

# Determination of the cost of prolonged hospitalization in cardiovascular surgery intensive care unit to the institution

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## Abstract

In the provision of health services, health institutions should be perceived as an enterprise to use limited resources most effectively and efficiently, evaluate them optimally and ensure production efficiency. Therefore, cost information enables the most efficient utilization of resources in hospital enterprises and allows managers to use decision-making mechanisms most accurately. This study was conducted to determine and compare the costs of prolonged hospitalizations in the cardiovascular surgery intensive care unit of a university hospital. Our study was descriptive and retrospective. The hospitalizations in the cardiovascular surgery intensive care unit of the hospital were analyzed according to the prolonged hospitalization criteria determined by the social security institution. 29 extended hospitalization patient bills were determined in three years. The mean age of the prolonged hospitalization of patients was 67 years, the duration of hospitalization was 680 days, and the mean hospitalization day was 18.64. The items with the highest expenditure in prolonged hospitalization of patients were determined as drug costs, general applications and intervention costs, medical consumables costs, and laboratory costs. The increase in costs during the hospitalization and treatment process is mainly due to medication, general practices, interventions, and medical consumables. Related decision-makers should make root-cause analyses, and plans should be made to reduce costs.

**Keywords:** Hospital management, cost control, prolonged hospitalization

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## Introduction

A healthy life is considered a constitutional and the most fundamental human right in many national and international documents. Regardless of the economic and political structures, it is the responsibility of the states to protect the health of individuals in social terms, treat sick individuals, create environments suitable for the living standards of disabled citizens and improve the level of social health [1]. Health is the source of life and underpins the need for all people to be healthier and the demand for health services [2]. Health is a need that affects all of us, regardless of our economic or cultural status, age, gender, or social status, and that we encounter throughout our lives. In 2012, Kızılçeç defined health economics as “*the application of economic rules to health services*” [3]. In addition to the formulation of health policies and the realization of legal regulations, it also covers the arrangements for activities such as production, division, distribution, and financing of health services and their economic results [2].

Despite the increasing demand for health services worldwide, the limited resources available in service delivery have brought the quantitative aspect of hospital management to the forefront. One of the significant steps to ensure cost control is to determine current costs [4,5]. The provision of health services by using limited resources most efficiently is the reason for the emergence of health institution management and is among the main objectives [6]. Although the primary purpose of hospital enterprises is not to make a profit, the calculation of costs has a strategic significance in terms of the effective use of resources [7]. In hospitals, which are institutions aiming to achieve the highest service quality with scarce resources, the first step in achieving this goal is to carry out detailed cost analysis studies [8].

Healthcare organizations are increasingly focusing on the determinants and variations of hospital length of stay to improve the quality of healthcare services and the management of hospital costs [9]. Today, determining the cost structure of the whole hospital and calculating the cost per patient, the costs of a unit or

department are also within the scope of the applications. The aim at this point is to make the evaluation, planning, and auditing processes of the costs of different working departments and, accordingly, the financial situation effective [10]. Cost calculations in hospitals can be carried out appropriately and thus be effective in management decision processes only if the costs per unit can be calculated and determined regularly and associated with cost points [11]. Determining the costs of goods and services produced in hospital enterprises is a very comprehensive, attention-demanding, and time-consuming process. In the provision of health services, it is only possible to set the price to be demanded in return for the service with cost calculations. Our study aimed to determine and compare the costs of prolonged hospitalizations in the Cardiovascular Surgery (CVS) Intensive Care Unit.

## Materials and Methods

In this study, a cost study was carried out on a total of 29 extended hospitalization patient invoices between 2012, 2013, and 2014 in the CVS intensive care unit at Karadeniz Technical University Farabi Hospital.

### *Research design*

Our study is a retrospective, descriptive study. The data were collected from the hospital costs of the prolonged hospitalization of patients in the CVS intensive care unit of Karadeniz Technical University Farabi Hospital between 01.01.2012-31.12.2012 in 2012, between 01.01.2013-31.12.2013 in 2013, and between 01.01.2014-20.05.2014 in 2014 retrospectively by using of existing records and documents. In addition, cost data were obtained by comparing patient records, accounting department, and data processing records.

### *Research sample/Study group/Participants*

The sample of our study consisted of a total of 29 prolonged hospitalization of patients who received treatment in the CVS intensive care unit in the relevant years.

### *Research instruments and processes*

#### *Data collection tools:*

The following documents for the years 2012, 2013, and 2014 were utilized.

- Invoices for prolonged hospitalization in the Cardiovascular Surgery (CVS) Intensive Care Unit for the years 2012, 2013, and 2014 (including May),
- Financial and income statements,
- Inventory accounting records and tables,
- Hospital information system records.

**Data collection process:**

The data were collected from the medical, administrative, financial, and technical records of the hospital. Organizational charts and workflow charts were used to identify activities and create activity pools. Patient records in the ward, accounting department, and data processing records were compared, and cost data were used.

The determination and billing of costs in hospital enterprises are determined within the scope of the Communiqué on Health Practices (CHP), which is constantly revised by the Social Security Institution (SSI), and the prices to be paid for these services are determined by the Health Services Pricing Commission (HSPC). For prolonged hospitalizations, the date of the diagnostic procedure is considered the first day, and the health services provided by the same health service provider within the periods specified below concerning this procedure are considered within the scope of the diagnostic procedure. [12].

- Group A (Specialized operations and interventions) for diagnostic procedures; 15 days,
- Group B (Special operations and interventions) in diagnostic procedures; 10 days,
- Group C (Major operations and interventions) in diagnostic procedures; 8 days,
- Group D (Intermediate operations and interventions) in diagnostic procedures; 5 days,
- Group E (Minor operations and interventions) is 3 days for diagnosis-based procedures.

Within the scope of our study, the data for each

year regarding the hospital costs of patients with prolonged hospitalization in the CVS intensive care unit for the years 2012, 2013, and 2014 were analyzed separately, and the Average Inpatient Patient Days (AID), Unit Cost of Inpatient Day (UCID) and Inpatient Unit Cost (IUC) were calculated with frequency analysis method, and finally, the data of each year were evaluated and compared as a whole. Formulas were calculated by taking the unit cost calculations proposed within the scope of the Hacettepe University Research Project (HURP) as an example [13,14].

**Average Inpatient Days (AID):** It can be expressed as the average inpatient day of a patient. It is the number obtained by dividing the total (clinic-based) number of inpatient days within a certain period (month, three months, or one year) by the number of discharged and deceased patients.

**AID = Number of inpatient days / Number of discharged and deceased patients**

The rate must be low because the duration of inpatient treatment of a patient should be low.

**Unit Cost of Inpatient Day (UCID):** It is calculated by associating the expenses incurred for the services provided to inpatients in hospitals within an operating period with the total number of inpatient days. The following formula is used in its calculation:

**UCID= Cost of Inpatient Services / Number of Inpatient Days**

The unit cost of an inpatient day shows the cost to the hospital for a single hospitalization day of an inpatient in an operating period.

**Inpatient unit cost (IUC):** It is calculated by associating the expenses incurred due to the services provided to inpatients in hospitals within an operating period with the total number of inpatients. The following formula is used in its calculation:

**IUC = Inpatient service expense / Number of inpatients**

Inpatient unit cost is the operating cost incurred by a hospital for an inpatient in an operating period.

### Statistical Analysis

The binary relationships between age and length of stay, age and death, age and total cost, length of stay and death, gender and death, length of stay, and total cost were analyzed using *Pearson* Correlation in SPSS Statistical Analysis Software. Firstly, data for the years 2012, 2013, and 2014 were analyzed, and *Pearson* Correlation analysis was used in SPSS Statistical Analysis Software. Statistical frequency analyses were performed for other variables. The analyses and findings are examined in detail in the results section.

### Ethical Considerations

Since the data used in our study did not contain any patient information, only institutional and data processing center permission was obtained. The permission of the institution and

data processing center is dated 24.10.2014 and numbered 48814514/200/.

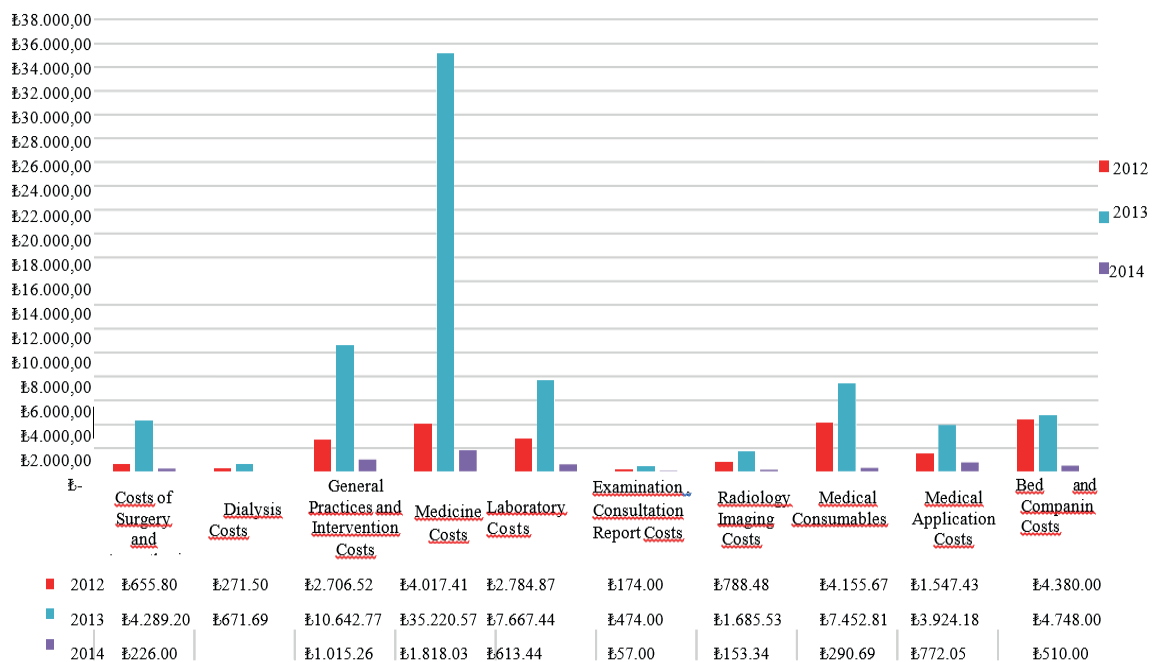
### Results

The mean length of stay of 29 prolonged hospitalization of patients in the CVS Intensive Care Unit of the hospital in 2012, 2013, and 2014 was 680 days. In our study, the mean age of the prolonged hospitalization of patients was 67 years, and 58.62% were male. Significant differences are observed in the rates of UCID over the years. The data for 2012, 2013, and 2014 showed that although there was a decrease in the number of patients in 2013 compared to 2012, there was a significant increase in total costs. AID was the highest in 2013 with 28.9 days, and the average of the three years was 18.64. The most important factors in the calculation

**Table 1.** Summary table of data analysis of prolonged hospitalization of patients in 2012, 2013, and 2014 in the CVS intensive care unit.

Years / Data	2012	2013	2014	Total / Average
<b>Total costs</b>	₺21,481.68	₺76,776.19	₺5,455.81	₺103,713.68
<b>Number of patients</b>	14	11	4	29
<b>Length of hospitalization</b>	302	309	69	680
<b>Average age</b>	65	70	66	67
<b>AID</b>	21.57	29.09	6.27	18.64
<b>UCID</b>	₺71.13	₺248.47	₺79.07	₺152.52
<b>IUC</b>	₺1,534.41	₺6,979.65	₺495.98	₺3,576.33

AID: Average Inpatient Days; UCID: Unit Cost of Inpatient Day; IUC: Inpatient Unit Cost



**Figure 1.** Prolonged hospitalization of patient costs in the CVS intensive care unit in 2012, 2013 and 2014.

of these rates are the total number of prolonged hospitalizations and days of hospitalization (Table 1). Determining the factors that increase the length of stay will provide important information on reducing costs and improving service delivery.

In our study, the cost items of prolonged hospitalization of patients were determined as medication, general applications and interventions, laboratory, radiology, medical consumables, dialysis, surgery and anesthesia, consultation, bed, and medical practice. The costliest expenses were drug costs ₺41,056.02, general practices and intervention costs of ₺14,364.55, medical consumables cost of ₺11,899.17, and laboratory cost of ₺11,065.75. The total cost of prolonged hospitalization was

found to be ₺103,713.68 (Figure 1).

*Pearson* correlation test showed that there were positive changes in the significance level (0.018) of the relationship between age and total costs, the significance level (0.016) of the relationship between the length of stay and death, and the significance level (0.01) of the relationship between the length of stay, and total costs of patients with prolonged hospitalization in the CVS intensive care unit in 2012, 2013, and 2014. Especially since the significance level of the correlation coefficient is less than 0.01, the duration of hospitalization and total cost are directly related.

**Table 2.** Correlation analyses between Age / Length of stay, Age / Death, Age / Total cost, Length of stay / Death, Gender / Death, Length of stay / Death.

		Age	Length of hospitalization	Death	Total Cost	Gender
Age	Pearson Correlation	1	,237			
	Sig (2-tailed)		,216			
	N	29	29			
Length of hospitalization	Pearson Correlation	,237	1			
	Sig (2-tailed)	,216				
	N	29	29			
Age	Pearson Correlation	1		,261		
	Sig (2-tailed)			,171		
	N	29		29		
Death	Pearson Correlation	,261		1		
	Sig (2-tailed)	,171				
	N	29		29		
Age	Pearson Correlation	1			-,436*	
	Sig (2-tailed)				,018	
	N	29			29	
Total Cost	Pearson Correlation	-,436*			1	
	Sig (2-tailed)	,018				
	N	29			29	
Death	Pearson Correlation	1	,445*			
	Sig (2-tailed)		,016			
	N	29	29			
Length of hospitalization	Pearson Correlation	,445*	1			
	Sig (2-tailed)	,016				
	N	29	29			
Gender	Pearson Correlation	1		,133		
	Sig (2-tailed)			,491		
	N	29		29		
Death	Pearson Correlation	,133		1		
	Sig (2-tailed)	,491				
	N	29		29		
Length of hospitalization	Pearson Correlation	1			,882**	
	Sig (2-tailed)				,000	
	N	29			29	
Total cost	Pearson Correlation	,882**	1			
	Sig (2-tailed)	,000				
	N	29	29			



## Discussion

Hospital enterprises have increasing importance due to the boosting demand for social and individual health services and the expectation of quality service. In addition to providing services mainly for the treatment of patients, hospitals are institutions where economically efficient and effective health care, education, research, and public health services are provided. Cost analyses provide the most objective information to decision-makers in evaluation and planning studies for the uninterrupted continuation, effectiveness, and efficiency of health services in hospital enterprises that are expected to provide services with limited resources. Cost information has strategic importance in following a realistic plan in all decision, implementation, and supervision stages. In this context, service production costs for hospital enterprises help to make healthy and sustainable decisions [15].

In hospitals, it is only possible to perform cost calculations in a healthy way and thus to be effective in management decision-making processes by regularly calculating the costs per unit and associating them with cost locations [10,16]. Evaluating the cost data of the unit ensures that the unit costs are realized at an optimal level by reducing costs and increasing efficiency. Thus, it is ensured that profit/loss amounts can be calculated on a divisional basis, shedding light on a more fair and realistic pricing study [14].

Differences are observed in the data of 2013 in the rates of unit cost inpatient day (UCID) by year. The data for the years 2012, 2013, and 2014 show that although there was a decrease in the number of patients in 2013 compared to 2012, there was a significant increase in total costs. The most significant factors in the calculation of these rates are the total number of prolonged hospitalization patients and hospitalization days, and the key factors in determining the costs were the length of hospitalization and drug costs. In the relevant cardiovascular surgery clinic, the ratio of drug costs to total costs was found to be quite high. This cost plan is confirmed by the relevant studies. Nosocomial infections are regarded as a global health burden in our country and the world. In addition to the increase in patient morbidity and mortality, it results in prolonged hospitalization,

the use of advanced antibiotic treatments, and higher additional costs [17]. Drug and especially antibiotic use and prolonged hospitalization are the best-defined parameters [18]. Drug costs can be significantly reduced through surveillance studies, training, and the use of evidence-based infection control measures, isolation methods, and rational antibiotic practices [19]. These measures will not only eliminate economic losses but will also contribute to the prevention of the increase in antibiotic resistance, albeit partially.

In the 3-year cost distribution of intensive care prolonged hospitalization bills, general practices, and intervention costs constitute the second largest cost after the high figures in drug costs. Patients with prolonged hospitalization are prone to systemic problems (hemodynamic variability during dialysis, pulmonary effusion, etc.) and metabolic disorders (metabolic acidosis, hyperkalemia, hypoalbuminemia, etc.) as risk factors [20,21]. The interventions negatively affect the quality of life of patients and increase the consumption of resources [22].

Another noteworthy cost item is the cost of medical consumables. The cost of a patient day in intensive care is approximately three to six times higher than in normal wards. Some interventions and treatments applied to patients may bring increased costs and prolonged hospitalization risks [23]. Although frequent invasive interventions (central venous catheter, urinary catheter, intubation, and total parenteral nutrition) are necessary in cases of indication in the intensive care unit, they may also lead to nosocomial infections [24]. It should also be taken into consideration that the increase in the cost of the prolonged hospitalization process is caused by high medical equipment-related expenses. In patients with prolonged hospitalization, the increase in diagnostic examinations and the use of advanced diagnostic parameters such as laboratory and radiology may be associated with increased costs. It is concluded that the implementation of necessary measures and interventions can promote the quality of health care and save costs [19]. The conclusion that prolonged hospitalization patient costs are related to the hospitalization day in our study is consistent with the study of Bülüç and Ağırbaş, suggesting that prolonged hospitalization is a

critical factor affecting the cost of hospitalization [25]. Accordingly, we believe that our study will contribute to the cost accounting, planning, performance audit, quality, and development issues of health managers by revealing that the costs of procedures and applications of prolonged hospitalization patients can be determined objectively through statistical methods.

The benefits of determining costs in hospital organizations for managers in decision-making processes are as follows [26].

- Budgeting,
- Valuation of the difference between standard cost and actual cost,
- Profitability,
- Pricing policy,
- Estimation of future costs,
- Expansion or contraction of the services offered,
- Reduction of outsourced services or in-house fulfilment.

Identifying the factors that increase prolonged hospitalization is beneficial for improving the delivery of health services. Patient hospitalization days are a significant indicator of resource consumption. Determining the factors that increase the length of stay will provide valuable information on reducing costs and improving service delivery. The most effective factors in the calculation of these ratios are the total number of prolonged hospitalization of patients and hospitalization days.

According to the Pearson correlation test performed to determine the relationship between the age and total costs of patients with prolonged hospitalization in the CVS intensive care unit in 2012, 2013, and 2014, there was a statistically significant negative relationship between the age of patients and total costs ( $p=0.018$ ). The total cost decreased as the age of the patients increased. The relationship between length of hospitalization and death was positive and statistically significant ( $p=0.016$ ). The increase in the length of hospitalization increases the risk of death. There was a statistically significant positive relationship between length of hospitalization and total costs ( $p=0.01$ ). Prolonged hospitalization increases total

costs [Table 2].

The fact that the cost information in the study was valid only for the relevant CVS intensive care unit of the hospital and cannot be generalized to other hospitals is considered a limitation of the study. In addition, the study covers the years 2012, 2013, and 2014, which is also considered a limitation in terms of time.

## Conclusion

In our study, the costs of prolonged hospitalization of patients were analyzed and information sources that can be effective in understanding the structure and functioning of the hospital were obtained. The cost increase in the length of hospitalization and treatment process is mainly due to the costs of medication, general applications and interventions, and medical consumables. Therefore, it is recommended to take measures to shorten the length of hospital stay of the patients and reduce the cost of drugs, which constitute a significant cost item.

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## Conflict of interest

There is no conflict of interest.

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