

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso^{1*}, Ermi Girsang² Johannes Bastira Ginting³

¹ Postgraduate Program in Public Health, Universitas Prima Indonesia, Medan, Indonesia

^{2,3} Department of Public Health, Faculty of Medicine, Dentistry, and Health Sciences, Universitas Prima Indonesia, Medan, Indonesia

Email : venessawongso@gmail.com*

Email: ermigirsang@unprimdn.ac.id

Email : johannesbastiraginting@unprimdn.ac.id

Received: 25/07/2026 | Revised:03/08/2026 | Accepted:20/08/2026 | Published: 04/09/2026

Abstract

Emergency Department Length of Stay (EDLOS) is an important indicator of emergency department service efficiency and patient flow. Prolonged EDLOS may reflect delays in clinical assessment, diagnostic processes, and treatment decisions. This study aimed to analyze factors associated with EDLOS efficiency among non-trauma patients at the Emergency Department of RSU Royal Prima Medan. An analytic observational study with a retrospective approach was conducted using secondary data from medical records of 334 non-trauma patients treated in April 2026. Data were analyzed using univariate, bivariate, and multivariate analyses with binary logistic regression using the enter method. The results showed that 171 patients (51.2%) had efficient EDLOS (≤ 4 hours), while 163 patients (48.8%) had inefficient EDLOS (> 4 hours). Bivariate analysis demonstrated significant associations between arrival time ($p=0.049$), triage level ($p=0.045$), diagnostic tests ($p=0.032$), and Turnaround Time (TAT) ($p=0.045$) with EDLOS. Age, sex, and disposition status were not significantly associated with EDLOS. Multivariate analysis identified TAT as the only significant factor, with inefficient TAT increasing the odds of inefficient EDLOS by 3.705 times (aOR=3.705; 95% CI: 1.044–13.146; $p=0.043$). Improving diagnostic TAT should therefore be prioritized to enhance emergency department efficiency and reduce prolonged EDLOS.

Keywords: Emergency Department; EDLOS; Non-Trauma Patients; Service Efficiency; Turnaround Time

INTRODUCTION

Emergency departments (EDs) are a critical component of modern hospital systems because they provide continuous, time-sensitive care for patients with acute and potentially life-threatening conditions. The increasing burden of chronic diseases, changes in population structure, urbanization, and fluctuations in emergency care utilization have placed substantial pressure on emergency services. During periods of increased healthcare demand, emergency departments may experience overcrowding, resource constraints, prolonged waiting times, and disruption of patient flow. These conditions can affect the timeliness, quality, and safety of emergency care (Badr et al., 2022; Baker et al., 2020; Huang et al., 2020). Patient flow has therefore become an important issue in emergency department management because delays at one stage of care may affect subsequent stages and ultimately increase the total time that patients remain in the emergency department (Chaou et al., 2020; Samadbeik et al., 2024).

The emergency department also functions as an important gateway to inpatient and intensive care services. Clinical assessment, triage, diagnostic examination, treatment, and disposition decisions performed in the emergency department determine the subsequent pathway of patients within the hospital. Consequently, inefficient processes in the emergency department may result in prolonged waiting, increased crowding, inefficient utilization of hospital resources, and potentially unfavorable patient outcomes (Anderson & Patel, 2020; Burgess et al., 2022). Previous research has demonstrated that prolonged emergency department length of stay is associated with adverse outcomes and increased healthcare utilization, indicating that time spent in the emergency department is not merely an operational indicator but also an important quality and patient-safety concern (Habib & Sudaryo, 2023; Ma et al., 2025; Sookmee et al., 2024).

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso et al

One of the commonly used indicators for evaluating emergency department performance is Emergency Department Length of Stay (EDLOS). EDLOS represents the interval between a patient's arrival at the emergency department and the patient's departure through discharge, admission, transfer, or referral. It integrates several stages of emergency care, including registration, triage, physician assessment, diagnostic investigation, treatment, clinical decision-making, and patient disposition (Anderson & Patel, 2020; Ayenew et al., 2024). Because EDLOS captures the cumulative effect of multiple processes, it can be used as an important indicator of emergency service efficiency and patient flow. Prolonged EDLOS has also been associated with greater hospital resource utilization and poorer clinical outcomes (Burgess et al., 2022).

The interpretation of EDLOS should nevertheless consider the complexity of emergency patients. EDLOS is a multifactorial outcome influenced by patient characteristics, clinical severity, triage category, arrival time, diagnostic requirements, consultation processes, treatment procedures, bed availability, and administrative processes (Kurhayati et al., 2025; Nhdi et al., 2021). Patients with more complex clinical conditions may require multiple diagnostic investigations and specialist consultations before a definitive clinical decision can be made. Consequently, non-trauma patients may experience prolonged stays because many of them require laboratory investigations, imaging, observation, and multidisciplinary decision-making before discharge or admission (Dziegielewski et al., 2023; Yogantara & Sinulingga, 2025).

Triage is another important component of emergency department efficiency. The triage process determines the priority of treatment according to clinical urgency and helps ensure that patients with more critical conditions receive immediate care. Differences in triage acuity may consequently influence the duration and sequence of emergency care (Mitchell et al., 2020; Völk et al., 2022). In addition, the time of patient arrival may influence EDLOS because emergency department workload and availability of healthcare resources can vary according to time of day. Variations in patient volume, staffing, diagnostic capacity, and bed availability may contribute to differences in waiting and processing times (Bhattacharyya et al., 2025; Huang et al., 2020).

Diagnostic examinations represent another potentially important source of delay. Emergency patients may require laboratory tests, radiological examinations, or other diagnostic procedures before physicians can establish a definitive diagnosis and determine disposition. The efficiency of these diagnostic processes is therefore important for controlling EDLOS. In particular, Turnaround Time (TAT) represents the time required to process and report diagnostic examinations. Previous research has demonstrated that shorter laboratory turnaround times are associated with shorter emergency department stays, suggesting that diagnostic process efficiency may be a critical component of emergency department patient flow (Vrijssen, 2022). Similarly, studies in Indonesia have identified diagnostic processes and service flow as important contributors to variations in EDLOS (Heryana et al., 2025; Mailani et al., 2025).

The relationship between EDLOS and hospital efficiency has also attracted increasing attention internationally. Efficiency should not be interpreted simply as reducing the duration of care, because excessively rapid processes could compromise clinical quality and patient safety. Rather, effective emergency department performance requires an appropriate balance between timeliness, resource utilization, clinical outcomes, and patient safety (Mehroolhassani et al., 2025; Toukola et al., 2025). From this perspective, EDLOS can function as a process indicator that identifies potential bottlenecks in emergency care and provides information for quality improvement and resource management.

International studies have identified numerous factors associated with prolonged EDLOS. A systematic review and meta-analysis by Ayenew et al. (2024) demonstrated that prolonged emergency department stay is associated with multiple patient and system-level factors. A recent scoping review further emphasized that EDLOS is influenced by a combination of patient characteristics, clinical factors, organizational factors, diagnostic processes, and patient-flow mechanisms (Kurhayati et al., 2025). Other studies have highlighted the importance of bed availability, boarding, patient disposition, and hospital-wide flow in determining emergency department performance (Motimele et al., 2025; Wang et al., 2025). These findings indicate that EDLOS should be understood as a multidimensional indicator rather than an outcome determined by a single factor.

The Indonesian context presents an important research setting because emergency department services operate within a healthcare system experiencing increasing demand and continuing efforts to improve hospital efficiency. Previous studies conducted in Indonesian hospitals have reported variations in EDLOS and identified several factors related to waiting time, patient flow, diagnostic processes, and service organization (Heryana et al., 2025; Mailani et al., 2025). Research in Medan has also demonstrated that many emergency department patients can be managed within four hours, although variation remains across hospitals and patient groups (Sitepu et al., 2024). The four-hour threshold is consequently relevant as a practical indicator for evaluating emergency service efficiency

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso et al

in the present study. The preliminary assessment at RSU Royal Prima Medan revealed a substantial proportion of non-trauma patients with EDLOS exceeding four hours. During January–March 2026, 1,244 non-trauma emergency department visits were recorded, and only 45.02% were categorized as efficient based on EDLOS, while 54.98% were categorized as inefficient. This situation indicates the presence of potential bottlenecks in the emergency service pathway and provides an important rationale for investigating the determinants of EDLOS efficiency at the hospital level.

The present study therefore focuses specifically on non-trauma patients because this group may require relatively extensive diagnostic assessment and clinical decision-making before disposition. The study examines patient characteristics and service-related factors, including age, sex, arrival time, triage level, diagnostic examination, diagnostic examination TAT, and disposition status. The conceptual framework in the thesis positions EDLOS efficiency as the dependent outcome, categorized as efficient when EDLOS is ≤ 4 hours and inefficient when EDLOS is > 4 hours. The urgency of this study lies in the need to identify modifiable factors that can be addressed by hospital management. Understanding whether prolonged EDLOS is primarily associated with patient characteristics, clinical severity, arrival patterns, diagnostic requirements, turnaround time, or disposition processes can support more targeted interventions. Rather than implementing broad interventions without identifying the principal bottleneck, evidence regarding the strongest determinant may help hospital managers prioritize improvements in diagnostic workflow, interdepartmental coordination, staffing, patient flow, and resource allocation.

Accordingly, this study aimed to analyze factors associated with the efficiency of emergency department services based on EDLOS among non-trauma patients at RSU Royal Prima Medan. Specifically, the study examined the relationships between age, sex, arrival time, triage level, diagnostic examination, diagnostic examination TAT, and disposition status with EDLOS efficiency and identified the factor with the strongest association. The findings are expected to contribute to emergency department management by providing empirical evidence for improving patient flow, reducing avoidable delays, optimizing resource utilization, and strengthening the quality and efficiency of emergency care.

LITERATURE REVIEW

Emergency Department Services

The emergency department is a hospital unit that provides continuous care for patients requiring immediate assessment and treatment. Its characteristics distinguish it from scheduled outpatient services because patients arrive unpredictably, clinical severity varies considerably, and decisions frequently have to be made under considerable time pressure. The emergency department therefore requires an organizational structure capable of responding rapidly while maintaining patient safety and clinical quality. Emergency department services involve several interconnected stages, beginning with patient arrival and registration, followed by triage, clinical assessment, diagnostic examination, treatment, clinical decision-making, and final disposition. The effectiveness of one stage may influence subsequent stages. For example, delays in triage may postpone physician assessment, while delays in laboratory or imaging examinations may postpone diagnosis and disposition. Therefore, emergency department efficiency depends not only on individual clinical performance but also on the coordination of the entire patient-flow system (Chaou et al., 2020; Samadbeik et al., 2024).

Emergency Department Efficiency

Healthcare efficiency refers to the ability of a healthcare system to achieve optimal outcomes using available resources. In emergency services, efficiency includes appropriate utilization of healthcare personnel, facilities, diagnostic resources, time, and hospital beds while maintaining acceptable clinical quality and patient safety. Efficiency should therefore not be equated solely with reducing costs or shortening service time (Kang et al., 2023; Wagner et al., 2025). In emergency departments, time-based indicators are particularly useful because emergency care is highly sensitive to delays. EDLOS, waiting time, time to physician assessment, diagnostic turnaround time, and boarding time can provide information regarding the performance of individual components of the emergency care pathway (Toukola et al., 2025). Performance indicators can consequently be used to identify operational bottlenecks and support continuous quality improvement.

Emergency Department Length of Stay

EDLOS is the total duration a patient spends in the emergency department from arrival until departure. Depending on the patient's clinical condition, departure may occur through discharge, admission to an inpatient unit,

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso et al

transfer to intensive care, or referral to another healthcare facility. EDLOS is considered an important composite indicator because it reflects the cumulative performance of several processes within the emergency department (Andersson et al., 2020; Ma et al., 2025). A prolonged EDLOS can have consequences beyond the emergency department itself. Long stays may increase emergency department crowding, reduce bed availability, increase workload among healthcare professionals, and interfere with the admission of new emergency patients. Evidence also indicates that prolonged EDLOS may be associated with increased inpatient utilization and mortality, although the strength of this association varies according to patient characteristics and healthcare settings (Burgess et al., 2022; Habib & Sudaryo, 2023). The four-hour threshold is commonly used as a practical benchmark in emergency department performance assessment. In the present study, EDLOS ≤ 4 hours are categorized as efficient, whereas EDLOS > 4 hours is categorized as inefficient. This operational definition is consistent with the research framework developed in the thesis and provides a clear outcome measure for statistical analysis.

Factors Associated with EDLOS

Patient Characteristics

Age may influence EDLOS because older patients frequently have multiple comorbidities, atypical clinical presentations, and more extensive diagnostic and monitoring requirements. However, the relationship between age and EDLOS may vary across settings. Sex may also be associated with differences in healthcare utilization and clinical presentation, although evidence regarding its independent effect on EDLOS remains inconsistent (Kurhayati et al., 2025).

Arrival Time

The time at which patients arrive at the emergency department may influence EDLOS through variations in patient volume, staffing, diagnostic service availability, and bed capacity. Peak periods may increase waiting times and create congestion, whereas variations in staffing and service availability outside regular working hours may also affect diagnostic and treatment processes (Bhattacharyya et al., 2025; Huang et al., 2020).

Triage Level

Triage determines the priority of emergency treatment according to the severity and urgency of the patient's condition. Patients assigned to higher-acuity categories may require immediate intervention, more intensive monitoring, multiple procedures, and specialist involvement. Consequently, triage level may influence EDLOS through the complexity and intensity of care required (Mitchell et al., 2020; Völk et al., 2022).

Diagnostic Examination

Diagnostic examinations are frequently necessary for non-trauma patients because their clinical presentations may involve multiple possible diagnoses. Laboratory and imaging investigations can support clinical decision-making but may also introduce additional waiting time. The effect of diagnostic examinations on EDLOS therefore depends not only on whether an examination is ordered but also on how efficiently the examination is performed and reported (Dziegielewska et al., 2023; Mailani et al., 2025).

Turnaround Time

TAT is particularly relevant because it represents the operational efficiency of diagnostic services. A prolonged TAT can delay diagnosis, treatment decisions, consultation, and disposition. Vrijnsen et al. (2022) demonstrated that shorter laboratory TAT was associated with shorter EDLOS, supporting the argument that diagnostic workflow is a potentially modifiable determinant of emergency department efficiency.

Disposition Status

Disposition status determines whether a patient is discharged, admitted, transferred, or referred. Patients requiring admission may experience additional delays because of inpatient bed availability and boarding. However, disposition is also influenced by clinical severity and hospital capacity, making its relationship with EDLOS potentially complex (Motimele et al., 2025; Prucnal et al., 2025).

Critical Synthesis and Research Gap

Previous studies demonstrate that EDLOS is influenced by a combination of patient-level, clinical, operational, and hospital-system factors. Nevertheless, several gaps remain. First, the magnitude and direction of associations vary among hospitals because emergency department organization, patient characteristics, staffing, diagnostic capacity, and bed management differ between settings. Second, many studies evaluate EDLOS as a continuous duration or focus on individual determinants, whereas fewer studies simultaneously assess patient characteristics and service-process variables using an operational efficiency threshold. Third, the distinction between the availability of diagnostic examinations and the efficiency of diagnostic processing is important. A patient may require a laboratory or imaging examination, but the presence of such an examination does not necessarily cause an

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso et al

inefficient EDLOS if the examination is processed rapidly. Conversely, even a routine diagnostic examination may contribute substantially to EDLOS when its turnaround time is prolonged. This distinction is particularly relevant to hospital management because TAT is potentially more directly modifiable than many patient characteristics. The present study addresses this gap by simultaneously examining demographic and service-related factors among non-trauma patients at RSU Royal Prima Medan and by identifying the most dominant factor associated with EDLOS efficiency. The thesis framework specifically includes age, sex, arrival time, triage level, diagnostic examination, diagnostic TAT, and disposition status as independent variables. The study is also important because the preliminary data at RSU Royal Prima Medan demonstrated that more than half of non-trauma patients during January–March 2026 had EDLOS exceeding four hours. The empirical identification of the principal bottleneck can therefore provide a more targeted basis for hospital quality improvement rather than relying solely on generalized strategies for reducing emergency department crowding.

METHOD

Study Design

This study employed a quantitative analytic observational design with a retrospective approach. Secondary data were obtained from medical records and/or the hospital information system of non-trauma patients who received emergency department services at RSU Royal Prima Medan. The retrospective approach was selected because the study evaluated previously recorded patient characteristics, service processes, timestamps, and EDLOS without manipulating the clinical care received by patients.

Study Setting and Period

The study was conducted in the Emergency Department of RSU Royal Prima Medan. The location was selected because of the substantial number of non-trauma emergency visits and the availability of medical-record and hospital information-system data required to measure EDLOS. Data collection covered non-trauma patients receiving emergency services during April 2026.

Population and Sample

The study population consisted of non-trauma patients who received care in the emergency department during the study period. Preliminary data from January–March 2026 showed 1,244 non-trauma emergency visits, consisting of 473 visits in January, 316 in February, and 455 in March, with an average of approximately 415 visits per month. The sample size was calculated using the Slovin formula with a 5% margin of error. The minimum sample obtained was 303 patients, and an additional 10% was included to anticipate incomplete data, resulting in a final sample of 334 patients. Purposive sampling was used to select eligible records. Inclusion criteria consisted of patients who attended the emergency department during April 2026, had non-trauma diagnoses, completed the emergency department care process, and had clearly recorded arrival and departure times. Patients who were dead on arrival, referred to another facility before completion of emergency care, or had incomplete demographic or time data were excluded.

Variables and Operational Definitions

The dependent variable was emergency department service efficiency based on EDLOS. EDLOS was defined as the interval from the patient's arrival at the emergency department until departure through discharge, admission, referral, or transfer. $EDLOS \leq 4$ hours were categorized as efficient, while $EDLOS > 4$ hours were categorized as inefficient.

The independent variables consisted of patient characteristics and service-related characteristics. Patient characteristics included age and sex. Service-related characteristics included arrival time, triage level, diagnostic examination, diagnostic examination TAT, and disposition status. These variables correspond to the conceptual framework of the study, which positions EDLOS efficiency as the dependent outcome and demographic and service characteristics as explanatory variables.

Data Collection

Data were obtained from secondary sources, specifically patient medical records and/or the hospital information system. A structured data collection sheet was used to record relevant variables. Information included patient characteristics, arrival time, service-related variables, and departure time required to calculate EDLOS. The use of recorded timestamps enabled the researchers to obtain an objective measurement of the duration of emergency department care. Data Analysis, Data analysis was performed using three stages: univariate, bivariate, and multivariate analysis. Univariate analysis was used to describe the distribution of patient characteristics and study variables. Bivariate analysis was performed to examine the association between each independent variable and EDLOS efficiency. Variables considered relevant for the multivariate analysis were subsequently entered into a

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso et al

binary logistic regression model using the enter method. Binary logistic regression was used because the dependent variable had two categories, namely efficient EDLOS (≤ 4 hours) and inefficient EDLOS (> 4 hours). The multivariate analysis was intended to identify the independent factor most strongly associated with EDLOS efficiency after controlling for other variables included in the model. Ethical Considerations, the study used secondary patient data obtained from medical records and/or the hospital information system. Patient confidentiality was maintained during data collection and analysis, and the study was conducted following the applicable research ethics requirements. The thesis includes ethical clearance as one of the study documents and lists it among the research appendices.

RESULTS AND DISCUSSION

1. Characteristics of Non-Trauma Patients and EDLOS

A total of 334 non-trauma patients who received services in the Emergency Department (ED) of RSU Royal Prima Medan during April 2026 were included in this study. The characteristics of the patients were assessed based on age group, sex, arrival time, triage level, diagnostic tests, Turnaround Time (TAT), disposition status, and Emergency Department Length of Stay (EDLOS). The majority of patients were adults, followed by elderly patients and children. Female patients accounted for 171 patients (51.2%), while male patients accounted for 163 patients (48.8%). Most patients arrived outside working hours (216; 64.7%), whereas 118 patients (35.3%) arrived during working hours. Regarding triage, most patients were categorized as green (250; 74.9%), followed by yellow (73; 21.9%) and red (11; 3.3%). With regard to diagnostic tests, 198 patients (59.3%) did not undergo diagnostic tests, whereas 136 patients (40.7%) underwent such examinations. Among all patients, 118 (35.3%) had efficient TAT and 18 (5.4%) had inefficient TAT, while the remaining patients did not undergo diagnostic tests. In terms of disposition, 228 patients (68.3%) were discharged for outpatient care, whereas 106 patients (31.7%) were admitted. Overall, 171 patients (51.2%) had an efficient EDLOS (≤ 4 hours), while 163 patients (48.8%) had an inefficient EDLOS (> 4 hours).

Table 1. Characteristics of Non-Trauma Patients

Variable	Category	n	%
Age group	Children	53	15.9
	Adults	205	61.4
	Elderly	76	22.8
Sex	Female	171	51.2
	Male	163	48.8
Arrival time	Working hours	118	35.3
	Outside working hours	216	64.7
Triage	Green	250	74.9
	Yellow	73	21.9
	Red	11	3.3
Diagnostic tests	Not performed	198	59.3
	Performed	136	40.7
TAT	No examination	198	59.3
	Efficient	118	35.3
	Inefficient	18	5.4
Disposition	Outpatient	228	68.3
	Inpatient	106	31.7
EDLOS	Efficient (≤ 4 hours)	171	51.2
	Inefficient (> 4 hours)	163	48.8

The finding that 48.8% of patients experienced an EDLOS exceeding four hours is important from a hospital management perspective. Although slightly more than half of the patients received efficient emergency care, nearly half still experienced prolonged stays. This suggests that the emergency department continues to have potential bottlenecks in its patient-flow process. EDLOS reflects several interconnected processes, including triage, clinical assessment, diagnostic investigation, treatment, decision-making, and disposition; therefore, prolonged EDLOS may reflect inefficiency at one or more stages of the emergency care pathway (Andersson et al., 2020; Nhdi et al., 2021). This finding is also consistent with previous research indicating that prolonged EDLOS is associated with emergency department crowding and may have consequences for patient outcomes and hospital resource utilization (Burgess et al., 2022; Ma et al., 2025). Consequently, the proportion of patients exceeding the four-hour threshold should be

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso et al

considered not merely as a time indicator but also as an operational signal for identifying areas requiring improvement.

2. Bivariate and Multivariate Analysis of Factors Associated with EDLOS

The bivariate analysis examined the relationships between age, sex, arrival time, triage level, diagnostic tests, TAT, and disposition status with EDLOS efficiency. The results showed that arrival time, triage level, diagnostic tests, and TAT were significantly associated with EDLOS. In contrast, age, sex, and disposition status were not statistically associated with EDLOS.

Table 2. Bivariate Analysis of Factors Associated with EDLOS

Variable	Category	Efficient n (%)	Inefficient n (%)	p-value
Age	Children	23 (43.4)	30 (56.6)	0.333
	Adults	111 (54.1)	94 (45.9)	
	Elderly	37 (48.7)	39 (51.3)	
Sex	Female	87 (50.9)	84 (49.1)	0.904
	Male	84 (51.5)	79 (48.5)	
Arrival time	Outside working hours	102 (47.2)	114 (52.8)	0.049
	Working hours	69 (58.5)	49 (41.5)	
Triage	Green	135 (54.0)	115 (46.0)	0.045
	Yellow	34 (46.6)	39 (53.4)	
	Red	2 (18.2)	9 (81.8)	
Diagnostic tests	Not performed	111 (56.1)	87 (43.9)	0.032
	Performed	60 (44.1)	76 (55.9)	
TAT	Efficient	56 (47.5)	62 (52.5)	0.045
	Inefficient	4 (22.2)	14 (77.8)	
Disposition	Outpatient	123 (53.9)	105 (46.1)	0.140
	Inpatient	48 (45.3)	58 (54.7)	

Source: Research data, April 2026.

Age and EDLOS

Age was not significantly associated with EDLOS ($p=0.333$). The proportion of inefficient EDLOS was highest among children (56.6%), followed by elderly patients (51.3%) and adults (45.9%). Although elderly patients are theoretically more likely to experience prolonged emergency stays because of multiple comorbidities, atypical presentations, and greater diagnostic and monitoring requirements, the present findings indicate that age was not an independent determinant of EDLOS in this setting. This finding suggests that operational factors may be more influential than demographic characteristics in determining EDLOS at RSU Royal Prima Medan. Kurhayati et al. (2025) similarly emphasized that EDLOS is a multifactorial outcome involving interactions between patient characteristics and healthcare processes. Thus, the absence of a significant relationship between age and EDLOS does not imply that age is clinically irrelevant, but rather that its effect may be mediated by other factors in the emergency care process.

Sex and EDLOS

Sex was not significantly associated with EDLOS ($p=0.904$). The proportion of inefficient EDLOS was almost identical between female patients (49.1%) and male patients (48.5%). The relatively similar proportions indicate that emergency service processes at RSU Royal Prima Medan were not substantially differentiated according to biological sex. This finding supports the principle that emergency treatment should primarily be determined by clinical urgency, severity, and medical needs rather than demographic characteristics. The result is also consistent with the broader understanding that EDLOS is more strongly affected by clinical and operational processes than by sex alone (Kurhayati et al., 2025).

Arrival Time and EDLOS

Arrival time was significantly associated with EDLOS in the bivariate analysis ($p=0.049$). Patients arriving during working hours had a higher proportion of efficient EDLOS (58.5%) than those arriving outside working hours (47.2%). Conversely, inefficient EDLOS occurred in 52.8% of patients arriving outside working hours compared

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso et al

with 41.5% among those arriving during working hours. This finding suggests that differences in staffing, supporting services, patient volume, and diagnostic availability between working and non-working hours may influence patient flow. Previous literature has also emphasized that emergency department performance can vary according to workload and the availability of healthcare resources at different times of the day (Huang et al., 2020; Bhattacharyya et al., 2025). However, arrival time was no longer statistically significant in the multivariate model. This indicates that its initial association with EDLOS may be influenced or mediated by other operational factors, particularly the efficiency of diagnostic processes.

Triage Level and EDLOS

Triage level was significantly associated with EDLOS in the bivariate analysis ($p=0.045$). Patients classified as green had the highest proportion of efficient EDLOS (54.0%), whereas only 18.2% of red-triage patients had efficient EDLOS and 81.8% experienced inefficient EDLOS. This pattern is clinically plausible because patients with higher acuity generally require more intensive assessment, intervention, monitoring, and diagnostic procedures. Previous studies have similarly identified clinical severity and triage acuity as factors associated with EDLOS (Mailani et al., 2025). Nevertheless, triage was not statistically significant in the final multivariate model. One possible explanation documented in the thesis is the relatively small proportion of red-triage patients, which accounted for only 3.3% of the sample. Therefore, the observed relationship in the bivariate analysis may not remain independently significant after other variables are considered.

Diagnostic Tests and EDLOS

Diagnostic tests was significantly associated with EDLOS in the bivariate analysis ($p=0.032$). Among patients who underwent diagnostic tests, 55.9% had inefficient EDLOS, compared with 43.9% among patients who did not undergo diagnostic tests. The result indicates that patients requiring laboratory or other diagnostic examinations tended to remain longer in the ED. Non-trauma patients may require a more extensive diagnostic work-up before a definitive diagnosis and disposition decision can be established. Previous studies have also reported that diagnostic requirements can contribute to prolonged EDLOS (Mailani et al., 2025; Nhdi et al., 2021). Diagnostic tests itself was not retained as an independent determinant in the multivariate analysis. This is an important finding because it indicates that the existence of a diagnostic examination may be less important than the efficiency with which the examination is processed. In other words, the diagnostic examination may become a bottleneck primarily when its processing time is prolonged.

Turnaround Time and EDLOS

TAT demonstrated a significant relationship with EDLOS in the bivariate analysis ($p=0.045$). Among patients with inefficient TAT, 77.8% experienced inefficient EDLOS, compared with 52.5% among patients with efficient TAT. The importance of TAT became even clearer in the multivariate analysis. Patients with inefficient TAT had 3.705 times greater odds of experiencing inefficient EDLOS compared with patients with efficient TAT ($aOR=3.705$; 95% CI: 1.044–13.146; $p=0.043$).

Table 3. Multivariate Logistic Regression Analysis

Risk factor	aOR	95% CI	p-value
Arrival time			
Working hours	Reference	–	–
Outside working hours	0.946	0.438–2.040	0.887
Triage			
Green	Reference	–	–
Yellow	0.804	0.257–2.520	0.708
Red	6.318	0.978–40.819	0.053
TAT			
Efficient	Reference	–	–
Inefficient	3.705	1.044–13.146	0.043
Disposition			
Inpatient	Reference	–	–
Outpatient	1.366	0.379–4.924	0.633

Source: Research data, April 2026.

The finding is consistent with evidence demonstrating that laboratory TAT is an important determinant of EDLOS. Vrijnsen et al. (Vrijnsen, 2022) reported that shorter laboratory TAT was associated with shorter EDLOS in a retrospective cohort study. The current study therefore strengthens the argument that diagnostic-process efficiency is an important and potentially modifiable component of emergency department performance. The result also has substantial managerial implications. Unlike age, sex, or clinical severity, TAT can potentially be improved through organizational interventions, such as streamlined specimen transportation, laboratory prioritization for emergency samples, point-of-care testing, automated result notification, workflow redesign, and continuous monitoring of laboratory performance.

Disposition Status and EDLOS

Disposition status was not significantly associated with EDLOS in the bivariate analysis ($p=0.140$). Patients discharged for outpatient care had 46.1% inefficient EDLOS, compared with 54.7% among admitted patients. Although patients requiring admission may theoretically experience longer stays because of bed availability and boarding, the present study did not demonstrate a statistically significant relationship. In the multivariate model, disposition status also remained non-significant ($p=0.633$; aOR=1.366; 95% CI: 0.379–4.924). This finding indicates that the final disposition decision alone was not the principal bottleneck in this study. Instead, the results point more strongly toward the internal efficiency of the diagnostic process, particularly TAT, as the factor that most directly influences whether patients remain in the ED beyond four hours.

3. Dominant Factor Associated with EDLOS

The multivariate analysis provides the most important finding of this study. Although arrival time, triage level, and diagnostic tests were significantly associated with EDLOS at the bivariate level, their effects disappeared after adjustment. In the final model, TAT was the only factor that remained statistically significant ($p=0.043$). Inefficient TAT increased the odds of inefficient EDLOS by 3.705 times compared with efficient TAT. This finding suggests that the main challenge in improving EDLOS efficiency at RSU Royal Prima Medan is not necessarily the characteristics of the patients entering the ED, but rather the efficiency of the service process after diagnostic investigations have been requested. The finding is consistent with the concept of EDLOS as an integrated measure of patient flow. Diagnostic examinations frequently form a critical link between clinical assessment and final disposition. When diagnostic results are delayed, physicians may be unable to finalize treatment decisions or determine whether a patient can be discharged or requires admission. Thus, prolonged TAT may generate a cascade of delays that ultimately increases total EDLOS (Heryana et al., 2025; Vrijnsen, 2022). From a hospital-management perspective, the result suggests that interventions aimed at reducing EDLOS should prioritize diagnostic turnaround optimization rather than focusing exclusively on reducing patient arrival volume or changing triage procedures. The thesis recommends establishing a TAT standard of ≤ 140 minutes, conducting regular monitoring, strengthening coordination between the ED and supporting units, utilizing point-of-care testing where appropriate, and implementing notification systems for examination results. The result also supports a broader patient-flow perspective in which emergency department efficiency depends on coordination across organizational boundaries. Improving EDLOS therefore requires collaboration between physicians, nurses, laboratory personnel, radiology services, admission units, and hospital management. Patient-flow interventions that address bottlenecks across the health system have been emphasized in recent reviews of emergency department performance (Samadbeik et al., 2024).

4. Implications for Emergency Department Management

The findings have several practical implications. First, the fact that 48.8% of patients had EDLOS >4 hours indicate that the hospital still has an opportunity to improve emergency service efficiency. Second, the bivariate results demonstrate that several aspects of patient flow—arrival time, triage, diagnostic examinations, and TAT—are related to EDLOS. Third, the multivariate results indicate that TAT is the most actionable determinant. Therefore, improvement strategies should focus on shortening the interval between the request for a diagnostic examination and the availability of the result. Such strategies may include establishing explicit TAT standards, monitoring TAT as a key performance indicator, prioritizing emergency specimens, improving communication between the ED and laboratory, using point-of-care testing when clinically appropriate, and developing automated result notification systems. These strategies are consistent with the thesis recommendation that RSU Royal Prima Medan establish and monitor a TAT target of ≤ 140 minutes. The findings should nevertheless be interpreted within the study's limitations.

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso et al

The study used retrospective secondary data, meaning that its accuracy depended on the completeness and accuracy of medical-record documentation. In addition, only selected patient and service variables were analyzed, while other potentially relevant factors were not included. Finally, the study was conducted at a single hospital, limiting the generalizability of the findings to hospitals with different organizational structures and patient characteristics.

CONCLUSION

This study demonstrated that the efficiency of emergency department services among non-trauma patients at RSU Royal Prima Medan remains an important operational issue. Of the 334 patients included in the study, 51.2% had an efficient EDLOS (≤ 4 hours), while 48.8% had an inefficient EDLOS (> 4 hours). This indicates that although slightly more than half of the patients received care within the four-hour target, a substantial proportion continued to experience prolonged stays. The bivariate analysis showed significant associations between arrival time, triage level, diagnostic tests, and TAT and EDLOS. In contrast, age, sex, and disposition status were not significantly associated with EDLOS. After adjustment using multivariate logistic regression, however, only Turnaround Time of diagnostic tests remained statistically significant. Patients with inefficient TAT had 3.705 times higher odds of experiencing inefficient EDLOS than patients with efficient TAT (aOR=3.705; 95% CI: 1.044–13.146; $p=0.043$).

These findings indicate that improvement of EDLOS efficiency at RSU Royal Prima Medan should prioritize optimization of the diagnostic examination process, particularly reduction of TAT. Hospital management should consider implementing and continuously monitoring a TAT standard of ≤ 140 minutes, strengthening coordination between the ED and supporting diagnostic services, and utilizing technologies such as point-of-care testing and automated result notification where appropriate. Future research should examine additional determinants of EDLOS, including staffing patterns, emergency department workload, laboratory and radiology workload, bed availability, boarding time, specialist consultation, and patient-flow characteristics. Multicenter prospective studies would also be valuable to improve the generalizability of the findings and to evaluate whether interventions designed to reduce diagnostic TAT can produce sustained reductions in EDLOS and improvements in emergency service quality.

REFERENCES

- Anderson, P., & Patel, S. (2020). Emergency department efficiency: The impact of design on performance. *Journal of Healthcare Design*, 12(3), 45–60.
- Andersson, J., Nordgren, L., Cheng, I., Nilsson, U., & Kurland, L. (2020). Long emergency department length of stay: A concept analysis. *International Emergency Nursing*, 53, 100930. <https://doi.org/10.1016/j.ienj.2020.100930>
- Ayenew, T., Gedfew, M., Fetene, M. G., Telayneh, A. T., Adane, F., Amlak, B. T., Workneh, B. S., & Messelu, M. A. (2024). Prolonged length of stay and associated factors among emergency department patients in Ethiopia: Systematic review and meta-analysis. *BMC Emergency Medicine*, 24. <https://doi.org/10.1186/s12873-024-01131-6>
- Badr, S., Nyce, A., Awan, T., Cortes, D., Mowdawalla, C., & Rachoin, J. S. (2022). Measures of Emergency Department Crowding, a Systematic Review: How to Make Sense of a Long List. *Open Access Emergency Medicine*, 14, 5–14. <https://doi.org/10.2147/OAEM.S338079>
- Baker, T. L., Greiner, J. V., Maxwell-Schmidt, E., Lamothe, P. H., & Vesonder, M. (2020). Guidelines for Frontline Health Care Staff Safety for COVID-19. *Journal of Primary Care & Community Health*, 11. <https://doi.org/10.1177/2150132720938046>
- Bhattacharyya, D. S., Neiterman, E., Mac, C., Cheung, K., Dang, E., Jaffer, A., McCready-Branch, B., Gauhar, A., & Butt, Z. A. (2025). Interventions to reduce wait times in emergency departments in Canadian hospitals: A scoping review. *Public Health*, 245, 105778. <https://doi.org/10.1016/j.puhe.2025.105778>
- Burgess, L., Ray-Barruel, G., & Kynoch, K. (2022). Association between emergency department length of stay and patient outcomes: A systematic review. *Research in Nursing & Health*, 45, 59–93. <https://doi.org/10.1002/nur.22201>
- Chaou, C.-H., Chiu, T.-F., Pan, S.-L., Yen, A. M.-F., Chang, S.-H., Tang, P., Lai, C.-C., Wang, R.-F., & Chen, H.-H. (2020). Quantifying Dynamic Flow of Emergency Department (ED) Patient Managements: A Multistate Model Approach. *Emergency Medicine International*, 2020, 1–9. <https://doi.org/10.1155/2020/2059379>
- Dziegielewski, J., Schulte, F. C., Jung, C., Wolff, G., Hannappel, O., Kumpers, P., Bernhard, M., & Michael, M. (2023). Resuscitation room management of patients with non-traumatic critical illness in the emergency department (OBSERvE-DUS-study). *BMC Emergency Medicine*, 23, 1–10. <https://doi.org/10.1186/s12873-023-00812-y>

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso et al

- Habib, H., & Sudaryo, M. K. (2023). Association Between the Emergency Department Length of Stay and In-Hospital Mortality: A Retrospective Cohort Study. *Open Access Emergency Medicine*, 15, 313–323. <https://doi.org/10.2147/OAEM.S415971>
- Heryana, A., Suhartika, E., Handayani, P., & Azteria, V. (2025). Optimizing Emergency Department Length of Stay via Patient Flow Policy. *Indonesian Health Information Management Journal*, 13, 8–19. <https://doi.org/10.47007/inohim.v13i1.666>
- Huang, P. F., Kung, P. T., Chou, W. Y., & Tsai, W. C. (2020). Characteristics and related factors of emergency department visits, readmission, and hospital transfers of inpatients under a DRG-based payment system: A nationwide cohort study. *PLoS ONE*, 15, 1–18. <https://doi.org/10.1371/journal.pone.0243373>
- Kang, J., Peng, R., Feng, J., Wei, J., Li, Z., Huang, F., Yu, F., Su, X., Chen, Y., Qin, X., & Feng, Q. (2023). Health systems efficiency in China and ASEAN, 2015–2020: A DEA-Tobit and SFA analysis application. *BMJ Open*, 13. <https://doi.org/10.1136/bmjopen-2023-075030>
- Kurhayati, K., Emaliyawati, E., & Trisyani, Y. (2025). An Updated Scoping Review of Factors Associated with Length of Stay in Emergency Department. *Journal of Multidisciplinary Healthcare*, 18, 3191–3203. <https://doi.org/10.2147/JMDH.S525451>
- Ma, K. J., Hsu, Y. C., Pan, W. W., Chou, M. H., Chung, W., & Wang, J. Y. (2025). Effects of emergency department length of stay on inpatient utilization and mortality. *Health Economics Review*, 15, 11. <https://doi.org/10.1186/s13561-025-00598-8>
- Mailani, F., Simandalahi, T., & Purnama Sari, A. (2025). Analysis of factors influencing length of stay in the emergency department in public hospital, Padang, Indonesia. *Medical Journal of the Armed Forces India*, 81, 52–57. <https://doi.org/10.1016/j.mjafi.2023.11.009>
- Mehroolhassani, M. H., Behzadi, A., & Asadipour, E. (2025). Key performance indicators in emergency department simulation: A scoping review. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, 33, 1–20. <https://doi.org/10.1186/s13049-024-01318-7>
- Mitchell, R., McKup, J. J., Bue, O., Nou, G., Taumomoa, J., Banks, C., O'Reilly, G., Kandelyo, S., Bornstein, S., Cole, T., Ham, T., Miller, J.-P., Reynolds, T., Körver, S., & Cameron, P. (2020). Implementation of a novel three-tier triage tool in Papua New Guinea: A model for resource-limited emergency departments. *The Lancet Regional Health – Western Pacific*, 5, 100051. <https://doi.org/10.1016/j.lanwpc.2020.100051>
- Motimele, L., Lalloo, V., Sefala, T., Engelbrecht, A., Majake-Mogoba, L., & Basu, D. (2025). Factors contributing to extended length of stay in the emergency department and potential strategies for improving patient flow in a central hospital in the Gauteng Province, South Africa. *African Journal of Emergency Medicine*, 15, 100896. <https://doi.org/10.1016/j.afjem.2025.100896>
- Nhdi, N. Al, Asmari, H. Al, & Thobaity, A. Al. (2021). Investigating indicators of waiting time and length of stay in emergency departments. *Open Access Emergency Medicine*, 13, 311–318. <https://doi.org/10.2147/OAEM.S316366>
- Prucnal, C. K., Meeker, M. A., Copenhaver, M., Jansson, P. S., Cash, R. E., Hillmann, W., Knuesel, S., Macias-Konstantopoulos, W., & Sonis, J. D. (2025). Patterns in Duration of Emergency Department Boarding and Variation by Sociodemographic Factors. *Western Journal of Emergency Medicine*, 26, 1640–1647. <https://doi.org/10.5811/westjem.42477>
- Samadbeik, M., Staib, A., Boyle, J., Khanna, S., Bosley, E., Bodnar, D., Lind, J., Austin, J. A., Tanner, S., Meshkat, Y., de Courten, B., & Sullivan, C. (2024). Patient flow in emergency departments: A comprehensive umbrella review of solutions and challenges across the health system. *BMC Health Services Research*, 24, 1–36. <https://doi.org/10.1186/s12913-024-10725-6>
- Sitepu, F. M. U., Gaol, R. L., & P, I. H. (2024). Length of Stay Pasien Non Bedah Di Instalasi Gawat Darurat Rumah Sakit Santa Elisabeth Medan Tahun 2024. *Jurnal Ilmiah PANNMED*, 19, 323–328. <https://doi.org/10.36911/pannmed.v19i3.2205>
- Sookmee, W., Liabsuetrakul, T., Tantarattanapong, S., & Wuthisuthimethawee, P. (2024). Emergency Department Length of Stay and in-Hospital Mortality of Non-Traumatic Patients in a University Hospital. *Journal of Health Science and Medical Research*, 42, 1–10. <https://doi.org/10.31584/jhsmr.20231018>
- Toukola, T. K., Mertanen, R. K. K., Kaartinen, J. M., Tuunainen, E. A., Castrén, M. K., & Torkki, P. M. (2025). Outcome metrics in recommended performance measurement tools for emergency department performance evaluation: A systematic review. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, 33. <https://doi.org/10.1186/s13049-025-01442-y>
- Völk, S., Koedel, U., Horster, S., Bayer, A., D'Haese, J. G., Pfister, H.-W., & Klein, M. (2022). Patient disposition

ANALYSIS OF FACTORS RELATED TO THE EFFICIENCY OF EMERGENCY DEPARTMENT SERVICES BASED ON EMERGENCY DEPARTMENT LENGTH OF STAY (EDLOS) IN NON-TRAUMA PATIENTS AT ROYAL PRIMA HOSPITAL MEDAN

Venessa Wongso **et al**

- using the Emergency Severity Index: A retrospective observational study at an interdisciplinary emergency department. *BMJ Open*, 12, e057684. <https://doi.org/10.1136/bmjopen-2021-057684>
- Vrijssen, B. E. L. (2022). Shorter Laboratory Turnaround Time Is Associated With Shorter Emergency Department Length of Stay: A Retrospective Cohort Study. *BMC Emergency Medicine*, 22(1), 1–7. <https://doi.org/10.1186/s12873-022-00763-w>
- Wagner, T. H., Hoomans, T., Salloum, R. G., & Levy, D. E. (2025). Efficiency in health care: Connecting economic evaluations with implementation objectives. *Implementation Science Communications*, 6. <https://doi.org/10.1186/s43058-025-00763-4>
- Wang, S. T., Weng, S. J., Yeh, T. Y., Chen, C. H., & Tsai, Y. T. (2025). Optimizing Emergency Department Patient Flow Through Bed Allocation Strategies: A Discrete-Event Simulation Study. *INQUIRY*, 62. <https://doi.org/10.1177/00469580251335799>
- Yogantara, N. T., & Sinulingga, E. B. (2025). Faktor Penyebab Keterlambatan Waktu Tinggal Pasien di Departemen Gawat Darurat: Studi Literature Review. *Prepotif Jurnal Kesehatan Masyarakat*, 9, 3524–3531. <https://doi.org/10.31004/prepotif.v9i2.46082>