

# A Retrospective Study on the Factors Affecting Patients Length of Stay at the Burn Center RSUD Dr. Soetomo Surabaya During 2017-2019 60

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## Abstract

**Background:** Length of stay (LOS) is one of contributor in hospital costs, and attention has been paid to reducing LOS without compromising the quality of care for patients. Hospitals with a burn center have a longer average LOS than hospitals without a burn center, which can result in higher hospitalization costs. This study aims to identify the epidemiological and clinical factors that affect LOS in burn patients.

**Methods:** We conducted a retrospective cross-sectional study in design included all patients admitted to the Burn Center Soetomo General Hospital Surabaya between January 2017 - December 2019 who arrived within 48 hours after injury and survived till discharge. Patients who arrived after 48 hours following the injury, death during treatment and discharge against medical advice are excluded. Epidemiological and clinical data, such as age, gender, pre-existing co-morbidities, total body surface area (TBSA) burn wound, depth of burn, inhalation trauma, burn etiology, hospital acquired pneumonia (HAP), sepsis, anemia and hypoalbuminemia collected and subjected to statistical analysis.

**Results:** Of all 249 patients admitted, 136 patients are eligible in the inclusion criteria. Median LOS in the total population was 17 days. The population most often treated for more than 28 days is a patient with a burn area of 30.5-40%, experiencing HAP and hypoalbuminemia. LOS significantly increased with TBSA, inhalation trauma, comorbidities, HAP, sepsis, anemia and hypoalbuminemia.

**Conclusion:** There are several factors associated with the increased LOS observed in burn patients. This study confirmed and identified new factors that were significantly associated with LOS and were not previously discussed in the literature which allows better prediction of LOS and management of patients with burn injuries.

*Keyword: burn Injury, length of stay*

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## 1. Introduction

Length of stay (LOS) is one of contributor in hospital costs, and attention has been paid to reducing LOS without compromising the quality of care for patients (Sá Nchez et al., 2007; Stavrou et al., 2011). Hospitals

with a burn center have a longer average LOS than hospitals without a burn center, which can result in higher hospitalization costs (Ahn & Maitz, 2012; Patil et al., 2010). 61

There is a strong correlation between quality of life (QOL) with LOS and TBSA. The greater the TBSA and the longer the LOS, the lower the quality of life. The longer the patient is in the hospital, the loss of physical skills that may lead to demotion in the workplace and make the patient unable to carry out activities in household life (Kishawi et al., 2020). This study aims to elucidate the epidemiological and clinical factors that affect LOS in burn patients.

## 2. Methods and material

We conducted a retrospective cross-sectional study in design included all patients admitted to the Burn Center Soetomo General Hospital Surabaya between January 2017 - December 2019 who came within 48 hours after injury, and survive till discharge. Exclusion criteria are patients who came after 48 hours after injury, death during treatment and discharge against medical advice. Epidemiological and clinical data, such as age, gender, pre-existing co-morbidities, total body surface area (TBSA) burn wound, depth of burn, inhalation trauma, burn etiology, hospital acquired pneumonia (HAP), sepsis, anemia and hypoalbuminemia collected and subjected to statistical analysis.

The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 25, SPSS Inc. Chicago, IL, USA). To determine the individual relationship between LOS and categorical independent variables, the Mann-Whitney and Kruskal-Wallis bivariate statistical tests were analyzed, while the nominal data independent variables were analyzed by Pearson bivariate statistics. The relationship between patient characteristics that had the most influence on LOS was selected using multivariate logistic regression analysis. The statistically significant value was set as  $p < 0.05$ .

## 3. Results

The total number of cases admitted to dr. Soetomo Regional General Hospital Surabaya for the period 2017 – 2019 was 249 cases of burn patients being treated, with a mortality rate of 28% ( $n=70$ ) and a group of patients who discharged against medical advice of 5% ( $n=13$ ). There were 67% ( $n=166$ ) burn patients who survived until they went home with improved wound conditions. This study focused on patients with acute burns less than 48 hours. There were 30 patients referred from other hospitals with burns of more than 48 hours which were the exclusion criteria in this study, leaving 136 patients with acute burns with incidence of less than 48 hours.

We saw higher incidence of adult with burns (66 cases), representing 48,5% of the total number of cases, pediatric group 34 cases (25%) and geriatric group 36 cases (26,5%). The median age of our cases was 32,5 years, More male patients than females were admitted, with a male/female ratio of 1:2,4. We noticed that patients with the longest median LOS mainly had a TBSA burned of 50,5-60%, than followed by those with >60% TBSA burned, as shown in table 1.

In general, the most common cause of burns was fire (44.1%), followed by hot water (21.3%). In the pediatric group, hot water was the most common cause of burns followed by fire. Meanwhile, in the adult and geriatric, the most common cause of burns was fire followed by electric injury. The highest median LOS was found in patients with burns due to hot oil followed by chemical burns (table 1). However, there was no statistically significant difference in the median LOS of patients based on the cause of burns (table 2).

We found a statistically significant difference in LOS for patients with inhalation trauma, preexisting comorbidities, sepsis, HAP, anemia and hypoalbuminemia, the majority of cases staying >28 days having this condition (table 2).

Binary regression analysis of the different variables among the patients using forward stepwise method, such as predictors for LOS more than 28 days are shown in table 3. Among all the variables that had a significant difference on LOS, only TBSA, HAP and hypoalbuminemia had a strong influence on LOS. These three factors contributed 47.4% of the influence on the LOS of burn patients and there were still 52.6% of the factors that influenced the LOS of the burn patient.

**Table 1. Characteristics of burn patients**

| Variable                     |                                                            | N = 136     | Median LOS   |
|------------------------------|------------------------------------------------------------|-------------|--------------|
| Age                          | Pediatric (0-16 year)                                      | 34 (25%)    | 21 (6-76)    |
|                              | Adult (17-45 year)                                         | 66 (48,5%)  | 16 (1-56)    |
|                              | Geriatric (>45 year)                                       | 36 (26,5%)  | 15 (1-54)    |
|                              | Median: 32,5 year                                          |             |              |
| Gender                       | Male                                                       | 96 (70,6%)  | 18 (1-76)    |
|                              | Female                                                     | 40 (29,4%)  | 14 (1-44)    |
| Pre-existing comorbidities   | Yes                                                        | 20 (14,7%)  | 22 (2-54)    |
|                              | No                                                         | 116 (85,3%) | 17 (1-76)    |
| TBSA                         | 0-10%                                                      | 47 (34,6%)  | 12 (1-56)    |
|                              | 10.5-20%                                                   | 34 (25%)    | 16 (5-52)    |
|                              | 20.5-30%                                                   | 26 (19,1%)  | 15 (8-37)    |
|                              | 30.5-40%                                                   | 12 (8,8%)   | 26 (14-42)   |
|                              | 40.5-50%                                                   | 9 (6,6%)    | 24 (11-47)   |
|                              | 50.5-60%                                                   | 5 (3,7%)    | 36 (28-76)   |
|                              | >60%                                                       | 3 (2,2%)    | 30 (26-47)   |
| Median: 15,25%               |                                                            |             |              |
| Depth of burn                | Mix superficial partial thickness – deep partial thickness | 103 (75,7%) | 15 (1-76)    |
|                              | Mix partial thickness – full thickness                     | 33 (24,3%)  | 21 (4-56)    |
| Etiology                     | Fire                                                       | 60 (44,1%)  | 17 (1-54)    |
|                              | Scald                                                      | 29 (21,3%)  | 14 (4-47)    |
|                              | Electric injury                                            | 33 (24,3%)  | 18 (1-56)    |
|                              | Hot oil                                                    | 6 (4,4%)    | 28,5 (11-76) |
|                              | Blast injury                                               | 3 (2,2%)    | 16 (12-23)   |
|                              | Chemical                                                   | 3 (2,2%)    | 28 (5-30)    |
|                              | Thermal contact                                            | 2 (1,5%)    | 10,5 (7-14)  |
| InhalasionTrauma             | Yes                                                        | 22 (16,2%)  | 23,5 (9-54)  |
|                              | No                                                         | 114 (83,8%) | 16 (1-76)    |
| Anemia                       | Yes                                                        | 15 (11%)    | 24 (1-52)    |
|                              | No                                                         | 121 (89%)   | 16 (1-76)    |
| Hipoalbuminemia              | Yes                                                        | 31 (22,8%)  | 30 (5-56)    |
|                              | No                                                         | 105 (77,2%) | 14 (1-76)    |
| Sepsis                       | Yes                                                        | 8 (5,9%)    | 36 (14-47)   |
|                              | No                                                         | 128 (94,1%) | 16 (1-76)    |
| Hospital acquired pneumoniae | Yes                                                        | 8 (5,9%)    | 36 (14-47)   |
|                              | No                                                         | 128 (94,1%) | 16 (1-76)    |
| Length of stay               | ≤28 days                                                   | 111 (81,6%) |              |
|                              | >28 days                                                   | 25 (18,4%)  |              |
| Median: 17 days              |                                                            |             |              |

**Table 2. Relationship between LOS and different variables of burn**

| Variable                     |                                                            | Length of stay |          | P      |
|------------------------------|------------------------------------------------------------|----------------|----------|--------|
|                              |                                                            | ≤28 days       | >28 days |        |
| Age                          | Pediatric (0-16 year)                                      | 27             | 7        | 0,986  |
|                              | Adult (17-45 year)                                         | 53             | 13       |        |
|                              | Geriatric (>45 year)                                       | 31             | 5        |        |
| Gender                       | Male                                                       | 79             | 17       | 0,753  |
|                              | Female                                                     | 32             | 8        |        |
| Pre-existing comorbidities   | Yes                                                        | 12             | 8        | 0,010  |
|                              | No                                                         | 99             | 17       |        |
| TBSA                         | 0-10%                                                      | 43             | 4        | <0,001 |
|                              | 10.5-20%                                                   | 31             | 3        |        |
|                              | 20.5-30%                                                   | 23             | 3        |        |
|                              | 30.5-40%                                                   | 6              | 6        |        |
|                              | 40.5-50%                                                   | 6              | 3        |        |
|                              | 50.5-60%                                                   | 1              | 4        |        |
|                              | >60%                                                       | 1              | 2        |        |
| Depth of burn                | Mix superficial partial thickness – deep partial thickness | 85             | 18       | 0,630  |
|                              | Mix partial thickness – full thickness                     | 26             | 7        |        |
| Etiology                     | Fire                                                       | 48             | 12       | 0,394  |
|                              | Scald                                                      | 25             | 4        |        |
|                              | Electric injury                                            | 28             | 5        |        |
|                              | Hot oil                                                    | 3              | 3        |        |
|                              | Blast injury                                               | 3              | 0        |        |
|                              | Chemical                                                   | 2              | 1        |        |
|                              | Thermal contact                                            | 2              | 0        |        |
| Inhalation Trauma            | Yes                                                        | 14             | 8        | 0,022  |
|                              | No                                                         | 97             | 17       |        |
| Anemia                       | Yes                                                        | 53             | 47       | 0,005  |
|                              | No                                                         | 103            | 18       |        |
| Hipoalbuminemia              | Yes                                                        | 14             | 17       | <0,001 |
|                              | No                                                         | 97             | 8        |        |
| Sepsis                       | Yes                                                        | 1              | 7        | <0,001 |
|                              | No                                                         | 110            | 18       |        |
| Hospital acquired pneumoniae | Yes                                                        | 2              | 6        | <0,001 |
|                              | No                                                         | 109            | 18       |        |

**Table 3. Binary regression analysis of the different variables as predictors for LOS >28 days among the studied patients with acute burn (n=136)**

| Independent variables as risk factors of LOS > 28 days | B      | S.E.  | P value | OR Exp(B) | 95% C.I.for EXP(B) |        |
|--------------------------------------------------------|--------|-------|---------|-----------|--------------------|--------|
|                                                        |        |       |         |           | Lower              | Upper  |
| TBSA                                                   | .049   | .017  | .004    | 1.050     | 1.016              | 1.086  |
| HAP                                                    | 2.037  | 1.014 | .044    | 7.668     | 1.052              | 55.911 |
| Hipoalbuminemia                                        | 2.298  | .568  | .000    | 9.951     | 3.269              | 30.295 |
| Constant                                               | -3.807 | .636  | .000    | .022      |                    |        |

Nagelkerke R Square: 0.474

#### 4. Discussion

In our study, the median LOS of burn patients was 17 days, with the shortest LOS 1 day and the longest 76 days. This finding is not much different from the epidemiological study conducted on 709 burn patients at the Burn Center of Cipto Mangunkusuma Hospital, Jakarta in 2013 – 2017 by Wardhana et al. (2019), where the median LOS is 15 days (Wardhana & Winarno, 2020). In this study, the median LOS in the 0-15 year age group was 21 days, while in the 16 year age group it was 16 days. However, statistically there was no significant difference in LOS by age group, the same thing was also found in the study of Lundgren et al. (2009) and Abdelwahab et al. (2018) (AbdelWahab et al., 2018; Lundgren et al., 2009). In several studies, it was found that elderly patients had a longer LOS (Khaliq et al., 2013; Taylor et al., 2017), on the other hand, Wang et al. (2018) actually found a decrease in LOS with age (Khaliq et al., 2013; Taylor et al., 2017; Wang, Nie, Zhang, Zeng, Yu, Wei, Yang, & Shi, 2018). According to Wang (2018), organ function increases gradually with growth, so wound healing can be faster in adults. In addition, nutrients absorbed in children with burns are divided for growth and healing while adults grow less and can focus their energy on wound healing (Wang, Nie, Zhang, Zeng, Yu, Wei, Yang, & Shi, 2018).

Based on gender, it was found to have no significant effect on LOS in our study and also in the study by Bartosch et al. (2012) and Abdelwahab et al. (2018), while Khaliq et al. (2013) found that males have a longer LOS (AbdelWahab et al., 2018; Bartosch et al., 2013; Khaliq et al., 2013).

Bartosch et al. (2013) found that there was an increase in LOS for 1,406 days for every 1% increase in TBSA (Bartosch et al., 2013). In this study, the median LOS was highest in the TBSA group of 50.5 – 60% at 36 days, while the median LOS in the TBSA group > 60% was 30 days. This could be due to the high mortality rate in the TBSA group > 60%. In logistic regression, TBSA was found to have a significant positive correlation ( $B=0.058$ ) ( $p=0.012$ ) on the occurrence of LOS over 28 days. Elevated TBSA causes serious exudate problems. There is a disturbance in the balance of wound healing as well as systemic damage, so the condition is more complicated and requires a longer treatment. The wider the TBSA, the longer it takes for the growth of the skin epithelium.

Wang et al. (2018) and Sierra Zuniga et al. (2016) found a significant effect on LOS based on wound depth on contrary our study found no significant relationship between wound depth and LOS (Sierra Zúñiga et al., 2016; Wang, Nie, Zhang, Zeng, Yu, Wei, Yang, Shi, et al., 2018).

Hypoalbuminemia was found as the variable with the greatest effect on LOS in our study with a positive correlation, which means that if the patient has hypoalbuminemia, the risk of experiencing LOS is more than 28 days. Another study found that low serum albumin levels on days 3-5 after burns were associated with a long LOS period in burn patients (Pérez-Guisado et al., 2013). Low serum albumin leads to reduced collagen synthesis and granuloma formation, thereby impairing the innate immune response. This causes slowed wound healing and a tendency to infection (Odunayo, 2016). In addition to this study the group of burn patients who had hypoalbuminemia had a higher mean TBSA than the group without hypoalbuminemia ( $p<0.001$ ).

We found the median LOS of patients with HAP was 36 days while those without HAP were 16 days. Statistically there was a significant difference in LOS based on the presence of HAP. The same thing was also found in the study of Edelman et al. (2007) (Edelman et al., 2007). Patients with HAP are associated with inhalation injury in patients with TBSA of more than 20% (Liodaki et al., 2015). Patients with inhalation injury in this study had a longer median LOS than those without inhalation injury.

Hussain and Dunn (2013) through their systematic review found predictor factors that affect LOS, including age, TBSA, burn depth, gender, inhalation trauma, type of surgery and burn depth (Hussain & Dunn, 2013). In this study, logistic regression analysis was carried out to determine the relationship and how big the value of the relationship between the variables studied was on LOS in acute burn patients. Gender, burn depth,

causes of burns, comorbidities, sepsis and anemia had no effect on LOS, while TBSA, HAP and hypoalbuminemia were the most influential factors on LOS. Of these three factors, HAP and hypoalbuminemia are modifiable factors, it is hoped that these findings can be one of the targets for treating burn patients to reduce the risk of morbidity.

In this study, age, TBSA and hypoalbuminemia only explained 56.6% of the effect on the LOS of burn patients and there were still 43.4% of the unknown factors influencing LOS. There are several potential limitations to this study. We did not examine burn management factors such as successful resuscitation, admission-event time, use of skin grafts and amputation procedures. The study only took samples in a short time due to data limitations in the previous period and was limited to only one burn center. Predisposition to burns, demographics and epidemiological characteristics vary each country. Therefore, it is important that burn units in each country carry out their own epidemiological studies on burn patients. Currently in Indonesia there is no national burn patient registration system such as the National Burn Repository owned by the American Burn Association, it is hoped that this system can be established to make it easier for clinicians to conduct reviews and research related to burns.

## 5. Conclusion

There are several factors associated with the increased LOS observed in burn patients. This study confirmed and identified new factors that were significantly associated with LOS and were not previously discussed in the literature which allows better prediction of LOS and management of patients with burn injuries.

## Conflicts of Interest

The authors declare that there are no conflicts of interest.

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