Comparison of Patient Costs in Internal Medicine and Anaesthesiology Intensive Care Units in a Tertiary University Hospital

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Objective: The allocation of the Gross Domestic Product (GDP) to health is limited, therefore it has made a need for professional management of health business. Hospital managers as well as employees are required to have sufficient knowledge about the hospital costs. Hospital facilities like intensive care units that require specialization and advanced technology have an important part in costs. For this purpose, cost analysis studies should be done in the general health business and special units separately.

Methods: In this study we aimed to compare the costs of anaesthesiology and internal medicine intensive care units (ICU) roughly.

Results: After approval of this study by Gazi University Faculty of Medicine Ethics Committee, the costs of 855 patients that were hospitalized, examined and treated for at least 24 hours in internal medicine and anaesthesiology ICUs between January 2012-August 2013 (20 months period) were taken and analyzed from chief staff of the Department of Information Technology, Gazi University Hospital.

Conclusion: At the end of the study, we observed clear differences between internal medicine and anaesthesiology ICUs arising from transactions and patient characteristics of units. We stated that these differences should be considered by Social Security Institution (SSI) for the reimbursement of the services. Further, we revealed that SSI payments do not meet the intensive care expenditure.

Keywords: Cost analysis, intensive care, reimbursement

Introduction

Health enterprises should make the best of the current resources while trying to offer the best service because of a shoestring budget for health. For this aim, cost analyses should be performed for the use of resources, their effectiveness and comparison of alternative treatments (1-3). Prospective financial planning can be conducted by benefiting from the previous cost data through cost analysis (4).

The level of health services, which is also considered to be an indicator of socio-economic development, should be in accordance with international standards, high quality and low cost (2). In this sense, the aim of cost analyses is to find not only the best clinical method but also the lowest cost (5). In hospitals requiring to be professionally managed, performing cost analyses of units will help administrators in decision-making processes (2). However, administrators of hospitals should never compromise on offering quality services while trying to deal with increasing costs (6).

Various methods such as conventional cost analysis, cost-effectiveness, cost minimization and cost-benefit analysis can be used in cost analysis studies. Although simple conventional cost analysis is used in most studies conducted on cost, a healthy comparison cannot be done because of differences in methodologies (7).

Despite the fact that classifications done in cost analyses can differ in some ways, hospital expenses can mainly be classified under the following three headlines:

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- Direct primary substance and material costs (medical consumables, medication, laboratory examinations, etc.)
- Direct staff costs
- General production costs (electricity, water, natural gas, communication, maintenance, repair, cleaning, medical waste, medical gas, depreciation building, etc.) (2).

In our study, rough costs (differences between incomes and expenses) of the Internal Diseases Intensive Care Unit (ICU) and Anaesthesiology ICU of Gazi Hospital in Gazi University Medicine Faculty were estimated to reveal the costs of ICUs, which have an important place in hospital costs (7, 8). Moreover, we tried to find out cost differences. We aimed to demonstrate that the pricing policy implemented for ICUs by the Social Security Institution (SSI) and the application of the same pricing for ICUs with different dynamics would not be valid and adequate.

Methods

The Internal Diseases ICU of Gazi Hospital in Gazi University Medicine Faculty is a 9-bed and 425 m² unit that provides tertiary intensive care services with 2 professors, 2 intensive care fellows, 4 internal medicine fellows, 13 nurses, 9 caretakers and 3 cleaning staff.

The Anaesthesiology ICU of Gazi Hospital in Gazi University Medicine Faculty is a 9-bed and 338 m² unit providing tertiary intensive care services with 2 professors, 2 intensive care fellows, 2 anaesthesiology fellows, 19 nurses, 9 caretakers and 4 cleaning staff.

Personnel classification, physical conditions and technical equipment were similar in both ICUs (Table 1).

Cost analyses are generally performed under three headings. In our study, direct primary substance and material costs were examined with staff costs and general production costs for both ICUs.

The ethical approval for this study was received from the Ethics Committee of Gazi University Medicine Faculty. The income and expense data of 855 patients who were examined and treated during their hospitalization for more than 24 h in the Internal Diseases ICU and Anaesthesiology ICU between January 2012 and August 2013 (for 20 months) were obtained from the data processing and accounting departments and were then evaluated.

The patients' demographic features, hospitalization duration, admission places, insurance type, and intensive care results were recorded. The total incomes and expenses of ICUs and examination costs, treatment service costs, bed costs, medication costs and consumables of patients were separately recorded. Moreover, the expense distributions of both ICUs, hospitalization diagnoses of patients and treatment stages

Table 1. General features of intensive care units

	Internal Diseases ICU	Anaesthesiology ICU
Professor	2	2
Intensive Care Fellow Doctor	2	2
Internal Medicine/ Anaesthesiology Fellow Doctor	4	2
Nurse	13	19
Caretaker	9	9
Cleaning staff	3	4
ICU Number of Beds	9	9
ICU Number of Ventilators	9	9
ICU Area (m ²)	425	338
ICU: intensive care unit		

were also recorded. The features of the two ICUs were examined, and we tried to reveal the differences between them.

Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) version 11.5 software. The results were presented as median and interquartile range for continuous data and as number and percentage for categorical data. The Mann-Whitney U test was employed for comparing the continuous data of the Anaesthesiology and Internal Diseases ICUs, and the chi-square test was used for comparing the categorical data. $P < 0.05$ was accepted to be statistically significant.

Results

A total of 855 patients (476 from the Internal Diseases ICU and 379 from the Anaesthesiology ICU) were included in the study. For both ICUs, the demographic features of patients, distributions of direct primary substance and material costs, diagnosis groups for hospitalization and treatment stages are presented in Tables 2, 3, 4 and 5. Total costs including staff and general production costs for both ICUs are shown in Table 6.

According to the statistical analysis, a significant difference was found between ICUs in terms of patients' ages, hospitalization places and intensive care results. The mean age of the patients in the Internal Diseases ICU was detected to be higher ($p < 0.001$). Patients from the emergency department were admitted to the Anaesthesiology ICU, and patients mostly from the inpatient clinic were admitted to the Internal Diseases ICU ($p < 0.001$). In the Anaesthesiology ICU, the rate of discharge from hospital to home was higher. However, in the Internal Diseases ICU, the rate of transfer to the clinic was higher ($p < 0.001$). The rate of self-paid patients was found to be higher in the Anaesthesiology ICU ($p = 0.042$). On the other hand, no statistically significant difference was

Table 2. General features of intensive care patients

ICU	Internal Diseases ICU (n, %)	Anaesthesiology ICU (n, %)	p value**
Number of patients	476 (55.7%)	379 (44.3%)	
Age (years)	66 [56-77]*	55 [34-73]*	<0.001
Gender			
Male	276 (58.0%)	226 (59.6%)	0.675
Duration of hospitalization (day)	5 [3-11]*	6 [2-13]*	0.362
Place of hospitalization			
Emergency Department	195 (41.0%)	232 (61.2%)	<0.001
Outpatient clinic	34 (7.1%)	32 (8.4%)	0.52
Clinic	247 (51.9%)	115 (30.3%)	<0.001
Type of social insurance			
"Bağ-Kur"	81 (17%)	56 (14.8%)	0.399
SSI	218 (45.8%)	184 (48.5%)	0.448
Retirement Fund	159 (33.4%)	110 (29%)	0.182
Wage Labour	2 (0.4%)	7 (1.8%)	0.042
Other	16 (3.4%)	22 (5.8%)	0.096
Result of intensive care			
Discharged home	88 (18.5)	131 (34.6)	<0.001
Transferred to a clinic	167 (35.1)	93 (24.5)	0.001
Death	221 (46.4)	155 (41)	0.11

ICU: intensive care unit; SSI: Social Security Institution; *median [25%-75% quartile]

**Chi-square test was used for comparing the rates, and the Mann-Whitney U test was used for comparing the medians.

found between both ICUs with regard to the hospitalization duration, gender and mortality rates (Table 2).

There was a statistically significant difference between the two ICUs in terms of the costs of some examinations and treatments. While laboratory examinations were performed more frequently in the Internal Diseases ICU ($p<0.001$), the frequency of surgical interventions and request for consultation from other departments was higher in the Anaesthesiology ICU ($p<0.001$). For both ICUs, a statistically significant difference was not available between the median direct primary substance and material costs (Table 3).

Moreover, a statistically significant difference was found between the diagnoses of patients hospitalized in both ICUs. While patients with postoperative, intoxication and trauma problems were more frequently admitted to the Anaesthesiology ICU, those with metabolic, gastrointestinal, renal and haematologic problems were more frequently followed-up in the Internal Diseases ICU ($p<0.001$) (Table 4).

Table 3. Distribution of direct primary substance and material cost in intensive care units

	Internal Diseases ICU	Anaesthesiology ICU	p value**
Examinations (TL)			
Blood examinations (total)	341.2 [151.4-735.8]*	215.3 [85.1-475.3]	<0.001
Infection examinations (total)	97 [33.6-309.6]	121.6 [44.8-321.9]	0.362
Radiology	71.9 [22.4-188.6]	67.3 [15-197.1]	0.371
Pathology	62.6 [11.2-192]	63.6 [11.2-81.7]	0.412
Blood Bank	393.1 [120.7-1139.4]	340 [177.7-823.3]	0.303
Treatment services (TL)			
Surgery	148.4 [69.6-274.6]	456.2 [284-790.3]	<0.001
Consultation	276.3 [119.4-572.9]	772.2 [259.5-3033.6]	<0.001
Interventional procedure	78.3 [78.3-234.9]	78.32 [78.32-137.1]	0.858
Medications	964.9 [325.6-3178.1]	760 [158.2-3097.1]	0.005
Bed fee	624 [312-1248]	624 [208-1352]	0.312
Consumables fee	519.3 [148.4-1751.4]	401 [95.7-1743.7]	0.172
Median cost (TL)	3795 [1448.9-9917.3]	3871.2 [1142.7-9525.7]	0.352
Total cost (TL)	4 803 003.78	3 607 933.25	

ICU: intensive care unit; *median [25%-75% quartile]

**Mann-Whitney U test was used for comparing the medians.

The rate of tertiary care patients was higher in the Internal Diseases ICU, but in the Anaesthesiology ICU, primary care patients were more frequently treated ($p<0.001$). The duration of hospitalization was longer for primary and secondary care patients in the Anaesthesiology ICU ($p<0.001$) (Table 5), which was attributed to the fact that the Anaesthesiology ICU directly discharged patients from ICU because there was no clinic or intermediate ICU where patients could be transferred to.

Staff costs, general production costs, direct primary substance and material costs and total incomes and expenses are presented for both ICUs in Table 6. It was found that there was no apparent difference between the two ICUs in terms of the amounts and distributions of costs, and reimbursement done by SSI for patients was inadequate.

Discussion

The costs of services given in ICUs occupy an important place both in hospital costs and in the allowances of SSIs (9).

Table 4. Hospitalization reasons of intensive care patients

Reason for hospitalization	Internal Diseases ICU (n=476, %)	Anaesthesiology ICU (n=379, %)	p value*
Pulmonary	106 (22.2%)	84 (22.1%)	0.519
Haematological	75 (15.8%)	11 (2.9%)	0.001
Metabolic	69 (14.5%)	14 (3.7%)	0.001
Cardiac	56 (11.8%)	44 (11.6%)	0.516
Neurologic	53 (11.1%)	41 (10.8%)	0.487
Gastrointestinal	40 (8.4%)	11 (2.9%)	0.001
Renal	45 (9.5%)	12 (3.2%)	0.001
Postoperative	3 (0.6%)	37 (9.8%)	0.001
Trauma	2 (0.4%)	68 (17.9%)	0.001
Intoxication	2 (0.4%)	38 (10%)	0.001
Other reasons	25 (5.3%)	19 (5%)	0.502

ICU: intensive care unit; *Chi-square test was used for comparing the rates.

Table 5. Treatment steps for intensive care patients

ICU care of patient	Internal Diseases ICU (n, %)	Anaesthesiology ICU (n, %)	p value**
Primary care	94 (19.7%)	182 (48%)	<0.001
Secondary care	217 (45.6%)	166 (43.8%)	0.628
Tertiary care	251 (52.7%)	155 (41%)	0.001
Day of hospitalization	Internal Diseases ICU	Anaesthesiology ICU	
Primary care	1 [1–2]*	2 [1–5]	<0.001
Secondary care	4 [2–6.25]	5 [2–9.25]	0.001
Tertiary care	5 [2–14]	5 [2–12]	0.515

ICU: intensive care unit; *median [25%–75% quartile]. **Chi-square test was used for comparing the rates, and the Mann–Whitney U test was used for comparing the medians.

According to the 2012 data of the Ministry of Health, 5,4% (76.358 million TL) of the gross national income (1.415.786 million TL) was used for health expenses (10). According to the same data, the total number of beds in hospitals in our country is 200.072, and the total number of beds in ICUs is 22.340 (9.957 in the hospitals under the Ministry of Health, 4.075 in university hospitals and 8.308 in private health institutions) (10). With the bed number rate of 10%, ICU costs take an important place in the health budget (9). In Turkey, the net budget for health costs in ICUs is not known. However, although ICUs in the United States of America (USA) constitute 10% of the bed number, their costs constitute approximately 20% of hospital costs (7, 8, 11). In USA, the growth of cost per bed in ICUs gets ahead of the growth in the general health costs and increases in health costs continue to leave the gross national product growth behind (5, 7).

Table 6. Total incomes and expenses of intensive care units

	Internal Diseases ICU	Anaesthesiology ICU
Staff costs	934 916.63 (15.6%)	972 612.75 (20%)
Academic and administrative staff	577 047.47	568 944.29
Patient transport and cleaning	357 869.16	403 668.46
General production costs	248 726.07 (4.2%)	275 925.86 (5.7%)
Food	56 895.06	64 220.08
Repairing equipment	1 026.60	39.15
Repairing procedure	25 695.84	470.82
Outsourced services	47 532.45	31 517.71
Fuel	18 941.13	12 950.24
Water	13 495.89	8 793.24
Electricity	34 733.83	21 160.12
Inventory stock	46 730.27	114 004.50
Maintenance contract	3 675.00	22 770.00
Direct primary substance and material costs	4 803 003.78 (80.2%)	3 607 933.25 (74.3%)
Total cost	5 986 646.48	4 856 471.86
Total income	3 243 220.93	2 323 334.93
Difference	–2 743 425.55	–2 533 136.93

ICU: intensive care unit

In accordance with the related notification of the Ministry of Health, ICUs were classified as primary, secondary and tertiary care units considering the criteria including bed capacity, features and clinical status of patients to be accepted, weighted ratio of related medical specialties, physical conditions, medical equipment and supplies required to be included, quality of staff and status of the health institution within which it is contained (12).

The fees are paid to ICUs with payment packages by SSI. According to this, ICUs can demand fixed fee at their own care level or lower care level. In a study, it was reported that the amount paid by SSI cannot meet the costs of services provided in ICUs. Moreover, it has also been stated that it is impossible to invest in a new ICU with currently available payments and that existing ICUs can be partially managed with this amount (9). In our study, it was revealed that the costs in both ICUs could not be covered with the payments made by SSI. In the study, the cost (loss) that could not be covered was 2.743.425,55 TL for the Internal Diseases ICU and 2.533.136,93 TL for the Anaesthesiology ICU.

In our country, the intensive care payment per day is 333,27 TL for primary care, 716,69 TL for secondary care and 1350,00 TL for tertiary care according to the SSI Health Practice Notice 2013 (13). In a cost study conducted in seven ICUs from different European countries, it was reported that direct costs in ICUs per day differed between 1.168 € and 2.025 € (3.387–5.872 TL) and that staff costs were the most important item (14). On the other hand, in our study, the greatest cost item was found to be the costs of examinations, medications and consumables. This can be explained by the lower labour cost in developing countries such as Turkey. Although global staff, general production and primary substance and material costs were similar to each other in both ICUs, statistically significant differences were found between each item and especially examinations and medications.

In a study, it was found that medication cost per patient in ICU increased by 12% in a year. On the other hand, in other clinics, medication cost per day demonstrated an increase of 6% in a year (15). In our study, the medication cost was one of the important expense items, and the medication cost was higher in the Internal Diseases ICU.

ICUs are expensive because they require high technology and highly qualified staff (9, 16, 17). Recently, the rate and types of critically ill patients followed-up with the use of advanced diagnostic and treatment methods have increased in every area of medicine (1, 16). It is specified that as the number of critically ill patients increases, the costs also increase in association with the severity of disease in some patient groups (cancer and immunosuppressive patients) and that the expenses in these groups should be examined in detail (18, 19). In other studies, it was reported that costs and mortality rates increased in elderly patients who were hospitalized in ICUs for a long time and who had more than one disease (9, 20). Therefore, temporary support units are recommended to be established for patients who will not benefit from intensive care treatment (9, 21). In a study performed on this issue, respiratory intermediate care unit can be an alternative to ICUs with regard to cost for patients with chronic obstructive pulmonary disease exacerbation (22). Together with that, the transfer of patients from ICUs to appropriate clinics and intermediate ICUs decreases both costs and morbidity rate. In this study, it was revealed that the patients in the Internal Diseases ICU could be transferred to other clinics after treatments were completed but that the patients in the Anaesthesiology ICU were followed-up until discharge from hospital because of unavailable units where they could be referred.

It should be kept in mind that the use of the same payment system for ICUs accepting old and clinically severe patients having comorbidities and requiring further examination can develop defensive behaviours in the admission of this type of patients and jeopardize patient safety.

Because of limited sources, costs should be carefully evaluated while making a decision on health economics. The number of studies on economic assessment is low, and further studies are needed on this issue. It is mostly seen that many obstacles related to politics, culture or cost analysis methodology are met while performing economic evaluation during decision-making processes. It is stated that there is an increase in the use of cost analysis especially in England but that this approach is not well received in the USA (23).

According to a cost analysis study that was conducted in the hospitals of Ankara University for comparing internal and surgical departments, approximately 22.3% of hospital costs were direct primary substance and material costs, 52.8% were staff costs, and 24.8% were general production costs (2). It is inappropriate to compare this study to ours. The study of Ankara University is valuable because it was a global cost analysis performed in a big university hospital in Turkey. On the other hand, our study is a local study comparing two ICUs that are known to have higher costs than the whole hospital.

In a study, the data on the cost of ICUs in Hungary and England were compared. Cost analyses were studied in three groups as clinical support, consumables and staff costs. In Hungary, 9.6% of ICU expenses were found to be for clinical support services, 60.6% were for consumables and 29.8% were for staff costs. On the other hand, these rates were 9.5%, 27.9%, and 62.6% in England, respectively. The total budget was lower in Hungary than in England, and this was attributed to the low salaries of workers and low number of nurses per bed (17). In our study, in the Internal Diseases ICU, 80.2% of the costs were for direct primary substance and material, 15.6% were for staff expenses and 4.2% were for general production. In the Anaesthesiology ICU, 74.3%, 20%, and 5.7% of the costs were direct primary substance and material, staff expenses and general production, respectively. Similar to Hungary, Turkey is a developing country with a cheaper labour force and expensive materials (mostly imported).

Clinicians are responsible for most intensive care costs (24). Therefore, clinicians as well as hospital administrators should also have knowledge of cost analysis (25). In a review related to cost analysis studies, it was specified that efforts for evaluating costs in ICUs and revealing cost differences among patients failed because of the misuse of methodologies and instruments (26). Moreover, it was observed that record keeping was insufficient. Therefore, it is necessary to establish a data recording system where every administrative, financial and medical procedure should be regularly recorded (2). Further well-designed and comparative studies on cost analysis, including larger patient populations, are needed (7).

Our study has some limitations. It is a single-centre study. It is impossible to generalize the results because it includ-

ed a limited number of patients and ICUs. Examinations ordered, medications and treatments can vary depending on the health centres, and accordingly, the cost can also differ. Furthermore, ICU dynamics, patient admission criteria and hospitalized patients' features can also vary in each centre. Patients in some ICUs can be more easily transferred to units with a bed, but patients in other ICUs are directly discharged from the hospital to their homes. Such features affect the costs. Moreover, cost analysis techniques differ among hospitals. Therefore, further large-scale multi-centre studies which are well-designed on cost analysis in ICUs should be performed with various types of ICUs.

Conclusion

In this cost analysis study conducted with the Internal Diseases ICU from the internal ICUs and the Anaesthesiology ICU from the surgical ICUs, many differences from patients' features to the procedures implemented were revealed. However, rough costs and cost distribution rates were similar between the two ICUs. It was found that reimbursement by SSI did not meet the costs of ICUs in our study. It is suggested that the same amount of repayment by SSI to ICUs with different dynamics is inappropriate.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Gazi University Faculty of Medicine.

Informed Consent: We present data without any individual characteristics of patients, therefore we didn't take inform consent of patients.

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