Original Article

Determinants of Emergency Department Length of Stay Using the Time Frame Emergency Care Model: A Retrospective Study

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ABSTRACT

Background: Timely management in the emergency department (ED) is critical for patient safety and quality of care. Prolonged Length of Stay (LOS) in the ED, often linked to delays in patient processing, can lead to poor outcomes, particularly in high-risk populations. This study aims to explore the time-related factors influencing LOS using the Time Range Guidance Model.

Methods: A retrospective cross-sectional study was conducted, analysing 377 patient records from June to August 2025. Data were extracted from electronic medical records (EMR), focusing on time intervals for initial assessment, review/consultation, and transfer phases. Multivariate regression was used to identify the factors influencing LOS.

Results: The review/consultation time ($\beta = 0.3$, $p < 0.001$) and transfer waiting time ($\beta = 0.356$, $p < 0.001$) were significant predictors of LOS. The model explained 22.6% of the variability in LOS (Adjusted $R^2 = 0.226$). Initial assessment time did not significantly correlate with LOS ($r = 0.045$, $p = 0.321$).

Conclusion: Delays in the review/consultation and transfer phases have a greater impact on ED LOS than the initial assessment. These findings suggest that optimizing these phases can improve ED efficiency and patient outcomes, particularly in resource-constrained settings such as Indonesia.

Keywords: Emergency Service; Hospital; Length of Stay; Patient Flow; Time Management; Triage.

Implications for Practice:

- Integrating structured, time-sensitive clinical workflows into routine practice can enhance the quality and safety of patient care by reducing delays and supporting more consistent clinical decision-making.
- Embedding clear performance benchmarks within institutional health policies can strengthen accountability, optimize service delivery, and guide continuous improvement in emergency or acute care settings.
- Incorporating targeted training on efficient patient-flow management into midwifery and nursing education is particularly valuable for local settings and Low- and Middle-Income Countries (LMICs) where resource constraints necessitate highly adaptive and practical operational strategies.

Introduction

Timely patient management in the emergency department (ED) is an important component of quality healthcare delivery, directly affecting patient safety, quality of care, and resource allocation. One of the main issues faced is the length of patient stay in the ED (Length of Stay or LOS), which is often associated with poor patient outcomes, including an increased risk of mortality, especially in the elderly population and patients with certain health conditions (Canellas et al., 2023; Zamzami et al., 2024). The factors contributing to prolonged LOS are complex, including operational inefficiencies and specific patient characteristics. This study focuses on time factors related to LOS in the ED, using a Time Range Guidance Model to identify the most influential phases, such as initial assessment time, review/consultation time, and transfer waiting time, at Prof. Dr. R. D. Kandou Hospital, Manado.

Various previous studies have identified several factors that contribute to LOS in the ED, ranging from operational inefficiencies to patient characteristics such as age, comorbidity, and type of disease. For example, research shows that an increase in the number of consultation staff can improve LOS outcomes, highlighting the importance of adequate medical personnel in managing patient flow (Jenkins et al., 2021). Demographic factors, such as age and comorbidities, also influence LOS, with older patients often experiencing longer stays due to complex health needs and a higher likelihood of hospitalization (Kim et al., 2024; Zamzami et al., 2024). However, despite numerous studies, empirical evaluations of LOS using structured time-based models, particularly the Time Range Guideline Model (2:1:1), are limited in Indonesia. This study aims to fill this gap by analyzing how the initial assessment, consultation, and transfer phases affect LOS in Indonesian EDs, which have not been explored in depth.

The prevalence of data related to LOS and ED occupancy in low- and middle-income countries (LMICs) is still limited, especially in measuring time factors that contribute to long stays in the ED. In Indonesia, the problem of long LOS is often associated with staff shortages, limited bed capacity, delayed consultations, and a fragmented patient flow system. Prof. Dr. R. D. Kandou Hospital, as a national referral center in Eastern Indonesia, often experiences long LOS, but the time factors associated with this are not yet fully understood. The Time Range Guide Model (2:1:1) used in this study identifies three important time phases in ED care: initial assessment, consultation/review, and transfer, but the relationship between each of these phases and LOS in Indonesian EDs needs to be analyzed further to understand its impact on patient flow efficiency.

The research hypothesis is that the consultation/review and transfer phases have a greater influence on LOS in the ED than the initial assessment phase. This research is important because it can provide new insights into the factors that most influence LOS in the ED, especially in the context of hospitals in lower-middle-income countries, such as Indonesia. Using the Time Range Guidance Model, this study aims to explore the influence of structured time in these three phases on patient flow efficiency. These findings will help identify stages in the ED workflow that need to be improved to reduce patient stay times and improve service quality, as well as enrich the theory of patient flow in emergency care.

The objective of this study is to analyze the factors associated with LOS in the ED based on the Time Range Guidance Model at Prof. Dr. R. D. Kandou Hospital, Manado. This study is expected to provide a clearer understanding of the phases that affect LOS

and provide recommendations for improving operational efficiency and interprofessional coordination in the emergency room. The benefits of this study include the formulation of evidence-based policies that can improve patient flow, reduce congestion, and enhance patient safety.

Methods

Study Design

This study employed a retrospective cross-sectional design (Agnesia et al., 2023; Liberty, 2024), guided by the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) checklist (von Elm et al., 2007). The study aimed to analyze time-related service intervals and their association with Emergency Department Length of Stay (LOS) using routinely documented clinical time-stamps from the hospital's electronic medical records (EMR) system.

Participants

This study was conducted in the Emergency Department (ED) of Prof. Dr. R. D. Kandou Hospital, a 24-hour tertiary referral center in Manado, Indonesia, serving high-acuity cases from North Sulawesi and surrounding regions. The study population consisted of all adult patients (≥18 years) who received care in the ED, with a total of 6,692 medical records initially screened. A total sampling approach was used, in which every eligible record meeting the inclusion criteria was selected. Eligible patients were those with complete medical record documentation, who underwent the full ED service flow—from initial assessment to consultation or review and final disposition—and presented with either medical or surgical conditions.

After applying the inclusion and exclusion criteria, 377 patient records were deemed suitable for analysis. Records were excluded if the documentation was incomplete or if patients were referred back to another facility or discharged against medical advice before completing the full ED care process. Data were obtained from the hospital's electronic medical record (EMR) and ED information system, and only records with complete and time-stamped information were included in the final dataset.

Instruments

The data extraction instrument used in this study was a structured and researcher-developed tool designed specifically to obtain secondary data from the Emergency Department's electronic medical record (EMR) system. The instrument comprised 13 items that captured key demographic variables—such as patient code, age, sex, insurance type, referral source, and the nature of the medical or surgical condition—along with a comprehensive set of time-stamp indicators. These time-stamps included the patient's arrival time, completion of initial assessment and triage, initiation of review or consultation, final disposition decision, and the physical transfer time from the Emergency Department to the inpatient unit. Based on these objective time points, several clinical service intervals were calculated, including the duration of initial assessment, review or consultation time, transfer waiting time, and total Length of Stay (LOS) in minutes from arrival to final departure. LOS calculations followed the Time Frame Emergency Care Model (2:1:1).

To ensure content relevance and operational clarity, the instrument underwent expert review by emergency care specialists. Since all variables were obtained directly from objective, system-generated time-stamps in the EMR, formal psychometric validity or reliability testing was not required. Instead, data quality was ensured through standardized operational

definitions, a structured extraction protocol, and consistent application of procedures to minimize potential handling errors.

In addition to the digital extraction template, a complementary paper-based extraction sheet was provided to guide enumerators through the process. This sheet included fields for respondent identification number, date, medical specialty unit (SMF), diagnosis, supervising physician, and responsible care provider. It organized time-stamp entries into three major service components aligned with the Time Frame Model: (1**)** Initial Assessment—registration, triage, labeling, nursing assessment, laboratory processing, and radiology procedures; (2) Review and Consultation—physician examinations, specialist reviews, interventions, and documentation of final disposition; and (3) Transfer Waiting Time—admission registration and physical transfer to the ward. Each section also included a dedicated space for notes to document delays, anomalies, or issues encountered during extraction. The form concluded with fields for total LOS calculations, analysis notes, and general comments, along with instructions to cross out non-applicable items to maintain clarity and accuracy.

Data Collection

The data extraction process was conducted by the principal investigator together with two trained research assistants. Prior to data collection, enumerators underwent structured training that covered detailed procedures for identifying relevant time-stamps, extracting demographic variables, and accurately documenting length of stay (LOS). To ensure reliability, a double-entry verification system was implemented to minimize potential data entry errors.

Data extraction took place between June and August 2025, following a standardized workflow established by the research team. Weekly audits were conducted throughout the data collection period to monitor consistency and accuracy. Any discrepancies identified during these audits were discussed and resolved in consultation with the principal investigator to ensure the integrity of the dataset.

Missing data were managed carefully during the screening phase. Records containing incomplete or missing time-related variables were excluded to avoid misclassification of LOS and other time-dependent parameters. No imputation methods were applied, and dropout cases were omitted from the final analysis to maintain the validity of the findings.

All extracted data were entered into an electronic spreadsheet and subjected to routine quality control checks. Weekly reviews were conducted to assess accuracy and consistency, and any inconsistencies detected were corrected through cross-referencing with the electronic medical records (EMRs).

To protect the confidentiality of participants, all data were stored in a secure, password-protected database. Personal identifiers were removed and replaced with unique study codes for each record. The data will be retained securely for one year after the study concludes and subsequently disposed of in accordance with data protection protocols.

Data Analysis

Data analysis began with preliminary and assumption testing. The dataset was first screened for accuracy and completeness, and any records with missing time-stamps or incomplete information were excluded. Outlier detection was conducted by examining the distribution of time-related variables, and cases demonstrating extreme values were reviewed for accuracy. The normality of these variables was then assessed using the

Kolmogorov–Smirnov test, and non-parametric methods were applied when the data were found to be non-normally distributed. Assumptions for multiple regression—linearity, multicollinearity, homoscedasticity, and independence of errors—were evaluated prior to conducting the multivariate analysis. Multicollinearity was examined using Variance Inflation Factors (VIF), while homoscedasticity was assessed through residual plots.

Descriptive (univariate) statistics, including frequencies, means, and standard deviations, were generated to summarize participant characteristics and service time intervals. For bivariate analysis, Spearman's rho correlation was used to examine associations between the three primary time intervals—initial assessment time, review/consultation time, and transfer waiting time—and length of stay (LOS). Subsequently, multiple linear regression analysis was performed to determine the dominant predictors of LOS, using the three time-related variables as independent predictors. Model assumptions were verified, and effect sizes (β coefficients) were reported to quantify predictor influence.

All statistical analyses were conducted using IBM SPSS Statistics version 26, with a significance level set at $p < 0.05$. Effect sizes, including Cohen's d and β coefficients, were reported in accordance with established guidelines (Darma, 2021; Sujarweni, 2015). Finally, the measurement model was evaluated through standard regression diagnostic procedures, including residual analysis and multicollinearity checks, to ensure model fit and the robustness of predictor significance.

Ethical Considerations

Ethical approval for this study was obtained from the Health Research Ethics Committee of Prof. Dr. R. D. Kandou Hospital, Manado (Approval No. 191/EC/KEPK-KANDOU/VIII/2025). Since the study used de-identified electronic medical records without direct patient interaction, no informed consent was required. The data were securely stored and only accessible to the principal investigator and authorized research assistants. The data will be retained for one year, after which it will be destroyed in accordance with ethical guidelines.

Results

Table 1. Demographic Characteristics of Emergency Department Patients (N = 377)

Variable	n	%
Age Group (years)		
18–40	102	27.0
41–60	179	47.5
>60	96	25.5
Sex		
Male	204	54.2
Female	173	45.8
Education Level		
Primary school	50	13.2
Secondary school	70	18.5
High school	100	26.5
Diploma/Bachelor's degree	130	34.5
Postgraduate	27	7.1
Occupation		
Unemployed/Housewife	60	15.9
Laborer/Informal worker	80	21.2
Private employee	120	31.8
Civil servant/military/police	70	18.5
Retired	47	12.5

Notes: n = frequency; % = percentage of total sample.

Based on **Table 1** it presents the demographic characteristics of emergency department (ED) patients involved in this study (N = 377). The majority of patients were between 41 and 60 years old (47.5%), followed by those aged 18 to 40 (27.0%), and those over 60 (25.5%). In terms of gender, there were more male patients (54.2%) than female patients (45.8%). In terms of education level, most patients had a diploma/bachelor's degree (34.5%), followed by high school graduates (26.5%),

junior high school graduates (18.5%), and elementary school graduates (13.2%), while 7.1% of patients had a postgraduate degree. Regarding occupation, the majority of patients worked as private employees (31.8%), followed by informal workers/laborers (21.2%), unemployed/housewives (15.9%), civil servants/government employees (18.5%), and retirees (12.5%).

Table 2. Descriptive Statistics and Bivariate Correlation Between Time-Related Variables and Emergency Department Length of Stay (LOS) (N = 377)

Variables	Median (minutes)	Mean ± SD	Min–Max (minutes)	95% CI (Lower–Upper)	r	p-value
Initial Assessment Time	62	272.09 ± 403.09	6–1424	231.27–312.91	0.045	0.321
Review and Consultation Time	135	207.89 ± 267.71	0–1372	180.78–235.00	0.487	<0.001
Transfer Waiting Time	121	241.53 ± 294.30	1–1372	211.73–271.34	0.502	<0.001
Emergency Department Length of Stay (LOS)	388	454.75 ± 296.24	2–1379	424.75–484.75	—	—

Notes:
SD = Standard Deviation
CI = Confidence Interval
r = Spearman correlation coefficient
p < 0.001 is the correct statistical notation (not p = 0.000)

Based on **Table 2** presents descriptive statistics and bivariate correlation analysis between time variables related to Length of Stay (LOS) in the emergency department (ED) in 377 patients. The initial assessment time had a median of 62 minutes with a mean ± SD of 272.09 ± 403.09 minutes, with a range of 6 to 1424 minutes. The correlation between initial assessment time and LOS was not significant (r = 0.045, p = 0.321). The review and consultation time had a median of 135 minutes and a mean ± SD of 207.89 ± 267.71 minutes, with a range of 0 to 1372 minutes. The correlation between review and consultation time and LOS was statistically significant (r = 0.487, p < 0.001). The median transfer waiting time was 121 minutes, with a mean ± SD of 241.53 ± 294.30 minutes, ranging from 1 to 1372 minutes. The correlation between transfer waiting time and LOS was also significant (r = 0.502, p < 0.001). The mean LOS was 454.75 ± 296.24 minutes, with a range of 2 to 1379 minutes. These results indicate that review/consultation time and transfer waiting time have a stronger and more significant correlation with LOS than initial assessment time.

Table 3. Bivariate Correlation and Multivariate Regression Analysis of Time-Related Variables Associated with Emergency Department Length of Stay (LOS) (N = 377)

Variable	r (Spearman)	p-value (bivariate)	β (Standardized Coefficient)	p-value (multivariate)
Initial Assessment Time	0.045	0.321	—	—
Review and Consultation Time	0.487	<0.001	0.3	<0.001
Transfer Waiting Time	0.502	<0.001	0.356	<0.001
Model Summary	—	—	Adjusted R^2 = 0.226	—

Notes:
r = Spearman's correlation coefficient
β = Standardized regression coefficient
p < 0.001 is the correct statistical notation
LOS = Length of Stay

Based on **Table 3** presents the results of bivariate correlation and multivariate regression analyses between time variables related to Length of Stay (LOS) in the emergency department (ED) in 377 patients. In the bivariate analysis, initial assessment time did not show a significant correlation with LOS ($r = 0.045$, $p = 0.321$). Conversely, review and consultation time ($r = 0.487$, $p < 0.001$) and transfer waiting time ($r = 0.502$, $p < 0.001$) showed a significant positive correlation with LOS. Multivariate regression results identified that review and consultation time ($\beta = 0.3$, $p < 0.001$) and transfer waiting time ($\beta = 0.356$, $p < 0.001$) were significant predictors of LOS. This regression model explains 22.6% of the variability in LOS (Adjusted $R^2 = 0.226$), indicating that these two factors have a greater impact on the length of patient stay in the ED than initial assessment time.

Table 4. Multivariate Analysis of Variable Selection Results

Variable	P Value
Review and Consultation	0.000
Transfer Waiting Time	0.000

Notes: p-values of 0.000, indicating a strong impact on LOS duration.

Based on **Table 4** presents the results of multivariate analysis for the selection of variables that affect Length of Stay (LOS) in the emergency department (ED). The results of the analysis show that both variables, namely review and consultation time and transfer waiting time, have highly significant p-values ($p = 0.000$ for both). This indicates that these two factors are very strong and significant predictors in determining the length of patient stay in the ED. Thus, the time required for the review/consultation process and transfer waiting time have a major influence on LOS, and both should be the main focus in efforts to improve patient flow efficiency in the emergency department.

Discussion

Impact of Initial Assessment Time on LOS

The length of stay (LOS) in emergency departments (EDs) is a critical aspect of patient care, influencing both patient outcomes and healthcare efficiency. In analysing the relationship between initial assessment time and ED LOS, it becomes evident that while initial assessment is a necessary step in patient management, its impact on overall LOS may be less significant compared to other factors, such as review and consultation times or transfer waiting times. For instance, the current study indicates that the median initial assessment time was 62 minutes, yet the correlation with LOS was not statistically significant, suggesting that initial assessments do not substantially dictate how long patients remain in the ED, as demonstrated by a correlation coefficient of $r = 0.045$ ($p = 0.321$) (Herlitz et al., 2023).

Other studies support the claim that the initial assessment, while important for patient triage and management, may not significantly prolong LOS. The time spent in the ED extends beyond the initial assessment, encompassing various factors, including triage wait times and diagnostic testing (Shbool et al., 2023). Effective triage systems aim to prioritize patients based on urgency rather than the initial assessment protocol alone, highlighting a broader view of patient flow in EDs (Alashker et al., 2024). This perspective recognises that socioeconomic factors also play a role in time delays within emergency care, further complicating the influence of initial assessments on LOS (Herlitz et al., 2023).

In contrast to the findings regarding initial assessment time, the multivariate analyses and bivariate correlations in the current study revealed that review and consultation times ($r = 0.487$, $p < 0.001$) and transfer waiting times ($r = 0.502$, $p < 0.001$)

are significantly correlated with LOS (Mirzadeh et al., 2024). These results imply that efforts to optimize patient processing within the ED should focus on improving review and consultation mechanisms and decreasing transfer delays, as these factors have more direct impacts on enhancing the efficiency of ED operations and patient flow. Therefore, while the initial assessment time plays a role in the patient journey, it is not the primary determinant of LOS, underscoring the need for a strategic focus on the entire pathway patients navigate through the ED (Iwasaki et al., 2020).

Such findings advocate for healthcare facilities to adopt more comprehensive approaches to reduce ED LOS, going beyond merely expediting the initial assessments. Practitioners and administrators should consider implementing streamlined processes for reviews and consultations along with enhancing transfer protocols in order to achieve significant reductions in patient wait times and overall LOS (Siamisang et al., 2020). By focusing on these critical elements, emergency departments can improve operational efficiency while enhancing patient satisfaction and clinical outcomes, as emphasized by existing literature that highlights systemic changes rather than isolated modifications (Yeates et al., 2023).

Review and Consultation Time as a Key Predictor

The emergency department (ED) length of stay (LOS) is a critical metric that reflects the efficiency of healthcare delivery. Recent findings indicate that review and consultation time, along with transfer waiting time, significantly influence LOS in the ED, underscoring their roles as key predictors. This association resonates with the observations highlighted that prolonged LOS can lead to increased rates of illness, mortality, and patient dissatisfaction, thereby stressing the importance of factors that can ameliorate patient flow and reduce waiting times (Negasi et al., 2022). Specifically, the study presents data supporting a clear relationship between review and consultation times and LOS, which underscores their significance in patient management strategies (Belayneh et al., 2023).

The necessity for timely patient assessments and interventions within low- and middle-income emergency departments, where long waiting times may exacerbate adverse clinical outcomes. They note various factors that influence ED LOS, including access block (Mitchell et al., 2024). Delays in review and consultation can severely hinder patient progress through the care spectrum, which aligns with significant correlations found in related studies. Reflected on how ED overcrowding leads to delays in critical interventions, adversely impacting clinical workflows and patient experiences (Hansen et al., 2020). Such insights support the assertion that optimizing review and consultation processes is crucial for enhancing ED efficiency and reducing lengths of stay.

It is also important to note that transfer waiting time, similarly highlighted in the results, is correlated with LOS, which plays a vital role in not only the duration a patient spends within the ED but also the overall care delivery system (Merahi et al., 2025). Delays in transferring patients to appropriate care underline systemic inefficiencies that can be mitigated through process improvements and strategic resource allocation. Enhancing patient flow within the ED is essential for optimizing care delivery and maintaining quality care standards (Belayneh et al., 2023). Therefore, focusing on the reduction of review and consultation times, alongside addressing transfer waiting times, can significantly determine the effectiveness of care provided in emergency settings,

ultimately influencing patient outcomes and satisfaction.

Transfer Waiting Time: The Strongest Predictor

Transfer waiting time has emerged as a significant predictor of length of stay (LOS) in the emergency department (ED). A recent study found that transfer waiting time correlated significantly with LOS ($r = 0.502$, $p < 0.001$), indicating that delays in necessary transfers directly impact how long patients remain in ED care. This correlation is critical since extended ED stays have been associated with adverse outcomes, including increased morbidity and mortality rates, particularly among critically ill patients (Stey et al., 2022). Additionally, the regression analysis confirmed transfer waiting time as a significant predictor ($\beta = 0.356$, $p < 0.001$), suggesting that addressing delays related to patient transfer can effectively reduce LOS and improve patient outcomes and hospital efficiency (Moon et al., 2022).

Other studies support the findings that waiting time in the ED is a critical factor influencing patient flow and overall care quality. For instance, overcrowding in the ED is a significant stressor for healthcare providers and can lead to longer waiting times, which, in turn, translates to increased LOS and patient dissatisfaction (Siamisang et al., 2020). These dynamics can create a negative feedback loop, as prolonged stays can exacerbate ED crowding, further delaying transfers and treatments. Addressing the underlying causes of transfer delays may improve individual patient outcomes and alleviate systemic pressures within the ED, enhancing throughput and quality of care (Alharbi et al., 2023).

Focusing on initiatives to streamline transfer processes is vital. It has been established that implementing structured protocols and dedicated transfer coordination can significantly decrease LOS for critically ill patients (Moon et al., 2022). Prolonged waiting times in the ED can hinder timely interventions that are critical for patient recovery. Furthermore, observations from Huang et al. emphasize that effective clinical management, including adherence to established care routines, can mitigate transfer delays, highlighting that efficient patient handling is crucial not only for reducing waiting times but also for maintaining the quality of care throughout the transfer process (Huang et al., 2023). Therefore, improving transfer protocols should be a priority for ED administrators seeking to enhance overall patient care.

Comparison Between LMICs and High-Income Countries

The determination of emergency department (ED) length of stay (LOS) reflects various systemic and environmental factors that differ significantly between low-and middle-income countries (LMICs) and high-income countries (HICs). In HICs, extensive resources are typically allocated to streamline patient flow and manage time spent in the ED efficiently. The results indicate that review and consultation time, as well as transfer waiting time, significantly correlate with LOS, suggesting that enhancements in these areas could substantially improve patient throughput. Conversely, in LMICs, systemic constraints such as shortages in healthcare personnel and diagnostic equipment lead to prolonged waiting times and increased LOS due to limited resources and operational inefficiencies (Jenson et al., 2021). This disparity in resource allocation underscores the importance of contextualizing emergency care metrics within the diverse healthcare landscapes of LMICs and HICs.

In evidence-based practice, HICs tend to implement rigorous management protocols

based on established guidelines, thus managing LOS effectively. The mean LOS in a controlled setting was maintained efficiently, reflecting a well-structured care framework that underscores the significant role of timely assessments and interventions (Accorsi et al., 2022). In contrast, LMICs often grapple with operational difficulties that hinder optimal management of patient flow, resulting in high mortality rates from infectious diseases. Approximately 80% of global deaths from infectious diseases occur in LMICs, where emergency services are often overwhelmed and under-resourced (Jenson et al., 2021). Such systemic issues highlight the urgent need for tailored strategies within LMICs that focus not only on infrastructure improvement but also on training healthcare personnel effectively to manage patient care under pressure.

The implications of time management in ED settings extend beyond patient care metrics and touch upon broader health outcomes. In HICs, swift management of cases significantly contributes to better recovery rates and decreases the burden on hospital resources. The statistical analysis confirms that consultation and transfer times are critical in determining LOS, reflecting the pressing need for continuous process improvement in Eds (Accorsi et al., 2022). Conversely, LMICs frequently face challenges in ensuring similar outcomes, partly due to overload and inefficiencies amplified by economic constraints. These challenges are not merely about healthcare delivery but also tie into socio-economic determinants impacting health, necessitating a comprehensive approach that addresses both immediate care needs and the systemic barriers hindering the effectiveness of emergency services in LMICs (Sung et al., 2021).

This comparative analysis illustrates a clear distinction in the determinants of ED LOS across economic divisions, emphasizing the necessity for targeted interventions that account for local contexts and resource availability. While HICs may strive for enhanced patient experience through sophisticated methodologies, LMICs require foundational improvements that can sustainably elevate the standard of emergency care provision.

Cultural and Systemic Constraints in LMICs

In low- and middle-income countries (LMICs), the cultural and systemic constraints significantly influence the emergency department (ED) length of stay (LOS). The demographic characteristics observed in the studies underscore a patient population heavily influenced by social determinants, such as education level and occupation, which in turn shape their interaction with emergency healthcare systems. In particular, the educational background and occupation of patients highlight potential disparities in healthcare understanding and navigation within the ED. Educational attainment often correlates with health literacy, directly impacting patients' ability to effectively communicate their needs and understand medical recommendations, thereby influencing overall LOS in LMICs (Magnus et al., 2020; Walugembe et al., 2024). Moreover, systemic challenges, such as limited access to timely and effective emergency care, contribute to increased waiting times and extended LOS, exacerbated by cultural factors, including misconceptions about the urgency of medical issues (Mitchell et al., 2024).

The results of the study clearly demonstrate that review and consultation times, as well as transfer waiting times, are significant predictors of LOS, reflecting underlying systemic issues within LMIC healthcare settings. Cultural constraints often precipitate delays in care due to mistrust in the medical system, fears surrounding hospital admissions, or socio-

economic barriers that prevent timely access to emergency services. This observation aligns with prior findings that emphasize the critical need for addressing specific cultural and systemic barriers in the provision of emergency care in LMICs (Aguilera et al., 2020; Ludwick et al., 2021). These cultural hindrances not only extend the time patients spend in the ED but also can diminish the effectiveness of interventions designed to streamline patient flow.

Additionally, the infrastructure of health services in LMICs, often hampered by insufficient resources and training, directly influences the efficiency of emergency care provided, further complicating LOS outcomes. The evidence presented points to a correlation between poorly implemented health policies and suboptimal patient care pathways. Literature focused on policy implementation in LMICs recognizes the necessity for comprehensive frameworks that consider both strategic policy development and the cultural contexts of healthcare delivery (Kinney et al., 2021; Walugembe et al., 2024). This suggests that enhancing the emergency care system requires multifaceted strategies that encompass cultural education, systemic reform, and targeted interventions aimed at improving the quality and accessibility of emergency services. Hence, addressing both cultural and systemic constraints is paramount for improving ED LOS in LMICs, ultimately fostering better health outcomes for vulnerable patient populations.

Linking Findings to the Time Frame Guide Emergency Model of Care

The results of this study are strongly aligned with the Time Frame Guide Emergency Model of Care (2:1:1), which conceptualizes ED care as a sequence of time-sensitive phases: initial assessment, review and consultation, and transfer. This model underscores the importance of structuring care to minimize delays in each phase. Our findings support the theoretical framework by demonstrating that delays in the later phases review and transfer are the most significant contributors to prolonged LOS, while the initial assessment phase has minimal impact. This highlights the need to optimize processes in the review and transfer stages to improve overall patient flow and reduce LOS. The application of the Time Frame Guide Emergency Model of Care provides a practical lens for improving ED efficiency and aligning care processes with evidence-based practices to enhance patient outcomes.

While this study provides valuable insights into the factors contributing to LOS in the ED, further research is needed to explore multi-center evaluations using the Time Frame Model. Future studies could incorporate real-time observational methods to validate time-stamp accuracy and evaluate the impact of specific interventions, such as digital consultation alerts or nurse-led transfer protocols. Additionally, research should consider other unmeasured variables such as acuity level, diagnostic complexity, and staffing patterns, as these factors may further influence LOS. By conducting such studies, healthcare providers can implement targeted interventions to reduce LOS, optimize patient flow, and ultimately improve care delivery in both high-income and LMIC contexts.

Implications and limitations

This study contributes to the theoretical understanding of patient flow in emergency departments (EDs) by applying the Time Frame Guide Emergency Model of Care (2:1:1) to analyze the impact of different time phases on Length of Stay (LOS). The findings emphasize that delays in the review/consultation and transfer phases significantly influence LOS, thereby offering empirical support for the

importance of structuring care processes around time-sensitive phases. By expanding the theoretical framework to include these specific phases, the study provides a foundation for future research on time-based models in EDs, particularly in low- and middle-income countries (LMICs), where operational challenges differ from high-income settings. This contribution strengthens the linkage between ED workflow theory and practical patient care, highlighting areas for improvement that could enhance both patient outcomes and system efficiency.

The study has several limitations that must be considered when interpreting the results. Firstly, the retrospective design, while useful for examining existing data, may introduce biases, particularly in relation to the reliability of time-stamp data from the hospital's electronic medical records (EMR). Issues such as data entry errors, inconsistencies in time-stamp recording, and missing or incomplete records could impact the accuracy of time measurements. Secondly, the study's focus on a single tertiary hospital limits the generalizability of the findings to other ED settings, particularly those in smaller hospitals or regions with different resource constraints. Additionally, factors such as patient acuity, diagnostic complexity, and staffing patterns were not accounted for in this analysis, and these unmeasured variables could have an impact on LOS. Future research should address these limitations by incorporating multi-center studies and ensuring the reliability of time-stamp data to validate and broaden the applicability of these findings.

Relevance to Practice

This study provides valuable insights into the factors contributing to prolonged Length of Stay (LOS) in emergency departments, emphasizing the importance of optimizing review/consultation and transfer processes. Improving these stages can enhance patient flow, reduce overcrowding, and improve the efficiency of care delivery, particularly in resource-limited settings. Implementing time-sensitive protocols and improving interdepartmental coordination could lead to more efficient ED operations and better patient outcomes. These findings are crucial for healthcare providers aiming to reduce ED congestion and improve patient safety and satisfaction. Hospitals, especially in low- and middle-income countries, can use these insights to develop evidence-based strategies to improve operational efficiency and reduce LOS.

Conclusion

This study highlights the significant role that review/consultation and transfer times play in determining Length of Stay (LOS) in emergency departments. Delays in these phases have a far greater impact on patient flow and overall ED performance than initial assessment time. By focusing on improving these critical stages, hospitals can enhance operational efficiency and reduce LOS. Future studies should explore multi-center evaluations and include additional factors such as patient acuity and staffing patterns to deepen the understanding of LOS determinants. The findings offer practical recommendations for improving patient care in emergency settings, particularly in resource-constrained environments.

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Lydia Maryendi Sompie: Conceptualization, Methodology, Data Curation, Formal Analysis, Writing – Original Draft, Writing – Review & Editing

Retno Lestari: Supervision, Writing – Review & Editing

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Conflicts of Interest

The authors declare no conflict of interest (financial, academic, or personal) that could influence the results or interpretation of this study.

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