Length of stay and its associated factors among adult patients who visit Emergency Department of University Hospital, Eastern Ethiopia

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Abstract

Objectives: This study was aimed to assess the length of stay and its associated factors among adult patients who visited Emergency Department of Hiwot Fana Specialized University Hospital, Eastern Ethiopia.

Method: A hospital-based cross-sectional study was conducted among 400 adult patients who visit the Emergency Department. Systematic random sampling technique and an interviewer-administered data collection method was used. Data analyses were done using STATA version 16. Bivariable and multivariable logistic regression analysis was used to control the potential confounders. The analysis outputs were presented using an odds ratio with a corresponding 95% confidence interval (CI). Independent variables were defined as statistically significant at p-values < 0.05 in the final model.

Result: A total of 169 [42.25% (95% CI: 37.5%–47.0%)] patients stayed longer than 24h in the Emergency Department. We identified factors significantly associated with length of stay in ED include: patients treated at orange triage type (adjusted odds ratio (AOR) = 0.267; 95% CI: 0.13–0.53), laboratory request (AOR: 3.05; 95% CI: 1.49–6.23), radiological requests (AOR: 1.80; 95% CI: 1.05–3.07), and diagnosed with medical condition (AOR: 2.27; 95% CI: 1.21–4.26).

Conclusion: A significant number of patients stay longer in the Emergency Department. Evaluation of the clinical diagnosis, diagnostic investigations, and organizational factors is essential to reduce the length of stay in the Emergency Department.

Keywords

Length of stay, Emergency Department, Ethiopia

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Introduction

Length of stay (LOS) in an Emergency Department (ED) indicates how well the department is performing and is a vital key performance indicator of healthcare services.¹ ED is a unit that serves an unscheduled patient population with anticipated needs for emergency care.² For many patients, it represents the “front door” of health system and accounts for about three-fifths of inpatient admissions.³

Globally, the percentage of patients who visit the ED rose by 65% between 2001 and 2011, leading to exaggerated waiting times, prolonged stays, overcrowding, and delayed admissions.⁴ Prolonged stay in ED can adversely affect patient outcomes, leading to increased length of hospital admission, higher inpatient cost, and mortality.⁶ Moreover, Singer et al.⁷ suggested that the mortality rate increased from 2.5% to 4.5% with increasing LOS for more than 12 h or more.

According to the Ethiopian Hospital Services Transformation Guidelines, 2016: the LOS for patients in the ED should not exceed one day.⁸ When beds in the ED are

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occupied by patients for more than 24 h, the ED becomes overcrowded.\(^9\) In addition, a shorter hospital stay minimizes the risk of infections and drug side effects, reduces unnecessary medical expenses, and increases the bed turnover rate, which helps increase the facilities’ profit margin, and improve the quality of treatment.\(^{10}\) Studies revealed that health professionals’ inability to perfectly triage and patients’ characteristics determine the LOS in ED.\(^{3,11}\) However, there is a variability based on the settings.\(^{12}\) Despite this, understanding the factors that contribute to the delays in an ED is a critical step in improving the patient care efficiency, which is rarely studied in the Ethiopian context.\(^{11}\) Therefore, this study aimed to assess the proportion of patients who stay longer than the recommended time in ED and to identify the contributing factors among adult patients who visit the ED of Hiwot Fana Specialized University Hospital, Eastern Ethiopia.

**Methods**

**Study setting and study period**

The study was conducted in Hiwot Fana Specialized University Hospital. The hospital is one of the two government hospitals affiliated to Haramaya University with a total of 210 beds and more than 250 health professionals. Emergency medicine and critical care department gives both emergency medical and surgical care services as a main gateway of the hospital. The study was conducted from 1st to 30th March, 2021.

**Study design and population**

Institutional-based cross-sectional study was conducted. All adult patients attending the emergency medicine and critical care units during the study period were eligible to be included in the study. However, patients who were unable to give their consent due to an inability to speak or altered mental status and who did not have an accompanying person were excluded.

**Sample size determination**

The sample size was calculated by using single population proportion considering the following assumptions: where \(n\) is the required sample size, \(Z_{\alpha/2}=1.96\) at 95% confidence interval, \(p\) is the proportion of patients that stayed longer than the recommended time, 38.4\(^%\),\(^3\) and \(d\) is the assumed marginal error (5\(^%\)); by adding 15\(^%\) nonresponse rate, it yields 417 participants that was considered for the final study.

**Sampling procedure**

Systematic random sampling technique was used to select the study participants. According to the patient’s registration record, on average about 880 patients visit the ED every month (which was calculated by taking the data of three consecutive months and dividing by 3). We have included every other patient according to their order of visit to ED.

**Study variables**

Variables included were sociodemographic characteristics including age, sex, marital status, educational status, occupation, religion, monthly income, and residence. Concerning the organizational and other related factors: mode of payment for health services, mode of presentation, means of transportation, date of presentation, time of presentation, triage type, first contact of health professionals, and shift change of healthcare workers. In addition, factors related to diagnostic investigations include: laboratory requests and their types and radiology service order and its types. Under the clinical characteristics of patients: vital sign, Modified Early Warning Score (MEWS), mental status, treatment given before arrival, frequency of presentation to ED, previous history of admission to hospital, history of comorbidity, previous medical conditions, current patient’s diagnosis, final outcome, and medication ordered were included. The outcome variable, LOS in ED was measured in hours and categorized as greater than and equal to 24 h and less than 24 h according to the Ethiopian Hospital Service Transformation Guidelines.\(^{13}\)

**Data collection tools and methods**

Data were collected by using the stop watch, structured checklist, and questionnaire. The stopwatch was used to measure the time duration of patients in the ED from the time of presentation to discharge and particular duration of stay in each service unit were filled on the structured checklists. In addition, the interviewer-administered questionnaire was used to address the variables including sociodemographic characteristics, organizational factors, diagnostic investigations, and clinical characteristics of patients that were developed through an extensive review of relevant literatures.\(^{11,14,18}\)

**Data collection procedures**

The data collection procedure is illustrated as follows: first, the data collectors identified eligible patients in the triage room upon arrival. Therefore, the time and other presentation-related characteristics were recorded at the triage room. Further, information such as sociodemographic characteristics was obtained by interviewing the patients at different treatment points or after the patient stabilized otherwise. Finally, information such as diagnostic investigations and clinical data were recorded from medical records. Overall LOS at the department and final disposition was recorded right before the patient was discharged from the ED. Six data collectors with bachelor degrees were deployed daily. Thereby, two data collectors worked 8-hour shifts to collect data. Consequently, data collection started early in the
morning from 8:00 am and continued over the next 24 h such that the first group collected the data from 8:00 am to 4:00 pm, the second group from 4:00 pm to midnight, and the third group takes over from midnight to 8:00 am.

**Data quality control**

For quality assurance, 2 days’ training was given for the data collectors on the tool contents, data collection technique, and ethical considerations. The interviewer’s manual was developed, which explains clearly all the standard steps and procedures for the study and addresses potential problems and questions to be raised. The questionnaire was prepared in English and translated into local language (Afaan Oromo and Amharic). The final versions of the questionnaire were pretested on 10% (47) of the sample at the Jugol Hospital 1 week prior to the actual data collection and necessary modifications were made accordingly. On-site supervision was performed to ensure the integrity and consistency of the completed questionnaire on a daily basis. In addition, data completeness was ensured throughout the data entry and data cleansing process.

**Statistical analysis**

The data was entered into Epidata version 2, and was exported into and analyzed by STATA version 16. Descriptive analysis: proportions, frequency, and summary of statistics and binary logistic regression analysis was done to identify factors associated with LOS in ED. Accordingly, variables yielding \( p \)-values \(< 0.05\) at bivariable logistic regression analysis were considered for multivariable logistic regression analysis. Factors significantly associated with outcome variable was identified at \( p \)-value \(< 0.05\) and adjusted odds ratios at 95% CI.

**Results**

**Sociodemographic Characteristics**

A total of 400 patients were enrolled in the study, with a 97% response rate. The mean age of the participants was 38 years, ranging from 18 to 80 years. The majority of patients 323 (80.75%) were married, 209 (52.25%) had no formal education, and 138 (34.5%) were farmers by occupation (Table 1).

**Organizational and others related factors**

Nearly one-fourth, 103 (25.75%) of patients presented with their visit on Friday, 181 (45.25%) patients were treated at orange or very urgent triage type, 366 (91.5%) patients were first seen by nurses, and 305 (76.75%) patients paid the medical expenses out of pocket. The mode of arrival for 218 (54.5%) patients was public transport, and the mean distance of patient’s home from health facility was 37 km (40.5 SD) (Table 2).

| Variable                  | Frequency | Percent |
|---------------------------|-----------|---------|
| Age                       | Mean 38 ± 15.76 |
| Sex                       | Male: 245, Female: 155 |
| Marital status            | Married: 323, Divorced: 11, Single: 60, Widowed: 6 |
| Educational status        | No formal education: 209, Primary: 106, Secondary: 37, College: 48 |
| Occupation                | Farmer: 138, Merchant: 46, Housewife: 41, Daily laborer: 79, Student: 23, Government employee: 40, Unemployed: 33 |
| Religion                  | Muslim: 294, Orthodox: 76, Protestant: 26, Others: 4 |
| Monthly income            | Mean 64USD |
| Residence                 | Urban: 196, Rural: 204 |

**Diagnostic investigations**

Laboratory services were ordered for 328 (82%) patients. The types of laboratory service ordered were complete blood count for the majority of patients 309 (94.21%). Moreover, radiology service was ordered for 153 (25%) patients (Table 3).

**Clinical characteristics**

The mean blood pressure of participants was 115 mmHg (±22.7 SD). The majority of patients, 290 (72.5%) presented at the ED for the first time, 81 (20.25%) had at least one comorbidity, and 158 (39.5%) patients improved and were discharged from the hospital. Any types of medications were ordered for 266 (66.5%) patients (Table 4).

**Length of stay**

A total of 169 (42.25% (95% CI: 37.5%−47.0%)) patients stayed longer than 24 h in the ED. Among those who stayed
longer than the recommended hours in the ED 116 (68.63%) were males, 101 (59.76%) have no formal education, 70 (41.42%) were rural residents, and 103 (61%) have MEWS of 1–4 (Figure 1).

### Table 2. Organizational and related factors at the ED, 2021.

| Variable                        | Frequency | Percent |
|---------------------------------|-----------|---------|
| Date of presentation            |           |         |
| Monday                          | 73        | 18.25   |
| Tuesday                         | 77        | 19.25   |
| Wednesday                       | 28        | 7.00    |
| Thursday                        | 66        | 16.50   |
| Friday                          | 103       | 25.75   |
| Saturday                        | 53        | 13.25   |
| Time of presentation            |           |         |
| Morning                         | 152       | 38.00   |
| Afternoon                       | 133       | 33.25   |
| Evening                         | 115       | 28.75   |
| Triage type                     |           |         |
| Red/immediate                   | 109       | 27.25   |
| Orange/very urgent              | 181       | 45.25   |
| Green/standard                  | 110       | 27.50   |
| First seen by healthcare worker |           |         |
| Nurse                           | 366       | 91.50   |
| General practitioner            | 34        | 8.50    |
| Shift change of healthcare workers |       |         |
| Yes                             | 40        | 10      |
| No                              | 360       | 90      |
| Mode of payment for health service |       |         |
| Out of pocket                   | 307       | 76.75   |
| Health insurance                | 41        | 10.25   |
| Free/exempted                   | 52        | 13.00   |
| Mode of presentation            |           |         |
| Alone                           | 55        | 13.75   |
| With spouse                     | 286       | 71.50   |
| With friends                    | 42        | 10.50   |
| With siblings                   | 17        | 4.25    |
| Mode of arrival/means of transportation | |         |
| Private                         | 110       | 27.50   |
| Public                          | 218       | 54.50   |
| Ambulance                       | 55        | 13.75   |
| By foot                         | 17        | 4.25    |

### Table 3. Diagnostic investigations conducted for the patient treated at the ED, 2021.

| Variable                        | Frequency | Percent |
|---------------------------------|-----------|---------|
| Laboratory request ordered      |           |         |
| Yes                             | 328       | 82      |
| No                              | 72        | 18      |
| Types of laboratory service ordered |       |         |
| Complete blood count            | 309       | 94.21   |
| Stool examination               | 6         | 1.83    |
| Urine analysis                  | 9         | 2.74    |
| Serum                           | 1         | 0.30    |
| Organ function test             | 2         | 0.61    |
| COVID-19 test                   | 1         | 0.30    |
| Radiology service ordered       |           |         |
| Yes                             | 153       | 38.25   |
| No                              | 247       | 61.75   |
| Types of radiology ordered      |           |         |
| X-ray                           | 117       | 76.47   |
| Ultrasound                      | 30        | 19.61   |
| Electrocardiography             | 6         | 3.92    |

### Table 4. Clinical characteristics of patients treated at the ED, 2021.

| Variable                        | Frequency/mean (SD) | Percent |
|---------------------------------|---------------------|---------|
| Vital sign                      |                     |         |
| Blood pressure                  | 115.26 ± 22.7       |         |
| Pulse                           | 100.76 ± 22         |         |
| Temperature                     | 36.44 ± 1           |         |
| Respiratory rate                | 22 ± 5.1            |         |
| Modified early warning score    |                     |         |
| 1–4                             | 259                 | 64.80   |
| 5–6                             | 98                  | 24.50   |
| >7                              | 43                  | 10.80   |
| Mental status during the presentation |             |         |
| Alert                           | 180                 | 45.00   |
| Comatose                        | 41                  | 10.25   |
| Confused                        | 179                 | 44.75   |
| Any treatment given before arrival |             |         |
| Yes                             | 62                  | 15.50   |
| No                              | 338                 | 84.50   |
| Frequency of presentation to ED |                     |         |
| For the first time              | 290                 | 72.50   |
| Previously presented            | 110                 | 27.50   |
| Previous history admission to the hospital | |         |
| Yes                             | 44                  | 11.00   |
| No                              | 356                 | 356.00  |
| History of comorbidity          |                     |         |
| Yes                             | 81                  | 20.25   |
| No                              | 319                 | 79.75   |
| Previous medical condition      |                     |         |
| Diabetes                        | 21                  | 25.93   |
| Asthma                          | 28                  | 34.57   |
| Pneumonia                       | 7                   | 8.64    |
| Tuberculosis                    | 2                   | 2.47    |
| Cardiovascular disorder         | 17                  | 20.99   |
| Others                          | 6                   | 7.41    |
| Current patient’s diagnosis     |                     |         |
| Trauma                          | 110                 | 27.50   |
| Medical                         | 197                 | 49.25   |
| Infectious                      | 28                  | 7.00    |
| Surgical                        | 65                  | 16.25   |
| Final outcome                   |                     |         |
| Improved and discharged         | 158                 | 39.50   |
| Admitted                        | 128                 | 32.00   |
| Referred to isolation center of the hospital | |         |
| Died                            | 15                  | 3.75    |
| Medication ordered              |                     |         |
| Yes                             | 266                 | 66.50   |
| No                              | 134                 | 33.50   |

Others: intestinal obstruction, acute appendicitis, and urinary tract infection.
Factors associated with LOS

Under the bivariable logistic regression model, age, sex, educational status, residence, distance of patient’s home from health facility in kilometer, time of arrival, triage type, laboratory request, radiological request, MEWS, and type of diagnoses were significantly associated with the outcome variable.

The output of multivariable logistic regression indicates patients treated at orange triage type were 74% less likely (AOR: 0.26; 95% CI: 0.13–0.53) to stay in ED compared to patients treated at green triage type. Moreover, patients who have received an order for laboratory investigation were three times (AOR: 3.05; 95% CI: 1.49–6.23) more likely to stay in ED and patients who received a radiological service stay 1.8 times (AOR: 1.80; 95% CI: 1.05–3.07) more likely in ED, than patients who did not have laboratory investigation and radiological investigation respectively. Compared to patients with trauma cases, the LOS for patients with a medical case were 2.27 times more likely (AOR: 2.27; 95% CI: 1.21–4.26) (Table 5).

Discussion

In the current study, 42.25% (95% CI: 37.5%–47.0%) of patients stay longer than 24 h in the ED. According to the Ethiopian Hospital Service Transformation Guidelines, the LOS in the ED should not be prolonged for more than 24 h. The current finding shows the proportion of patients who stayed longer than the recommended hours is higher than the result of the study conducted in the Netherlands, Switzerland, France, and the United States. The variation could be attributed to differences in sample size and quality of healthcare services.

Patients treated at orange triage type were less likely to stay in ED compared to patients treated at the green triage type. Similarly, the previously conducted studies identified the association of the triage type with the LOS in ED but with different description and number of triage categories. Moreover, the diagnostic investigation was significantly associated with the LOS. Patients without laboratory and radiological evaluations spend less time in an ED compared to their counterparts. Consistent with this finding, previously published data show that there is a correlation between the LOS in ED and diagnostic examinations. This could be due to the fact that the time required for diagnostic work-up increases the stay in the ED.

The current study result shows that patients with medical conditions stay longer in an ED as compared to patients who present with trauma. Previous study results indicated that the LOS in an ED is associated with the patient’s diagnosis, and severity of illness. It is evidenced that the clinical severity has a direct association with the LOS. Similarly, Sir et al. signified those types of presenting complaint and diagnosis that have a significant association with LOS in ED. Moreover, different types of presenting complaints may need different clinical approaches, and diagnostic investigation, which could contribute to the difference in LOS at ED.

Strength and limitations

The current study has used the pretested tools to measure the LOS in ED and to identify the associated factors. In addition, we collected the data prospectively through patient interview and observation, which could be the strength of the study. However, it was not without limitation. The cross-sectional nature of the study may deceive the cause–effect relationship. In addition, variables like bed occupancy rate, quality of emergency care services, standard level of ED, and communication gap between the patients and healthcare providers have not been included under the current study, which may impair the generalizability of the study.
Conclusions and recommendations

The present study identified that a significant number of patients stay longer in ED than a recommended time period. Patients treated at orange triage type, requested for laboratory and radiological investigation, and with medical diagnosis, stayed longer in the ED. Accordingly, we recommend special attention should be given to the patients with investigations ordered and with medical diagnosis to reduce the LOS. Perhaps, the slight homogenous nature of study participants in terms of marital status, occupation, and mode of payment for medical services needs cautious interpretation as regards the transferability of the findings to the settings with various heterogeneous characteristics of patients presenting to ED.

Future researchers have to incorporate factors including quality of emergency service, healthcare provider’s level of
job satisfaction, bed occupancy rate, and other factors that could affect the LOS in ED.

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Author contributions
All the authors made a significant contribution to the work reported equally: conception, study design, execution, acquisition of data, analysis, and interpretation. Also, they equally took part in drafting, revising, or critically reviewing the work. Moreover, they have made a mutual agreement on the journal to which the article has been submitted for publication. Finally, they agreed to share equal responsibility to be accountable for all aspects of the work and send the final approved version for publication.

Availability of data and materials
The data set used for analysis could be shared with reasonable request from corresponding author.

Declaration of conflicting interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval
An ethical approval letter was obtained from Haramaya University Institutional Research Ethics and Review Committee (IRERC) with a reference number (IHRERC/422/2021) before the commencement of the data collection. Informed, voluntary, written, and signed consent was obtained from each participant, and hospital administrators. Clear description of the study title, procedure, duration, possible risk, and benefits of the study was explained to the participants.

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