

## Analyzing the Cost of Care for Burn Injuries and Its Determinants in a University Hospital for Accidents and Burns

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### ABSTRACT

*Introduction: Providing care for burn patients is one of the most expensive parts of health care. Acquiring knowledge in this field is the first necessary step for the economic evaluation of the care of patients with burns. Therefore, the purpose of this study was to investigate the relationship between treatment costs and the etiology of burn patients in Taleghani Hospital for Accidents and Burns in Ahvaz. Materials and Methods: This was a descriptive-analytic study conducted at Taleghani Hospital for Accidents and Burns in Ahvaz in 2017. This retrospective study was designed based on the data available in patients' records. Two hundred and sixty two records were selected based on stratified random sampling. The study tool was a researcher-made checklist, and the data were analyzed using descriptive statistics such as percentage, mean and standard deviation, along with t-test, ANOVA, Pearson correlation coefficient and regression. Results: The average cost per patient was 97942891 Rials. There was a significant relationship between the patient's age and treatment costs ( $P = 0.009$  and  $r = 0.161$ ). The average cost of treating patients with second-degree burns (41186194 Rials) was significantly different from that of third-degree burns (171627024 Rials) ( $P = 0.000$  and  $t(120.990) = 7.158$ ). There was a direct and significant relationship between treatment costs and length of stay ( $P = 0.000$  and  $r = 0.874$ ). Conclusion: The results of this study can be of help to hospital managers and policymakers as well as health planners to analyze and control the costs of burn patients. Improving the quality of services, reviewing the care process, implementing treatment protocols, and paying attention to clinical guidelines and timely discharge of the patient can have an impact on reducing the length of stay and the cost of treatment.*

**Keywords:** Burn Care, Cost Analysis, Patient Etiology, Hospital.

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### INTRODUCTION

Caring for patients with burns is one of the most expensive parts of any health care system [1]. In fact, burns are one of the most costly incidents

in health care systems compared to other forms of trauma. The high cost of caring for burn injuries is due to a number of reasons such as the need for specialized medical centers, length of stay, surgical and non-surgical medical

supplies, intensive care, and the long rehabilitation time [2].

In 2004, 11 million people were burned [3], and each year, more than 265,000 people die from burn injuries [4]. In 2010, in the United States, the cost of loss of work due to flame burns was estimated to be 2520357000 USD for 3127 deaths [5]. In a study in Spain, the average annual cost of burn treatment was \$ 99,773 [6]. Mandal identified the length of hospital stay and surgical-related costs as the most important cost factors for burn injuries, which were directly related to the percentage of burned area and the severity of burns [7]. The degree and percentage of body burn are the main determinants of the cost of care for burn injuries [8]. Old age also has a strong impact on costs [9].

The epidemiology of burns and the cost of medical supplies used for treatment are important sources of reducing costs [10]. Almost 41% of injuries in Iran are due to burns. In a study in Tehran, burns caused by incidents were identified as the cause of 18% of deaths, which are ranked second after traffic accidents [11]. Most burns are caused by moist heat (hot liquids and steam), dry heat (surfaces and objects) and flames. Most burns occurring to children and adults are by hot liquids (e.g., boiling water) and fire flames [12]. It is difficult to accurately estimate the incidence of all burns in Iran [13]. Therefore, a comprehensive and accurate evaluation of the financial burden of burn patients is one of the challenges of the health system in Iran.

The greatest consequences and costs of providing care for burn patients are related to countries and communities with limited resources [14], and acquiring knowledge regarding the cost of burn injuries is the first necessary step for the economic evaluation of care for patients with burns [2]. Given the fact that care for burns has long been costly, the interest in analyzing and controlling the cost of this kind of care is increasing nowadays [15]. Many studies have been conducted on burns in Iran, but these studies have focused on the epidemiology of burn patients, and rarely has dealt with the costs of this specialized care. One of the methods to analyze the costs associated with burn injuries and the factors that affect them in our country is studying the records of patients receiving treatment in the hospital. The purpose of this study was to investigate the relationship between treatment costs and the etiology of burn patients in Taleghani Hospital for Accidents and Burns in Ahvaz.

## METHOD

This research is a descriptive-analytic study conducted at Taleghani Hospital for Accidents and Burns in Ahvaz in 2017. This retrospective study was designed based on the data available in patients' records. Since the standard deviation of the previous studies was 33, with a maximum acceptable error of 4 and a 95% confidence interval, the number of subjects was determined to be 262, selected among the patients under treatment in 2016. Sampling was done based on a stratified sampling method. Considering the fact that the patients' records were grouped based on the cause of burn, samples were examined from each group in proportion to the volume of each group. Burn cases were divided into 7 groups, including scald (boiling water, hot milk, hot tea, and hot food), fire flames (fire caused by oil and gasoline), gas, electricity, chemicals, contact, and others. The data collection tool was a researcher-made checklist that included variables such as age, sex, location, type of insurance, history of an underlying illness, cause of the burn, degree of burn, length of stay, and treatment costs. The validity of the checklist was reviewed and approved by faculty members and experts in the hospital. After obtaining the permit to conduct the study, the researcher referred to the hospital and in collaboration with the hospital, the necessary information was extracted from the patient records. It should be noted that, due to the incomplete information in the records, the variable underlying illness was excluded from the study. Meanwhile, by deleting the names of the patients in the checklist and using numbers instead, the ethics of the research was observed. Data were analyzed using descriptive statistics such as percentage, mean and standard deviation, along with t-test, ANOVA, correlation coefficient Pearson and regression analysis using SPSS version 16. Also, the significance level of inferential tests was determined to be 0.05.

## RESULTS

In this study, 262 records of burn patients were examined. The results of the study showed that 57.6% of the patients were male and 42.4% were female, and in terms of living place, 67.6% of them lived in the city and 32.4% in the village. The mean age of the patients was  $22.6 \pm 20.6$ , with the highest percentage of patients (32.8%) being in the age group under 6 years and the lowest (5%) in the age group above 60 years. Most of the patients (41.6%) were covered by Social Security Insurance (Table 1).

**Table 1-** Demographic data of patients.

Variables		Number	Percentage
Sex	Female	111	42.4
	Male	151	57.6
Age (year)	5 <	86	32.8
	6 -15	31	11.8
	16 - 25	37	14.8
	26 - 40	53	20.2
	41 - 60	42	16
	60 >	13	5
Location	City	177	67.6
	Village	85	32.4
Type of insurance	Social Security	109	41.6
	Health Services	47	17.9
	Armed Forces	11	4.2
	Rural Insurance	83	31.7
	Other	12	4.6

Table 2 shows that 46.9% of burns were due to scalding (boiling water, hot tea, hot milk, etc.) while burns with chemical substances (2.7%) were the least frequent. In terms of the degree of

burn, 56.5% were second-degree and 43.5% were third-degree burns. Finally, 34.7% of patients stayed in the hospital for more than 8 days (Table 2).

**Table 2-** Clinical information of the patients under study

Variables		Number	Percentage
Cause of burn	scald	123	46.9
	Fire flame	44	16.8
	Electricity	17	6.5
	Gas	41	15.6
	Chemicals	7	2.7
	contact	8	3.1
	Other	22	8.4
Degree of burn	Second-degree	148	56.5
	Third-degree	114	43.5
Length of stay	1 >	14	5.3
	1 - 3	88	33.6
	4 - 7	68	26
	8 >	91	34.7

The average cost per patient was 97942891 Rials. The costs of treatment for women (120464452 Rials) and men (81387307 Rials) were different ( $P = 0.042$  and  $t (177.156) = 2.044$ ). The average cost of women suffering from burns was higher than that of men. The results of the Pearson test showed a significant relationship between the patient's age and treatment costs ( $P = 0.009$  and  $r = 0.161$ ). Although the correlation was poor, the higher was the patient's age, the higher was the cost. Statistical surveys show that the cost of patients living in the city (80183696 Rials) is different from that of patients who live in the village (134923802 Rials) ( $P = 0.020$  and  $t (106.145) = 2.363$ ). The average cost of burn patients living in the village is higher than that of patients living in the city. The highest cost was reported for patients covered by Rural Insurance (13871574 Rials) whereas the least cost was

related to those covered by Armed Forces Insurance (36106494 Rials). There was a statistically significant difference (95% confidence) between hospitalization costs and insurance type ( $P = 0.023$  and  $F = 2.895$ ). The cost of burn treatment for patients who were covered by Rural Insurance was reported to be more than those covered by Social Security ( $P = 0.003$ ) and Armed Forces ( $P = 0.026$ ).

The highest average cost (178427613 Rials) was related to burns with flame while the least (32222804 Rials) was related to other items. There was a statistically significant difference (95%) between the cost of treatment and the cause of burns ( $P = 0.000$  and  $F = 5.04$ ). The cost of treatment of burns due to flame was significantly higher compared with scald and other items ( $P = 0.000$ ), while the cost of treatment of gas burns was higher in

comparison with scald ( $P = 0.005$ ) and others ( $P = 0.004$ ).

The results of the present study showed that the average cost of treatment for patients with second-degree burns (41186194 Rials) is different from that of patients with third-degree burns (171627024 Rials) ( $P = 0.000$  and  $t(120.990) = 7.158$ ). Therefore, it can be concluded that the costs of patients with third-degree burns are more than those of patients with second-degree burns.

With a 95% confidence, there was a direct and strong correlation between treatment costs and length of stay ( $P = 0.000$  and  $r = 0.874$ ). In fact,

the longer was the stay of patients in the hospital, the higher was their costs.

The results of multivariate regression showed that among age, sex, place of residence, type of insurance, cause of the burn, degree of burn and length of stay, only the variables age, degree of burn, and length of stay explain the costs of treatment for burn patients. In fact, about 77 percent of the variance in treatment costs for burn patients was explained by age, degree of burn, and length of stay, and the remainder belonging to other variables were not included in this study (Table 3).

**Table 3-** Stepwise regression model of independent variables for explaining the costs of patients' treatment.

Model	Correlation coefficient (R)	Coefficient of determination (R Square)	adjusted coefficient of determination (R <sup>2</sup> .adj)	F statistic	Significance level
Stepwise	0.879	0.774	0.771	292.56	0.000

Table 4 shows that at a significant level of 0.05, age, degree of burn, and length of stay of patients had a positive and significant effect on

increasing burn treatment costs by 0.833, 0.076, and 0.066, respectively.

**Table 4-** Effect coefficients of the final regression model of independent variables explaining patient costs

Independent variables	$\beta$ coefficient	T statistic	Significance level
Length of stay	0.833	25.041	0.000
Degree of burn	0.076	2.282	0.023
Age	0.066	2.202	0.029

Based on the results obtained, we can formulate the regression equation as follows:

Age (0.066) + Degree of burn  $\times$  (0.076) + Length of stay  $\times$  (0.833) = Treatment costs of patients

The above equation shows that the length of stay, in comparison with the degree of burn and age, has a more positive contribution to increasing the cost of burn treatment.

## DISCUSSION

The main purpose of the present study was to examine the relationship between the cost of treatment and the etiology of patients with burns at Taleghani Hospital for Accidents and Burns in Ahvaz. The findings of this study showed that the average cost per patient is 97942891 Rials. Rezaei and Karami Matin (2015), in a similar study, found that the average cost per patient was 20463227 Rials [16], which is different from the number obtained in the present study. It seems that the implementation of the Health Revolution Plan and the increase in the prices of medical supplies and personnel costs have led to an

increase in average costs. Another reason could be the difference in the type of hospital and the number of patients studied (sample size). Another study conducted by Sahin *et al.* (2011) stated that the average cost per patient was \$ 15250 [17]. Sanchez *et al.* (2008) found that the average annual cost of burn injuries in Spain was \$ 99,773 [6]. The average cost of treatment for women in the present study was higher than that of men, which is consistent with the results of Rezaei and Karami Matin [16]. This can be attributed to reasons such as the length of stay and the percentage of women burned. This study and many others acknowledge that the cost of burn patients is increasing, so that care should be taken in the prevention and reduction of burns, and training should be provided to the community members such as families and workers.

The results of the current study indicated that the costs of treatment for patients had a direct and significant relationship with age. According to the findings of a study conducted by Haikonen *et al.* (2014) in Finland, older age had a strong effect on cost, and for the treatment of most of

severe burn injuries over 400,000 euros is spent [9], which is consistent with the finding of the present study that the cost of treatment increases with the age of patients. Hop *et al.* (2014) believed that one of the reasons for the high cost of caring for burn patients is their long-term care and rehabilitation [18]. The results of the study by Cheng *et al.* (2018) also indicate that the length of hospitalization is related to age [19]. As patients get older, the need for special care and a longer stay in the hospital increases, which increases the cost of treatment. It seems that education and paying more attention to the elderly can be effective in preventing and mitigating cases.

In comparison with other causes of burns, those caused by flames had the highest average costs in the present study. This is consistent with the results of previous studies. According to Rezaei and Karami Matin (2015), the average cost of burns due to flames was higher than other items [16]. Various studies show that burns with fire are the most common cause of burns [12, 20, 21]. This has led to an increase in the average costs of burns with fire over other causes of burns. Therefore, the need for implementation of therapeutic protocols and clinical guidelines focusing on burns caused by flames is felt today more than ever before.

The results of our study also showed that there is a direct and significant relationship between the degree of burn and the cost of treatment. These results are similar to those obtained in other studies. In an epidemiological and cost analysis of burn injuries admitted to an emergency department of a tertiary burn center, Eser *et al.* (2016) found that the degree of burn and percentage of burned areas were the main determinants of the cost of care for burn injuries [8]. Hazar *et al.* (2013) also concluded that the degree of burn and the percentage of burned areas increase care costs [22]. This means that the higher is the severity of burns, the higher is the cost. Reviewing the process of providing care and conducting training courses for staff can be effective in reducing the costs in this regard.

Another finding from the present study was that the length of stay in hospital is directly related to patient costs, which indicates rising costs as a result of longer patient accommodation in hospital. The length of stay showed the highest contribution to the rise in costs compared to other factors. Rezaei and Karami Matin (2015) concluded that in Kermanshah the length of stay is more important than the percentage of burned area [16]. Mandal (2007) also states that the length of stay in the hospital is often identified as one of the most important causes of burns [7]. A study by the World Health

Organization (2015) found that due to their longer length of stay at hospitals, burn injuries impose higher costs upon the health care system [23]. By the same token, Torrati *et al.* (2000) indicated that the length of stay in hospitals increases the cost of care for burn patients [24]. In line with these results, the findings of the current study indicate that length of stay is a very effective factor in the cost of treatment for burn patients. Therefore, improving the quality of services, efficient and effective use of resources and timely discharge of patients can affect the length of stay and the cost of treatment. This research was beset by some limitations including the lack of control over some variables such as the history of underlying illnesses and the related costs in patients due to incomplete information in their records. Another limitation of the study is that the hospital under study admitted only second- and third-degree burn patients. Therefore, it was not possible to study the first-degree burns in this study.

## CONCLUSION

The present research can be of help to hospital managers, policymakers and health planners to analyze and control the costs of burn patients. Based on the results of this study, the length of stay, degree of burn, and age of the patient are the determining variables in the cost of treatment of burn injuries. Among these, the length of stay in the hospital plays a major role. Improving the quality of services, reviewing the care process, implementing treatment protocols, paying attention to clinical guidelines, and the timely discharge of the patient can have an impact on reducing the length of stay and cost of treatment. It should be noted that the accurate estimation of the length of stay plays a pivotal role in allocating the resources needed to treat burns. In addition, care should be taken in the prevention and reduction of burns, and training should be provided to the community members including families and workers. Future, studies are recommended to work on ways to reduce the length of stay, the cost of surgery, and the number of personnel needed for the treatment of burn patients. Also, studies intending to examine the costs need to take into account other aspects of patient care such as the history of the underlying disease, therapeutic protocols, clinical guidelines, and the type and amount of medications and medical supplies.

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#### **Conflict of interest**

The authors did not have any conflicts of interest with each other and organizations related to the subject of the article.

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