FACTORS AFFECTING LENGTH OF STAY IN PEDIATRIC EMERGENCY DEPARTMENT

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ABSTRACT

Background: Emergency medicine is the medical speciality that links primary care and specialist care treating unexpected illness and injury. Therefore, it must be available 24h a day as an essential component of a healthcare system. This study aimed to analyze factors affecting the length of stay (LOS) in the pediatric Emergency medicine. Patients and methods: This study was cross-sectional study which conducted in the Pediatric Emergency Unit of Zagazig University Hospitals on 1200 children. Results: There were statistically significant increase in length of stay among Arrival time at Am than Pm. There were statistically significant increase in length of stay among patients with respiratory findings and cardiac findings than without. In the present study, mean value of length of stay (hours) was low among discharged patients (0.20 ± 0.59) than admitted patients (0.51± 0.58). Conclusion: The Ped-CTAS triage system is a good tool for categorizing pediatric patients attending the ED. The 5-level triage system is a good tool predicting the utilization of medical resources.

Keywords: Emergency medicine, Length of stay, Children

INTRODUCTION

Emergency medicine now recognized as an essential part of public health service. As the services provided by emergency departments (EDs) increase and the management process becomes more complicated, patients stay in EDs for longer and EDs become more crowded(1).

A number of studies have discussed the adverse impacts of ED crowding, which include prolonged waiting times, increased complications, and increased mortality(2).

Previous literature has also demonstrated that prolonged ED length of stay (LOS) is not only a cause but also a result of ED crowding, yielding a vicious cycle(3).

Therefore, it is worthwhile to elucidate the factors associated with ED LOS in order to alleviate ED crowding and improve quality of care(4).
Many factors are responsible for ED LOS. Recent studies have shown that increased testing, consultation, radiology studies, and provision of less substantial treatment cause a significant increase in ED LOS\textsuperscript{(5)}. 

Some previous studies suggested that demographic characteristics, such as age and ethnicity, or the presence of junior residents or medical students, are associated with longer ED LOS\textsuperscript{(6)}. 

Regarding the patient populations, some of the studies focused on patients who were admitted or discharged, whereas others analyzed ED patient populations by grouping different patient dispositions together. However, it is possible that some of the influential factors, such as consultation or triage acuity level, will have different effects on patients with different final dispositions\textsuperscript{(7)}. 

In general, there are 3 final fates for ED patients: discharge, admission to the hospital, or expiring in the ED. It is difficult to differentiate the effects of certain factors on different endpoints if the analysis combines different dispositions as a unified group. It is also inadequate to analyze them separately, as a patient who expires in the ED while waiting for admission may be excluded from an analysis of the admitted patients group. The neglect of those deceased patients before admission would render the ED LOS underestimated. An alternative solution is to utilize the competing risk model for event-time analysis\textsuperscript{(8)}. The aim of this study was to analyze factors affecting the LOS in the pediatric ED. 

**Patients and Methods**

This Cross-sectional study was conducted in the Pediatric Emergency Unit of Zagazig University Hospitals from July 2019 until December 2019. Assuming that rate of admission of children in Emergency Department is 200 cases/month, so a comprehensive sample of 1200 children (559 males and 641 females). Their age ranged from 28 to 70 years with mean age 47.3\(\pm\)9.7 years. 6 months to 12 years with mean 3.62 years and body weight ranged from 6 to 60 K with mean 20.82 Kg. **Inclusion criteria were;** Children in Pediatric Emergency Department in Zagazig University Hospitals.Cardic, Renal, Chest, Dehydration, Neurological, Git.


**Data Collection Included:** Time of registration. Time of nursing. Time of physician assessment. Time of medical decision making (discharge vs. admittance). Use of specialty consultation and ancillary services, as well as time
of departure. Admitted patients were considered to have departed from the ED until they physically transported out of the ED to the hospital inpatient ward or another patient care facility. Observers recorded in addition to time, any relevant aspect of the process of care during the patients stay in the ED that may have had effect on ED LOS.

**Statistical Analysis**

The data were coded, entered and processed on computer using Statistical package for social science (SPSS) (version 24).

**RESULTS**

Figure 1; showed that most frequent findings among the studied group were fever and respiratory findings (66.3% & 50.7% respectively).

![Figure 1: General examination findings among the studied group.](image)

**Table (1): Length of stay and arrival time among the studied group:**

<table>
<thead>
<tr>
<th>Variable</th>
<th>(n=1200)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>Arrival time:</strong></td>
<td></td>
</tr>
<tr>
<td>Pm</td>
<td>338</td>
</tr>
<tr>
<td>Am</td>
<td>862</td>
</tr>
<tr>
<td><strong>Length of stay:</strong></td>
<td>Mean ± SD</td>
</tr>
</tbody>
</table>

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Table 1: showed that 71.8% of the studied cases came to hospital from 12 pm to 12 am. Also length of stay ranged from 0 to 2 hours with mean 0.48 hour.

Table (2): Relation between length of stay and sex:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Length of stay</th>
<th>MW</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.49 ± 0.49</td>
<td>0.21</td>
<td>0.83 NS</td>
</tr>
<tr>
<td>Female</td>
<td>0.48 ± 0.64</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sd: Standard deviation  
NS: Non significant (p>0.05)  
Table 2; showed that there was no statistically significant difference between male and female in length of stay.

Table (3): Relation between length of stay and cardiac finding:

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>N</th>
<th>Length of stay</th>
<th>KW</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HF</td>
<td>32</td>
<td>0.17 ± 0.14</td>
<td>9.92</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>18</td>
<td>0.29 ± 0.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>35</td>
<td>0.21 ± 0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1115</td>
<td>0.57 ± 0.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sd: Standard deviation  
KW: Kruskal Wallis test  
**: Highly significant (p<0.01)  
Table 3; showed that there were statistically significant decrease in length of stay among patients with cardiac findings especially HF comparing to cases without.

Figure (2): There were statistically significant decrease in length of stay among patients with respiratory findings especially F.B and pneumonia comparing to cases without.
Figure (2): Relation between length of stay and respiratory finding.

Table (4): Relation between length of stay and Neurological finding, fate, Arrival time:

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Length of stay Mean ± SD</th>
<th>KW</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurological</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Febrile convulsion</td>
<td>51</td>
<td>0.22 ± 0.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G.B.S</td>
<td>10</td>
<td>0.27 ± 0.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.S infection</td>
<td>53</td>
<td>0.26 ± 0.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>51</td>
<td>0.31 ± 0.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1035</td>
<td>0.57 ± 0.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharged</td>
<td>576</td>
<td>0.75 ± 0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Referred</td>
<td>38</td>
<td>0.51 ± 0.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admitted</td>
<td>574</td>
<td>0.20 ± 0.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died</td>
<td>12</td>
<td>0.12 ± 0.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrival time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pm</td>
<td>338</td>
<td>0.46 ± 0.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Am</td>
<td>862</td>
<td>0.61 ± 0.63</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sd: Standard deviation
KW: Kruskal Wallis test
*: Significant (p < 0.01) **: Highly significant (p < 0.01)

Figure (4): There were statistically significant decrease in length of stay among patients with neurological findings especially febrile convulsion.
comparing. There were statistically significant decrease in length of stay among patients died and admitted comparing to discharged or referred. There were statistically significant decrease in length of stay among cases arrived at pm than am

Figure 3; there was statistical significance positive correlation between length of stay and age, O2 saturation, BP and GCS and statistical significant negative correlation between length of stay and heart rate.

Figure (3a): Correlation between length of stay and age among the studied group.

Figure (3b): Correlation between length of stay and PSO2 among the studied group.
Figure (3c): Correlation between length of stay and HR among the studied group.

Figure (3d): Correlation between length of stay and Blood pressure among the studied group.
DISCUSSION

Predictor variables included patient-associated parameters (time of admission and discharge, ED occupancy, triage score, diagnosis, and demographic data) and external factors (weekday, time, and season). A total of 4885 visits were included. They found that, among the selected sample, females accounted for 2142 of the visits (43.9%).

This study showed that, most frequent findings among the studied group were fever and respiratory findings (66.3% & 50.7% respectively).

This agrees with Niska et al.\(^\text{(9)}\) who made a study in the USA and found that, the leading reasons for the pediatric ED among children (aged under 15 years) were fever and cough.

In Li et al.\(^\text{(10)}\) study, fever accounted for 17,741 (61.1%) of the pediatric ED patient visits.

In the present study, length of stay ranged from 0 to 6 hours with mean 0.48 minute. Harris and Hostetler\(^\text{(11)}\) revealed the overall mean LOS of 2.6 hours.

In our study, the 43.8% of patients were discharged from the ED in the current study. Compared with previous studies, the ED discharge rate of 71%\(^\text{(12)}\)

This study showed that, 71.8% of the studied cases came to hospital from 9am to 9pm.
This agrees with Bashkin et al. \textsuperscript{(14)} who aimed to examine LOS in the emergency department and explored the main factors that influence LOS and cause delay in patient care. Observations of 105 patients were performed over a 3-month period at the emergency room of a community urban hospital. They found that, 52\% were registered during the morning shift and 48\% during the evening shift.

Another predictive factor for prolonged ED-LOS was admission in the morning and around noon. While fewer patients consulted the ED in the morning compared to evening hours and ED occupancy increased over the day with a peak period between 4 and 8 p.m., the number of patients subject to prolonged LOS was highest before noon. Various authors assume that variations in staffing and organizational processes may contribute to reduced throughput in the morning hours\textsuperscript{(15)}.

This study showed that, there was no statistically significant difference between length of stay and sex.

This agrees with Dada and Sule, \textsuperscript{(7)} who found no statistically significant difference between length of stay and sex.

This study showed that, there was statistical significance positive correlation between length of stay and age.

Age is another factor that was found to be related to increased ED LOS across different nations\textsuperscript{(16)}.

This study showed that, there were statistically significant increase in length of stay among Arrival time at Am than Pm.

LOS tended to be longer for patients in the admission group who arrived during night shifts. This could be explained by the fact that the ED is often crowded during the day, and patients with lower acuity levels may wait longer to be treated and discharged. In addition, this hospital does not admit patients to wards during the night shift, so night shift arrivals need to wait until daytime to be admitted, thus prolonging the LOS. For expired patients, the recognition of serious conditions is often delayed at night, resulting in more critical situations on arrival at the ED.

Another study by Hofer and Saurenmann,\textsuperscript{(17)} found another predictive factor for prolonged ED-LOS was admission in the morning and around noon. While fewer patients consulted the ED in the morning compared to evening hours and ED occupancy increased over the day with a peak period between 4
and 8 p.m., the number of patients subject to prolonged LOS was highest before noon.

This study showed that, there were statistically significant increase in length of stay among patients with respiratory findings than without.

This agrees with Dada and Sule,(7) who aimed to determine whether the addition of a case manager and a physician advisor to the observation unit would decrease the length of stay (LOS) of observation patients. Their retrospective, observational study for observation patients was conducted in 2017. At a tertiary-care, medium-sized, urban, community hospital, the LOS for all observation patients in 2017 (2,981 clinical decision unit (CDU) patients and 1,248 non-cohort patients) was studied. They found that, patients with respiratory findings had significantly longer LOS.

This study showed that, there was statistically significant increase in length of stay among patients with cardiac findings than without.

This agrees with Leykum et al. (18) who found in their a retrospective analysis of LOS for cardiac patients revealed a increased LOS than without (2.4 days to 2.2 days, \( p = 0.05 \))

In the present study, mean value of length of stay (hours) was low among discharged patients (0.20 ± 0.59) than admitted patients (0.51±0.58).

This is in accordance with the study done by Chaou et al. (1) who aimed to evaluate different effects of relevant factors affecting ED LOS among different patient disposition groups. This was a retrospective electronic data analysis. The ED LOS and relevant covariates of all patients between January 2013 and December 2013 were collected. A total of 149,472 patients was included for analysis with an overall medium ED LOS of 2.15 [interquartile range (IQR) = 6.51] hours. They found that, for the admitted patients, the median LOS was much longer than for the discharged patients.

This might be explained by the fact that the priority for admission within a specific medical specialty is ranked according to both the severity of the disease and the arrival time, and that ICU waiting times are generally shorter than ward waiting times. It is clear from the previous literature that the LOS of the admitted patients is determined not only by ED or patient factors but also by hospital-level determinants such as hospital occupancy, admission-discharge ratio, and the daily hospital and ICU census(19).

Thus, some of the strategies developed to improve ED LOS for admission patients, such as creating specialized acute medical admission wards,
increasing ICU capacity, arranging admission immediately after evaluation, or developing disease-specific protocols, may be very different from those for discharged patients\(^{(20)}\).

In the present study, mean value of length of stay (hours) was high among referred patients \((0.75 \pm 0.076)\) than other patients.

**Bashkin et al.**\(^{(14)}\) in their study, revealed that, problems in continuum-of-care were found to affect ED LOS in another form, mainly among the admitted patients group. The process-from deciding to admit a patient until the patient was actually transferred from the ED to an inpatient hospital ward- took 43\% of the total ED LOS of admitted patients. Analysis of the admitting process using Ishikawa diagram revealed several possible explanations to the prolonged waiting times, one of them being deficient communication.

Physician referral was a strong predictor of prolonged ED-LOS in our study. The reason is most likely the higher complexity and severity of these cases, which are referred to the ED after a visit with a community-based pediatrician or family doctor. This association is reflected by lower levels of triage in referred children. Also, admission diagnoses made by primary care physicians and specialists are subject to certain inaccuracies, which may lead to increased ED-LOS, a fact reported by **Bernhard et al.**\(^{(21)}\) in a German adult ED of a tertiary care center. Furthermore, **Gaucher et al.**\(^{(22)}\) noted that patients who were referred by a physician are less likely to leave without being seen, which may prolong ED visit time.

The literature suggests that lack of continuum-of-care in the process of patient admissions is derived from deficient communication among medical staff **Kripalani et al.**\(^{(23)}\), and in our study, we found that it is associated with, and may have led to, prolonged ED LOS. Continuity of patient care is based on the effective transfer of information between medical staff members. A study that examined the handoff process between ED medical staff and Intensive Care unit (ICU) medical staff revealed that there was no structured and consistent approach to how handovers actually occurred, and nurses from both ED and ICU lacked clarity as to when the actual handover process began. Nurses from both settings recognized the importance of the information given and received during handover and deemed it to have an important role in influencing the quality and continuity of care\(^{(24)}\).

In a study examining the perceptions of ED physicians and hospitalizing physicians regarding handoff communication of patients transferred from ED to
inpatient settings researchers found that physicians perceived handoff communication as characterized by ambiguity about patients’ conditions and treatment. They found that poor communication practices and conflicting communication expectations presented barriers that exacerbated physicians’ information ambiguity. They noted that ED physicians and receiving inpatient physicians had different expectations about handoffs and those expectations influenced their interactions in ways that could result in communication breakdowns. Hospitalizing physicians expect ED physicians to produce definitive diagnoses, and admissions are delayed until confirmatory test results are provided, whereas emergency physicians might believe that their professional opinions are being questioned\(^{(25)}\).

**Conclusion:**

In conclusion, the application of a more accurate acuity and triage system for use in pediatric emergency care should provide greater patient safety and more timely utilization of appropriate ED resources. According to the severity of the disease, the Ped-CTAS triage system is a good tool for categorizing pediatric patients attending the ED. The 5-level triage system is a good tool predicting the utilization of medical resources. This study demonstrated good correlation among CTAS scores and patient severity (admission rate) and resource utilization. Reassessment should be carried out for all patients who exceeded the objective time by CTAS level in the waiting area to avoid the presence of patients who might deteriorate while waiting in the triage area. Proper training of the triage team is important for appropriate application of the system. In our study we found that 60% of patients attending the ED are in triage level 4 (non-emergent cases), which means that this percentage of patients can be dealt with in Primary Health Care (PHC) setting.

**REFERENCES**

1- Chaou CH, Chiu TF, Yen AMF, Ng CJ & Chen HH (2016). Analyzing Factors Affecting Emergency Department Length of Stay Using a Competing Risk-accelerated Failure Time Model. Medicine, 95(14), e3263. doi:10.1097/md.0000000000003263


