Turnaround Time of Patients in Emergency Department at a Tertiary Care Teaching Hospital in Uttarakhand, India: A Cross-sectional Study

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ABSTRACT

Introduction: The Emergency Department (ED) is the point of first contact for any critically ill patient needing immediate medical attention. EDs use a triage system which ensures people who are critically ill are treated first. Turnaround Time (TAT) for the ED is taken as the time from the patient's arrival in the ED to either their hospitalisation or discharge.

Aim: To estimate the TAT of patients in the ED at a tertiary care teaching hospital.

Materials and Methods: This cross-sectional study was conducted from August 1 to August 31, 2022, at the ED of Himalayan Hospital, Dehradun, Uttarakhand, India. A sample size of 300 patients were selected using a simple random sampling technique. Data were collected by direct observation using a data collection sheet. Timings were recorded with the help of a stopwatch. Statistical analysis was performed using the data analysis tool in Microsoft Excel and Statistical Package for Social Sciences (SPSS) version 23.0. Pearson coefficient of correlation (r-value) and p-value were calculated. The level of statistical significance was set at 5% (p-value <0.05).

Results: Most of the patients attending the ED were over 60 years of age 65 (21.7%). Only 24 (8%) patients were triaged as priority 1 (Red), whereas priority 2 (Yellow) and priority 3 (Green) patients were 135 (45%) and 141 (47%), respectively. It was observed that a maximum of 79 (26%) patients reported to the ED between 4 pm to 8 pm. A total of 186 (63%) patients were given final disposal within three hours of their arrival in the ED. The overall average length of stay in the ED was 2 hours, 53 minutes, and 4 seconds, or 173 minutes.

Conclusion: The study provided valuable insight into the causes of the increased TAT of patients in the ED. The highest time (1 hour, 48 minutes, and 59 seconds±1 hour, 31 minutes, and 43 seconds, constituting 63% of the total time in the ED) was taken by radiological investigations in the ED, followed by the time of 36 minutes and 30 seconds±39 minutes and 3 seconds (21% of total time in the emergency) for shifting patients.

Keywords: Discharge, Hospitalisation, Patient satisfaction, Triage

INTRODUCTION

The ED is known to be one of the most congested units in any hospital, facing greater pressure in terms of patient load and healthcare resources compared to other healthcare departments. Studies across various countries have reported that the quality of care decreases when the ED is overcrowded [1]. EDs have experienced dramatic increases in patient volume over the past decade [2-4]. Providing timely clinical care is the primary concern of EDs. On the other hand, crowding is a prevalent problem in EDs, which prolongs patient waiting times. Extended waiting times increase dissatisfaction with healthcare systems, delay the admission of new patients, and interfere with presenting medical care to admitted patients [5]. ED crowding has been described as a patient safety issue and a worldwide public health problem [6]. Overcrowding can result in delayed treatment, long patient waiting times with longer stays, overburdened working staff, patient elopement, a high medical error rate, low productivity, and finally result in poor patient outcomes [7]. The lack of timely decision-making and service providence in EDs has led to increased risks of adverse outcomes, mortality, patient and family dissatisfaction, cost increases, violence, and interference with everyday events in EDs [8]. Emergency Department Length Of Stay (EDLOS) is the time interval between a patient's arrival at the ED and the time the patient physically leaves the ED [9,10].

Triage originates from the French word "trier," which describes the processes of sorting and organising. Triage is utilised in healthcare to categorise patients based on the severity of their injuries and the order in which multiple patients require care and monitoring.

The triage system was first implemented in hospitals in 1964 when Weinerman ER et al., published a systematic interpretation of civilian EDs using triage [11]. Triage is "Prioritising sick or injured people for treatment according to the seriousness of the condition or injury" [12]. It is essential to understand that triage is dynamic, meaning a patient can change triage statuses with time [13]. Triage is a face-to-face encounter that should occur within 15 minutes of arrival or registration and generally requires less than five minutes of contact [14]. When triaged accurately, patients receive care in an appropriate and timely manner by emergency care providers. Proper triage helps limit their injuries and complications. However, incorrectly triaged patients could sustain further damage and complications [15,16].

Various triage systems are applied in different hospitals to best suit each ED's resource availability, economic situation, and patient capacity [17]. The more popular variants of the triage system with good reported reliability rates are the Emergency Severity Index (ESI), Canadian Triage and Acuity Scale (CTAS), Manchester Triage System (MTS), and Australasian Triage Scale (ATS) [18]. However, the All India Institute of Medical Sciences triage protocol (ATP) was used in the present study [19]. Simple Triage and Rapid Treatment (START) protocols are used in disaster situations [20]. Turnaround Time (TAT) is the time interval from the start of a process to the completion of the process. It represents the total amount of time the patient spends in the department. Systematic studies evaluating patients' TAT in the ED of hospitals are lacking in India. The aim of this study was to estimate the TAT of patients in the ED from their arrival to their final disposition. This will help achieve the objective of identifying causes of delay, which, in turn, will help reduce the TAT of patients in the ED.

MATERIALS AND METHODS

This cross-sectional study was conducted for one month, from August 1 to August 31, 2022, in the ED of Himalayan Hospital, a Tertiary Care teaching hospital in Uttarakhand, India. Ethical clearance was obtained from the Institutional Ethics Committee (IEC) with reference no. HIMS/RC/2022/307. Informed consent was obtained from all the participants for the study.

Inclusion criteria: The study included male and female populations in the age group from neonates (less than one month in age) to 90 years. Patients utilising the ED services were primarily residents from the adjoining nine districts of Uttarakhand and four neighbouring states. All patients coming to the ED during the study period, except those meeting the exclusion criteria, were included in this study.

Exclusion criteria: Patients coming to the ED solely for follow-up checks when the OPDs had closed were excluded from the study.

Sample size calculation: The sample size (n) was calculated to be 300 based on Yamane's formula for sample size calculation using a margin of error (e) of 0.05 and a population size (N=1200) (N=1200 represents the total population who attended the ED during the study period) as follows:

$$n=\frac{N}{1+N\,(e^2)}$$

Sampling procedure: Probability sampling was used, specifically a simple random sampling technique.

Study Procedure

Data collection methodology and parameters studied: Data was collected from primary and secondary sources.

Primary source: Data was collected through direct observation by the researcher using a data collection sheet [Annexure-1], which contained parameters like Date, Unique Health Identification Number (UHID), Patient name, age, gender, time of arrival (A), time of completion of triage/documentation (B), nursing assessment start time (C) and completion time (D), doctor assessment start time (E) and completion time (F), time sent for investigations (G) and return to ED (H), time of shifting patient (I) to Intensive care unit/ward/operation theatre, and idle time at each stage. The difference between parameters 'B' and 'A' represented the time taken for triage/documentation, the difference between parameters 'D' and 'C' meant the time taken for nursing assessment, the difference between parameters 'F' and 'E' represented the time taken for doctor assessment, the difference between parameter 'H' and 'G' meant the time taken for investigations, and the difference between parameter 'I' and 'H' represented the time taken for shifting the patient. Researchers also recorded the idle time between each of these parameters. Time was monitored with the help of a stopwatch during the observation period. Neither ED staff nor patients were involved in the process of data collection. The time was recorded in hours, minutes, and seconds.

Secondary sources: Available literature, hospital information system records, and emergency registration records.

STATISTICAL ANALYSIS

The statistical analysis was done using the data analysis tool in Microsoft Excel and SPSS version 23.0. Researchers also calculated demographic details, standard deviation, frequency per hour slots, Pearson coefficient of correlation (r), and p-value. The level of statistical significance was set at 5% (p-value <0.05). Additionally, the average, median, range of time, and analysis of time variance by ANOVA were also calculated.

RESULTS

Patients coming to the ED of Himalayan Hospital are primarily residents of this hilly state of Uttarakhand. As the majority of the districts in the state do not have rail or air services, these patients have to travel long distances on tortuous roads in rugged, hilly terrain. Based on the age criteria, these patients were grouped into six categories. The first age group, up to 12 years, also included neonates. After that, the patients were grouped into age group frequency of <12 years, 13-24 years, 25-36 years, 37-48 years, 49-60 years, and above 60 years of age. The number and percentage of males and females in each group were also calculated. Details of the demographic data are depicted in [Table/Fig-1].

Age (years)	N (count)	Male n (%)	Female n (%)	N (Count)%
up to 12	30	22 (73.3)	8 (26.7)	10
13 to 24	48	23 (47.9)	25 (52.1)	16
25 to 36	60	28 (46.7)	32 (53.3)	20
37 to 48	55	25 (45.5)	30 (54.5)	18
49 to 60	42	16 (38.1)	26 (61.9)	14
>60	65	22 (33.8)	43 (66.2)	22
Total	300	136 (45.3)	164 (54.7)	100

[Table/Fig-1]: Demographic distribution.

Triage of patients: After arrival at the ED, patients were triaged according to the severity of their medical condition. Patients requiring immediate resuscitation and urgent surgery were triaged as "Red" (Priority 1). Patients requiring possible resuscitation and early surgery were triaged as "yellow" (Priority 2). Patients with minor ailments and injuries were triaged as "Green" (Priority 3). The frequency distribution of triaged patients, along with percentages, is depicted in [Table/Fig-2].

Triage/Priority	n (%)
Red	24 (8)
Yellow	135 (45)
Green	141 (47)
Total	300 (100)

[Table/Fig-2]: Triage distribution.

Time of arrival of patients: The arrival pattern of patients at the emergency department was divided into four hourly time slots starting from midnight. It was observed that a maximum of 79 (26%) patients reported to the ED between 4 pm and 8 pm. The arrival time and the number of patients coming to the ED showed a strong positive correlation with an 'r' value of 0.59 between the two variables and a statistically significant p-value of 0.001. This signifies that as the day progressed, the number of patients arriving at the ED also increased. The frequency distribution of patient arrivals in different time periods is depicted in [Table/Fig-3].

Time of arrival	n (%)	r and p-value
Midnight to 4 am	21 (7)	
4 am to 8 am	23 (8)	
8 am to 12 noon	64 (21)	r-value=0.59
12 to 4 pm	72 (24)	p-value=0.001
4 pm to 8 pm	79 (26)	
8 pm to 11.59 pm	41 (14)	

[Table/Fig-3]: Time of arrival of patients (N=300).

Length of stay in ED: The total length of time taken by patients in the ED from arrival to final shifting/disposal was calculated in one-hour intervals. It was observed that 80 (26.7%) patients spent between one and two hours (1-2 hours) in the ED after their arrival, and 186 (62%) patients were given final disposal within three hours (≤3 hours) of their arrival. The Pearson coefficient (r-value) of -0.83 reveals a negative correlation between the time spent in the ED and the number of patients attended in each hour, implying that the number of patients was inversely related to an increase in the length

of time taken in the ED. This had a statistically significant p-value of (p-value <0.002). The frequency distribution of patients as per the time taken in the ED is depicted in [Table/Fig-4].

Length of time taken by patients in ED (hours)	n (%)	r and p-value
<1	32 (10.7)	
1-2	80 (26.7)	
2-3	74 (24.7)	
3-4	47 (15.7)	
4-5	35 (11.7)	
5-6	17 (5.7)	r=-0.83 p<0.002
6-7	8 (2.7)	
7-8	2 (0.7)	
8-9	1 (0.3)	
9-10	3 (1.0)	
10-11	1 (0.3)	

[Table/Fig-4]: Length of time in the Emergency Department (ED) (N=300).

Based on the observations recorded in the data sheet, the time taken for triage and documentation, nursing assessment, doctor assessment, investigation, and patient shifting to ward/department was calculated. The total length of stay in the ED was calculated by adding all these parameters, including the idle time. The mean, median, minimum, maximum time, and percentage of the total time taken by each variable were calculated.

On average, the highest time (hr: min: sec) of 01:48:59±01:31:43 (63% of total time in the ED) was taken by radiological investigations in the ED, followed by the time of 00:36:30±00:39:03 (21% of total time in the ED) taken for patient shifting. The delay in radiological investigations was primarily due to a long waiting line for investigations in the radiodiagnosis department. As the ED does not have an integrated emergency radiology unit, patients have to be sent to the central radiodiagnosis department of the hospital for procedures like ultrasound, Doppler, Computed Tomography (CT) scan, and high-resolution X-rays. In addition, the shortage of radiology technicians, especially at night, also added to the delay.

The delay in shifting patients to the ward and ICU was also analysed. Major causes of delay in shifting were due to multiple specialty consultations before shifting, lack of available beds in intensive/critical care units, and delays in bill clearance by patients' relatives due to financial constraints. However, no patient in the ED was denied treatment due to bill non clearance. Delays in decision-making by relatives further delays in the shifting.

The average time (hr: min: sec) taken for doctor assessment was 00:15:29±00:04:18 (8.9% of total time in the emergency room). The highest recorded time for doctor assessment was 01:01:00, and the lowest was 10 minutes. Details of time taken, along with the mean, median, maximum and minimum times, and the percentage of total time taken in the ED, are depicted in [Table/Fig-5].

Time variance between groups and sources of variation were analysed using ANOVA. The results are summarised in [Table/Fig-6]. The overall average length of stay in the ED was 02:53:04 or 173 minutes ±01:44:28 or 105 minutes.

DISCUSSION

Patients arrive in the ED either by ambulance or is brought by their conveyance. They are quickly triaged upon reaching the ED, and initial documentation is completed. Patients in the ED triage area are categorised into colour-coded "Red," "Yellow," and "Green" categories by a triage nurse. Patients needing immediate care are categorised as "Red," defined by the presence of altered physiological parameters, time-sensitive conditions, or conditions requiring immediate attention. Yellow-triaged patients do not meet "Red" criteria but have semi urgent conditions requiring admission for monitoring, evaluation, and treatment. Green-triaged patients are given minor treatment and are discharged [20].

Based on their triage status, the patient is shifted to the Red (Priority 1), Yellow (Priority 2), or Green zone (Priority 3), where they undergo initial nursing assessment. The main objectives of triage and initial assessment are to identify patients with potentially life-threatening conditions, accurately assess non-life-threatening conditions and injuries, prevent ED crowding, and support infection prevention and control. The first assessment includes a brief history, pain score,

	Time taken for triage and documentation (hr: min: sec)	Time taken for nursing assessment (hr: min: sec)	Time taken for the doctor assessment	Time taken for investigation	Time taken for shifting	Total length of stay in ED (hr: min: sec)	Total length of stay in ED (Min)
Average time (Mean)	00:04:30	00:07:43	00:15:29	01:48:59	00:36:30	02:53:04	173.04
Median	00:04:00	00:07:00	00:15:00	01:25:30	00:27:00	02:25:25	145.25
SD	00:01:49	00:03:28	00:04:18	01:31:43	00:39:03	01:44:28	104.59
Min time taken	00:02:00	00:04:00	00:10:00	00:08:00	00:01:00	00:25:00	25.00
Max time taken	00:15:00	00:30:00	01:01:00	08:46:00	05:17:00	15:49:00	949.00
% (Max time taken by activity in minutes/ Maximum total length of stay in minutes)	1.6%	3.2%	6.4%	55.4%	33.4%	-	100%

[Table/Fig-5]: Details of time taken by patient care activity (N=300).

ANOVA summary							
Groups	Count	Sum (hr:min:sec)	Average (hr:min:sec)	Variance			
Time taken documentation	300	22:31:36	00:04:30	1.6 E-06			
Time taken nursing assessment	300	14:37:00	00:07:43	5.8 E-06			
Time taken doctor assessment	300	05:23:32	00:15:29	8.9 E-06			
Time taken for investigation	300	16:54:10	01:48:59	0.00406			
Source of variation	Sum of squares (SS)	Degree of freedom (df)	Mean square (MS)	F statistic	p-value	F crit	
Between groups	1.08875	3	0.36292	356.46	2 E-165	2.61234	
Within groups	1.21766	1196	0.00102				
Total	2.30641	1199					

[Table/Fig-6]: Comparison of time taken for documentation, nursing and doctor assessment and investigation.
*Analysis of variance test (ANOVA)

and Modified Early Warning Score (MEWS). The time for the initial assessment must be minimised. All patients arriving by ambulance must be assessed within 15 minutes of their arrival in the emergency [21]. This conformed to the present study findings, where the average time for documentation and triage was four minutes and thirty seconds (00:04:30), and nursing assessment was done within seven minutes and forty-three seconds (00:07:43).

A study by Qureshi NA found that ED utilisation by non urgent patients increased from 50% to more than 70%, leading to overcrowding and decreasing the care time for urgent patients and life-threatening cases [22]. This finding was consistent with the present study, where the number of non urgent patients (Triaged Green) was 141 (47%). Travers JP and Lee FC reduced the waiting times for walk-in patients from 35.5 minutes to 19 minutes by placing a senior emergency physician with the triage nurse to examine non urgent patients [23]. However, in the present study, it was observed that triage was done by the triage nurse alone.

As per the National Centre for Health Statistics, ED visit rates were highest for infants aged <1 year, followed by adults aged ≥75 years [24]. However, in the present study, the highest number of patients (22%) coming to the ED were in the age group of ≥60 years, closely followed by patients aged 25-36 years (20%). In the present study, out of 300 patients, 136 (45.3%) were males and 164 (54.7%) were females. The Pearson coefficient of correlation value (r) of 0.18 indicated a positive correlation between them. The mean age of the patients was 40.7 years±20.9 years. However, Bukhari H et al., observed the mean age of study patients to be 37.93 years±22.88 years, among whom 58.3% were male [25].

Prolonged length of stay in the ED was defined as staying longer than two hours after the patient arrived in the ED until they wards received them. The common reason for the delay was multiple consultations with further investigations, accounting for 70 (48%) [26]. The present study corroborated the above finding, where 63% of the total time was taken for investigations, followed by 21% of the time in shifting patients.

In the study by Tiwari Y et al., the peak arrival time for patients coming to the ED was "9:00-12:00 h" [27]. This finding was a variance from the present study, which showed the highest number of 79 (26%) patients arriving in the ED between 4:00 pm and 8:00 pm. This was closely followed by 72 (24%) patients arriving between 12:00 pm and 4:00 pm.

The total time spent in the ED is from arrival to the time the patient leaves the department (by admission, referral, or discharge). In the present study, the average length of stay in the ED was 02:53:04 or 173 minutes (two hours fifty-three minutes and four seconds)±01:44:28 or 105 minutes (one hour forty-four minutes and twenty-eight seconds). The total time from triage to patient disposition from the ED was less than 2 hours (≤ 2 hr) in 112 (38%) cases, between 2 to 4 hours (2-4 hr) in 121 (41%) cases, between 4 to 6 hours (4-6 hr) in 52 (16%) cases, and more than 6 hours (≥6 hr) in 15 (5%) cases. These findings are at variance with the Al Nhdi N et al., study where the length of stay was 03:36:00 (three hours and thirty-six minutes) [28].

As brought out earlier in [Table/Fig-4], the present study findings revealed that 79% of ED patients were given disposition within four hours of their arrival, which was lower than the accepted four-hour rule in the UK. In the UK, the acceptable percentage of patients "admitted, referred for specialist assessment, or discharged" within four hours is 85% [29,30].

Limitation(s)

A major limitation of this study was that the data was collected manually with the help of a data collection sheet, and the study period was limited to one month. This precluded analysis of seasonal variation. As with any observational study, deficits in proper documentation may introduce the possibility of subjective bias.

CONCLUSION(S)

This study has attempted to estimate patients' Turnaround Time from their arrival to final disposition in the ED. The main reason for the delay was radiological investigations, which consumed 63% of the total time in the ED. Delays in radiological investigations were primarily due to long waiting lines for investigations in the radiodiagnosis department, followed closely by the time taken to shift the patients (21%). The primary cause of the shift delay was multiple specialty consultations and the non availability of empty beds, especially in intensive/critical care units.

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ANNEXURE-1

Data collection sheet.

Date	Patient UHID	Name	Age	Gender	Time of arrival (A)	Time of completion of triage/ documentation (B)	Idle time	Nursing assessment		Idle time	Doctor assessment		Idle time	Investigations		Idle time	Time of shifting to ward/ICU (I)
								Start (C)	Finish (D)		Start (E)	Finish (F)		Taken (G)	Return (H)		