the overall process of training a resident in the hospitals. Then, a questionnaire was designed by considering all the resources used by residents, such as disposables and consumables, equipment and instruments, payments for residents, number of nutrition packs, number of professors and residents in any field, and overhead of training programs. The questionnaire also contained the amount of consumption and the duration of equipment utilization by the residents. This was the qualitative part of the study.

The estimation of the costs of education per resident was the quantitative part of the study. For estimating the costs of residency training in hospitals, there was no conclusive methodology; therefore, two scenarios were designed for analysis by an expert panel.

The qualitative phase was in common for the scenarios, and all of the resources used for residency training were identified in both scenarios. Cost items that entirely attributed to the training were allocated to the internal and surgical fields; nevertheless, for cost items that were used for treatment and education, such as disposables and consumables and equipment, the cost drivers were used. Therefore, the difference between the scenarios was related to the cost drivers explained as follow:

- In the first scenario, a technical advisory panel consisting of health economics, medical sciences professors in all fields, and the managers of the hospitals was used. The expert panel defined the portion of residents of hospital resources. Based on the identified cost headings from the panel of experts, the residents' use of all resources was visually traced.
- Considering the residents as employees of the hospitals due to their continued presence was the second scenario. Then, the clinical staff-to-resident ratio was calculated, and the costs of residency training were estimated based on the ratio.

Accordingly, by estimating the portion of residency training from the cost items of hospitals and the costs items that attributed to the education, the total costs of any fields and the average costs of education per resident in any fields were estimated. The average overhead costs were also considered. The formula for the calculation of the residency training costs by the scenarios was as follows:

$$\text{Average cost of training for residents} = \frac{\beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_n X_n + u}{R}$$

where indicates the cost of resources used by residents like as disposables and consumables depreciation of equipment and instruments, payments for residents, overhead of training programs. indicates the overhead costs was different based on the scenarios. As previously mentioned, for the first scenario, was calculated by observing the activities and consumption of resources, and the ratio of residents to the entire clinical staff (i.e., nurses and physicians) was obtained for the second one as follow:

$$\beta = \frac{R}{\mathrm{R} + \mathrm{N} + \mathrm{P}}$$

where R, N, and P are the numbers of residents, nurses, and physicians in each hospital at the study time, respectively. X is the cost items as disposables and consumables and equipment depreciation. U stands for the overhead costs.

All types of costs were converted into US dollars ($US) using the 2018 exchange rate (1 $US = 42000 Rial) that was reported by the central bank of Iran (18). Excel software (version 2010) was used for analyzing the costs.

Because the present study was a costly investigation, the sensitivity analysis was not performed, although two scenarios were defined to assess the robustness of the results. This study was approved by the Health Management and Economics Research Center, Iran University of Medical Sciences (no.: IR.IUMS.REC.1397.925).

Results

A total of 736 residents were spending their educational practices in the hospitals affiliated with the Iran University of Medical Sciences in 2018. There were a total of 22 courses in the selected hospitals. The surgery residents were considered 35% of the total population.

Based on the panel results, the salaries and payments of professors and residents, the costs of depreciation of the hospital building, the costs of depreciation and repairing the equipment and instruments, the costs of disposables and consumables, the overhead costs of training programs, and the costs of nutrition packs were defined as costs items. The costs of the salaries of professors and residents and depreciation of the buildings were excluded because the costs items were not paid by the hospitals. The cost components are defined as follow:

- Resident's payments: Although the resident's salary was paid by the university, monthly payments made by the hospitals to the residents were considered.
- Disposables and consumable costs: All the consumables used by residents for educational measures, such as disposable clothing and gloves, sterile gloves, syringes, and all kinds of kits, were included because they were provided by the hospitals. The portion of education and treatment was not defined in financial documents; therefore, it was estimated by defining two cost drivers as two scenarios. Based on the panel results, the residents used about 35% of disposables and consumables in the hospitals; therefore, 35% of the total costs of consumables in the hospitals were evaluated for the first scenario. The ratio of residents to clinical employees was calculated for consumption for the second scenario.
- Costs of depreciation and repairing the equipment and instruments: The depreciation and repairing costs of any equipment used by residents were included. The equipment was analyzed using an estimated useful life of 15 years. Based on the panel results, the time of equipment used by residents was two times higher than the professors

considered for the first scenario. The ratio of residents to clinical employees was calculated for the depreciation of the equipment for the second scenario. The repair of equipment was considered only for the second scenario because, according to the panel results, the residents did not damage the equipment.

- Overhead costs of training programs: Any costs for consumables and spaces, such as papers, video projectors, resorts, classes, conference rooms, and nutrition pack costs, in the hospitals were considered. Nutrition pack costs were calculated by the number of meals used by residents multiplied by unit costs.

Based on the results, payments for residents and costs of disposables and consumables had the highest portion of training costs in the hospitals for residents, respectively. The cost category of the residents' practical courses in hospitals is provided in Table 1.

The total costs of the hospitals for training residents were $US 586,720.35 and $US 572,358.10 based on scenarios 1 and 2, respectively. Based on scenario 1, the average costs of a surgical resident and an internal medicine resident were $US 10710.13 and $US 9204.88, respectively. With a slight difference, the average costs of a surgical resident and an internal medicine resident were $US 10284.32 and $US 9048.11 based on the second scenario, respectively (Figure 1). About 65% of the total costs were spent on the internal medicine residents. The costs of education per surgical resident in the hospitals were about 1.2 times higher than an internal medicine resident.

The percentage of educational costs of residents from the whole costs of the hospitals was also estimated that was less than 10 for H, F, D, B, A, and G hospitals; however, the aforementioned percentage was 26 and 31 for C and E hospitals, respectively. Table 2 shows the mean and total costs of residency training in every hospital. Based on both scenarios, the residents used the highest resources in hospital B, and the lowest costs were related to hospital H.

The mean costs per internal medicine resident in hospital F were the maximum ($US 10135.69); nonetheless, the mean costs per internal medicine resident

Table 1. Cost ($US) Category of Residents' Education in Hospitals

Cost category		Cost ($US)	%
Scenario 1	Disposables and consumables	77,329.74	13.18
	Depreciation of equipment and instruments	32,856.34	5.6
	Payments for residents	295,120.34	50.3
	Overhead of training programs	181,413.93	30.92
	Total	586,720.35	100
Scenario 2	Disposables and consumables	58,609.47	10.24
	Depreciation of equipment and instruments	19,689.12	3.44
	Repair of equipment	6,295.94	1.1
	Payments for residents	301,003.13	52.59
	Overhead of training programs	186,703.21	32.62
	Total	572,358.10	100

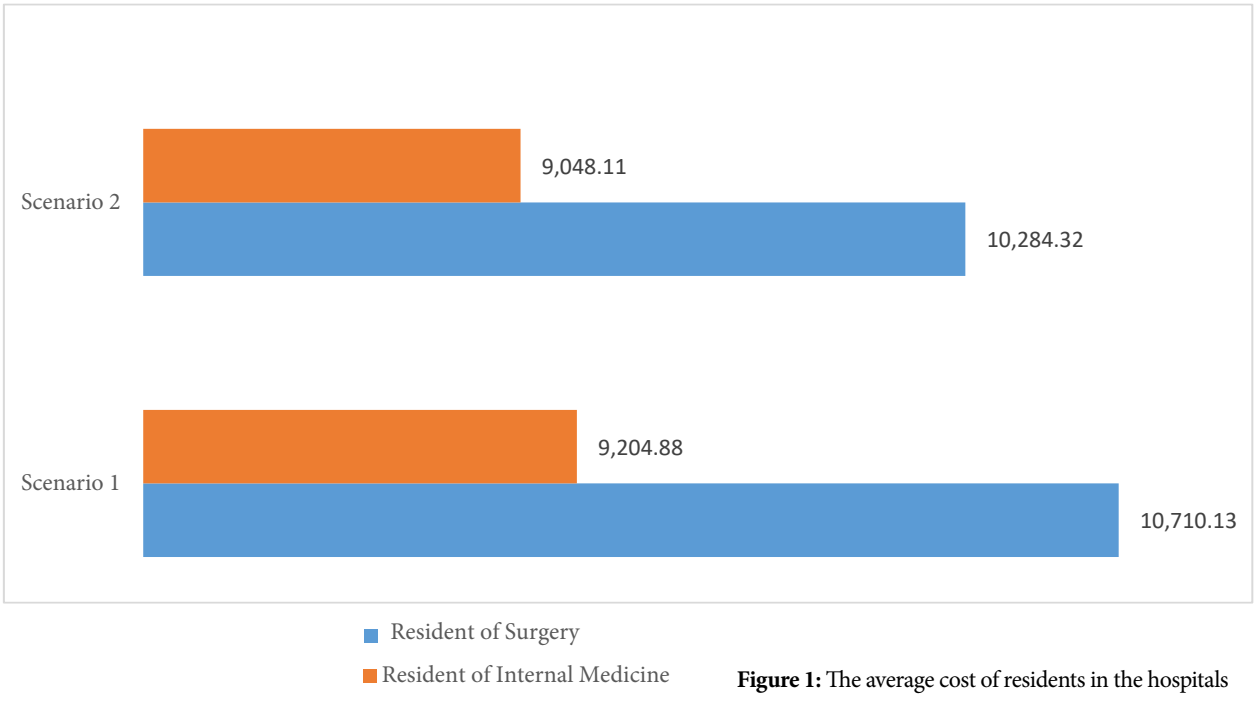

Figure 1: The average cost of residents in the hospitals

Table 2. Costs ($US) of Residents' Education per Hospital

Hospitals	Mean cost ($US) per resident		Total cost ($US)
Scenario 1			
	Surgery resident	**Internal resident**	
A	9,849.63	9,276.00	142,581.78
B	10,167.02	8,812.00	212,161.09
C	10,558.13	9,484.73	96,994.12
D	10,713.82	9,497.78	20,211.60
E	-	8,455.41	48,859.83
F	18,452.74	10,135.69	32,469.40
G	11,471.37	9,526.67	25,366.24
H	-	8,076.30	8,076.30
Scenario 2			
A	9,821.89	8,979.03	139,742.64
B	9,782.90	8,684.69	207,435.34
C	10,368.69	9,426.20	96,146.96
D	10,190.45	9,204.39	19,394.84
E	-	8,350.48	45,949.59
F	15,964.85	9,994.91	30,560.98
G	10,548.94	9,463.10	25,051.45
H	-	8,076.30	8,076.30

were the minimum ($US 8076.30) in hospital H based on scenario 1. The results were similar for the second scenario. The highest and lowest mean costs for surgical residents were related to hospital F ($US 18452.74) and A ($US 9849.63) based on scenario 1, respectively; however, based on scenario 2, hospital F ($US 15964.85) and B ($US 9782.90) had the highest and lowest mean costs for surgical residents, respectively. There were no surgical residents in hospitals E and H.

The costs of residents per field were also calculated in this study, shown in Table 3. Surgery, neurology, urology, and anesthesiology were the fields with the highest costs in the hospitals based on both scenarios; nevertheless, psychiatry, occupational medicine, and geriatrics and gerontology had the lowest costs.

Factors that increase the hospitals' costs and the training costs accordingly in the hospitals were identified by the panel experts. The first important element was the lack of independence in equipment production and importing the equipment that takes time and costs.

Table 3. Costs ($US) of Residents' Education per Field

	Scenario 1		Scenario 2	
Specialty	**Total**	**Mean**	**Total**	**Mean**
Orthopedics	30,791.12	10,263.71	29,618.39	9,872.80
Pediatrics	58,483.67	9,747.28	55,504.11	9,250.68
Emergency medicine	48,178.26	9,635.65	47,887.47	9,577.49
Urology	11,351.99	11,351.99	11,104.98	11,104.98
Immunology	8,515.62	8,515.62	8,394.17	8,394.17
Nephrology	13,199.97	13,199.97	12,700.73	12,700.73
Anesthesiology	43,832.06	10,958.02	41,427.39	10,356.85
Forensic science	24,402.58	8,134.19	26,044.92	8,681.64
Dermatology	17,171.00	8,585.50	17,047.95	8,523.98
Surgery	39,065.68	13,021.89	36,172.18	12,057.39
Neurosurgery	9,415.76	9,415.76	9,497.65	9,497.65
Oncology	28,574.62	9,524.87	28,579.25	9,526.42
Psychiatry	30,182.59	6,036.52	37,983.22	7,596.64
Internist	84,579.44	9,397.72	81,882.53	9,098.06
Obstetrics and Gynecology	30,620.69	10,206.90	29,792.48	9,930.83
Geriatrics and Gerontology	7,872.99	7,872.99	7,872.99	7,872.99
Occupational medicine	7,403.15	7,403.15	7,403.15	7,403.15
Infectious diseases	18,681.03	9,340.52	17,975.38	8,987.69
Cardiology	19,173.10	9,586.55	18,646.02	9,323.01
Ear, Nose and Throat	19,242.06	9,621.03	19,143.07	9,571.53
Nephrology	18,652.48	9,326.24	18,536.29	9,268.15
Neurology	9,254.21	9,254.21	9,143.79	9,143.79

Dependency on the international exchange rate due to importing some disposable and consumable equipment and instruments, economic shocks, and inflation were other important factors for increasing the costs. In addition to raising the costs of education, economic shocks have delayed providing training requirements and finally increased the opportunity costs of training. Other factors were hospital size, referral hospitals in some fields, number of beds and patients, training time, and program size.

Discussion

This investigation was conducted to gain insight into the actual costs of residency training in hospitals affiliated with Iran University of Medical Sciences for an academic year. Based on the results, the total costs of the hospitals for training residents were $US 586,720.35 and $US 572,358.10 based on scenarios 1 and 2, respectively. About 65% of the total costs of residency training were spent on internal residents, although the costs of education per internal resident were about 1.2 times lower than a surgical resident in the hospitals. Surgery, neurology, urology, and anesthesiology were the fields with the highest costs in the hospitals; however, psychiatry, occupational medicine, and geriatrics and gerontology had the lowest costs based on both scenarios.

Based on the results, the costs of education were not related to the number of beds, the size of the hospitals, and the number of residents; however, they depend on the number of trials and errors and activities in each field. Higher education courses have lower costs than others. If the costs of training were related to the size of the hospitals or the number of beds, the costs should be reduced by increasing these variables; nevertheless, the results of the present study did not confirm this issue.

The costs of resources used by residents were not documented in the hospitals, and the calculation of the exact costs was impossible. Then, the authors tried to define a method to estimate the costs and defined two scenarios to extract the education costs from the whole. Nearly, similar results were obtained; then, the ratio of the residents to clinical employees was the best choice because it did not waste time and was more accurate. Several studies have extended this to calculate the costs related to medical students in different ways. Although comparing the studies is difficult due to the difference between cost items and calculation methods, it was tried to investigate some of them in this study.

Verma et al. compared the costs of medical education by traditional and time-driven activity-based costing (TDABC) methods in India. Based on the results, 172.20 and 98.80 lacs were estimated for medical students' education by traditional and TDABC methods, respectively. The authors suggested that TDABC is a more accurate method of costs calculation than the traditional one because the second method allocates all resource costs irrespective of consumption (19). Due to the costing perspective, the TDABC method was not used in the present study. The costs by residents were traced, and if all resources in the hospital were considered, we would face overestimating the costs of education.

Franzini et al. calculated the costs per undergraduate medical student at the University of Texas-Houston Medical School, United States, in 1994-95. They used a cost-construction model for the calculation of the costs. In the model, the costs of the entire program, such as instructional costs, educational costs, and milieu costs, were considered. Student contact hours, enrollment, required full-time-equivalent faculty and residents, professional-activity profiles, faculty and resident salaries, and supporting resource costs were considered cost drivers. Based on their results, the costs of 4-year education for the undergraduate medical program were about $US 82,692,280 at the university, and the costs per student were annually about $US 192,023 (20). The present study estimated the costs of education for an academic year. The hours of using the equipment for calculating the costs of equipment in the first scenario and the number of clinical individuals in the wards for calculating the costs of all topics except the overhead costs were considered in the present study; nevertheless, the difference between the studies is due to the costing perspective.

Koenig et al. estimated the mission-related costs of teaching hospitals that were about $US 27 billion for all teaching hospitals in 2002. The aforementioned study did not calculate the costs per medical student (21). In the present study, the costs of teaching in all hospitals were estimated at about $US 586,000, and the costs of teaching were about $US 10,000 per resident, which were higher than those of the aforementioned study.

Ben-Ari et al. estimated the costs of internal residents in the United States in 2013. The average costs were estimated within the range of $US 183,188 to $US 199,486. They identified the fixed and variable costs. All the items dependent on the program size of education were considered variable costs (22). Two scenarios were considered in the current study, and the study performed by Ben-Ari et al. was more similar to the first scenario; nevertheless, they defined another category of costs for education. The costs of disposables and consumables and the costs of depreciation and repairing the equipment and instruments were different in the present study that increased by the program size. A large part of the costs included fixed costs, such as a resident's salary, which was 50% of the total costs for education.

For the estimation of the educational costs, some studies compared the teaching and non-teaching hospital costs (23, 24). However, there is a high gap roughly in estimating the actual costs of education. Due to lower tariffs in teaching hospitals, the burden of admissions is higher than in non-teaching hospitals. Then, if the researchers decided to estimate a medical student's educational costs, they would face overestimating the costs. Therefore, this method was not chosen for the current study.

Additionally, the present study investigated that training time, especially for equipment and instruments,

was a factor that affected and increased the education costs; nonetheless, the results are in contrast with the results of a study by Babineau et al. They calculated the costs of operative training for surgical residents. Based on the results of the aforementioned study, although the operation time increased due to education, it was not an effective factor in increasing the financial burden on hospitals. Babineau et al. argued that because lots of training costs were categorized as fixed costs, they did not impose a financial burden on hospitals (25).

Time is one of the factors leading to the depreciation of equipment and capital assets. Accordingly, time can increase cost items, such as repairing the equipment, and shorten their useful life. Therefore, time imposes the need to buy new equipment in the hospital earlier than usual.

Training is an opportunity for hospitals to provide human resources; however, they can negotiate with the university to allocate more funding for residency training.. Policymakers should consider the educational needs and the need to provide new equipment for forecasting the budgets of education in hospitals.

Limitations

The estimated costs of education per field per resident for the first time were the strength of the present study in Iran; nevertheless, it was not possible to calculate all the components of resident's costs in the hospitals, such as administrative costs in the university, due to the costing perspective. Another limitation was that it was not possible to measure the effect of education on third-party payer costs. Finally, the results cannot be generalized to all of the hospitals in Iran due to different cost management strategies.

Conclusion

The financial burden of medical students was high in teaching hospitals in Iran University of Medical Sciences; nonetheless, because they are low-wage professionals and generate revenue for hospitals, not accepting them would lead to an opportunity cost. The costs of education were not related to the number of beds, the size of the hospitals, and the number of residents, but related to the number of trials and errors, activities, and years of study in each field. The important factors that increased the costs of hospital resources and educational costs accordingly were economic shocks and inflation.

The overarching part of the study was the methodology that is generalized for estimating the costs of educations in hospitals for any setting. It was not possible to find a gold standard for calculating the costs of medical education; nevertheless, it is better to identify the costs of perspective for the first step and calculate the costs per resident for the second one. The results showed that for estimating the costs of medical education in teaching hospitals, the ratio of residents to clinical employees is the best choice. Monitoring and controlling costs, as well as resource quotas for resident training, can be a way to reduce training costs in hospitals. Universities can cover some parts of the educational costs of residents to motivate hospitals to make an appropriate setting for residents.

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Conflicts of Interest: The authors declare that there is no competing interest.

Ethical Approval: This study did not involve any human subjects.

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