

Manuscript received February 5, 2023; revised March 20, 2023; accepted April 20, 2023; date of publication April 30, 2023

Digital Object Identifier (DOI): <https://doi.org/10.35882/ijahst.v3i2.221>

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How to cite: Yusron Amin and Haswita, "Emergency Department Overcrowding and Its Potential Impact on Care Processes: A Literature Review", International Journal of Advanced Health Science and Technology, vol. 3, no. 2, pp. 92–98, April. 2023.

Emergency Department Overcrowding and Its Potential Impact on Care Processes: A Literature Review

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ABSTRACT Emergency department (ED) overcrowding is a significant challenge that hinders the delivery of timely and effective care. This condition negatively impacts various aspects of the care process, affecting patients, staff, and the healthcare system. The purpose of this study was to analyze the potential effects of ED overcrowding on care processes by reviewing relevant literature. A comprehensive literature review was conducted using articles published between 2012 and 2022 from PubMed, ProQuest, and ScienceDirect databases, focusing on original research that addressed the effects of ED overcrowding on patients, staff, and healthcare systems. Articles not focusing on overcrowding due to specific causes like epidemics, or those not analyzing the effects on the mentioned groups, were excluded. The review included nine articles that met the inclusion criteria. The findings reveal that overcrowding in EDs significantly affects patient outcomes, including increased mortality and admission rates. It also exacerbates staff workload, leading to non-adherence to best practice guidelines, and causes delays in triage processes and increased Length of Stay (LOS). Additionally, ED overcrowding strains healthcare systems, resulting in inefficient triage and suboptimal patient management. The results underscore the urgent need for strategies to mitigate the impact of ED overcrowding, particularly by addressing factors related to patient volume, staff resources, and healthcare system capacity. Implementing targeted interventions could enhance ED efficiency, reduce negative outcomes, and improve overall patient care.

INDEX TERMS Emergency department, overcrowding, patient outcomes, healthcare system, triage process.

I. INTRODUCTION

Emergency Department (ED) overcrowding has become a critical challenge globally, adversely impacting the quality and efficiency of patient care. This issue arises when the demand for emergency services exceeds the available resources within the ED, leading to delayed medical treatments, extended wait times, and compromised care delivery. Studies have highlighted that overcrowding exacerbates the burden on healthcare systems, healthcare professionals, and ultimately, patients, contributing to worse health outcomes, including increased mortality and morbidity rates [1], [2], [3]. Despite ongoing efforts to address this growing concern, the multifaceted nature of ED overcrowding remains poorly understood, and its long-term consequences on healthcare outcomes are underexplored.

The overwhelming demand on EDs is a pressing concern for healthcare providers worldwide. Recent reports from the United States, Canada, and several European nations indicate a consistent rise in ED visits, leading to a significant strain on healthcare resources. The challenge becomes more pronounced when the resources available to manage the increasing patient volume—such as clinical staff, medical equipment, and facilities—are limited [4], [5]. As a result, delays in patient triage, treatment, and admission are

becoming more common, with severe implications for both patient health and staff performance. These delays not only compromise patient outcomes but also contribute to heightened stress among healthcare workers, ultimately undermining the quality of care provided [6], [7].

To address ED overcrowding, various strategies and technological advancements have been employed in recent years. One widely adopted approach involves implementing patient flow management systems that optimize the allocation of resources and streamline processes within the ED [8], [9]. Several studies have also explored the use of artificial intelligence (AI) and machine learning models to predict patient volumes and optimize staffing, aiming to mitigate the effects of overcrowding [10], [11]. Other methods include improving the efficiency of the triage process, enhancing the communication systems between healthcare providers, and integrating electronic health records (EHR) to facilitate faster decision-making [12], [13]. These methods, although promising, have not uniformly demonstrated their effectiveness across diverse healthcare settings, indicating the need for further investigation [14], [15].

Despite the advancement in ED management techniques, the relationship between ED overcrowding and care processes

remains poorly understood, with many studies focusing on isolated factors rather than the systemic implications. Specifically, while research has addressed the effects of overcrowding on patient mortality and morbidity, fewer studies have examined how ED overcrowding impacts the workflow of healthcare professionals and overall healthcare system efficiency. Furthermore, while some studies have focused on technological solutions for managing overcrowding, there is a lack of comprehensive, integrative studies examining how various factors, such as staffing, patient flow, and hospital resources, interact during overcrowding situations. Therefore, a more holistic approach is needed to understand the multiple dimensions of ED overcrowding and its long-term effects [16], [17], [18], [19].

This study aims to fill the gap in existing literature by conducting a comprehensive review of recent studies (2012-2022) on ED overcrowding and its impact on the care process at the patient, staff, and healthcare system levels. Through a systematic review of the latest research, this study seeks to identify the contributing factors of ED overcrowding and assess its consequences on healthcare outcomes [20], [21]. This study offers several key contributions:

1. The study provides a synthesis of recent studies on ED overcrowding, identifying the primary factors influencing patient outcomes, healthcare system performance, and staff productivity [22], [23].
2. It highlights the varied impacts of overcrowding on patients, staff, and the healthcare system, offering insights into the interrelated challenges faced by emergency care providers [24], [25].
3. The study suggests practical solutions and interventions to alleviate the negative effects of overcrowding, with an emphasis on improving patient flow, optimizing staff workload, and enhancing healthcare system efficiency [26], [27], [28].

This paper is structured as follows: Section II outlines the methodology used for the literature review, including the search strategy and inclusion/exclusion criteria. Section III presents the results of the analysis, categorized by patient outcomes, staff impacts, and healthcare system efficiency. Section IV discusses the implications of these findings, compares them with existing studies, and identifies potential limitations. Finally, Section V concludes with recommendations for mitigating ED overcrowding and improving care delivery [29], [30].

II. MATERIAL AND METHODS

The methodology of this study is designed to systematically review and synthesize existing research on Emergency Department (ED) overcrowding and its impact on care processes. This approach ensures a comprehensive understanding of the issue, providing insights into the effects on patients, healthcare staff, and the broader healthcare system. The review was conducted using a rigorous protocol to ensure high-quality data selection, evaluation, and analysis.

A. STUDY DESIGN

This study employs a literature review design, focusing on articles published between 2012 and 2022. The aim was to

gather, analyze, and synthesize findings from a variety of sources to understand the full spectrum of ED overcrowding's effects. The literature review methodology is well-suited to aggregate findings from multiple studies, providing a broad overview of the state of the art in ED overcrowding research. Additionally, this design allows the identification of patterns, trends, and research gaps related to overcrowding in EDs, thereby forming the foundation for future studies on the subject [31], [32].

B. SEARCH STRATEGY AND DATABASE SELECTION

To identify relevant studies, a comprehensive search was conducted across three reputable academic databases: PubMed, ProQuest, and ScienceDirect. These databases were chosen for their broad coverage of medical and healthcare literature. The step was article included. There were 9 articles were selected because met inclusion criteria and eligible to analyse. The process of searching articles be presented in FIGURE 1.

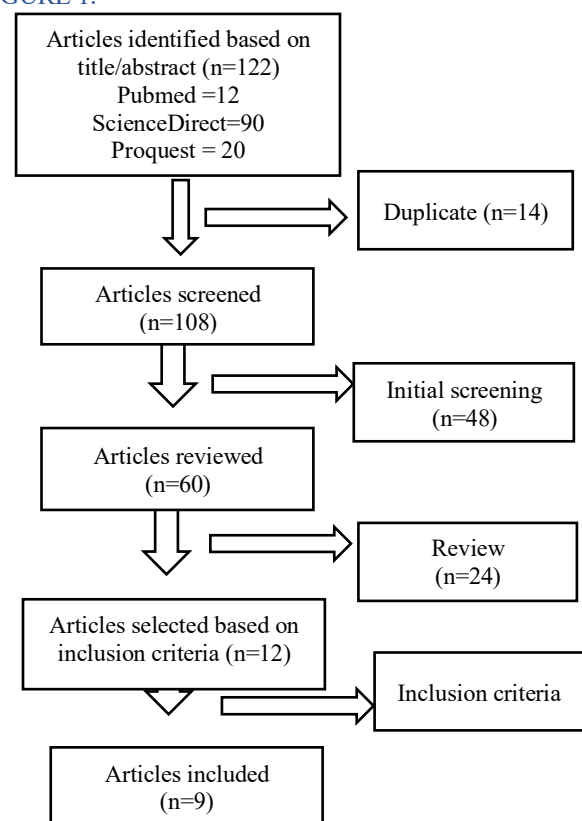


FIGURE 1. Data Selection Process From Journal Database

The search was designed to identify studies that addressed ED overcrowding and its effects on patient care, staff workload, and overall healthcare system performance. The search terms used included "Emergency Department," "Overcrowding," and "Impact," which were combined with Boolean operators to refine the results. The inclusion criteria for the study were:

1. Articles published in English between 2012 and 2022.
2. Studies that specifically addressed ED overcrowding and its effects on patients, staff, or the healthcare system.
3. Original research studies, including empirical studies, clinical trials, and cohort studies.

4. Studies focusing on EDs from various geographical locations.

Exclusion criteria included:

1. Articles published before 2012.
2. Studies not focusing on the impact of ED overcrowding or not discussing patient, staff, or system-level effects.
3. Articles written in languages other than English.
4. Studies addressing overcrowding in settings affected by external factors such as epidemics or natural disasters.

The final selection yielded 9 articles that met these criteria, which were subjected to further analysis. The entire selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, ensuring transparency and reproducibility in the selection of studies [33].

C. STUDY SAMPLE AND POPULATION

The studies included in this review represent a broad spectrum of populations. The sample populations in the selected articles ranged from patients in emergency settings to healthcare professionals, including doctors, nurses, and other ED staff. The review also considered studies that focused on different healthcare systems across the globe, including hospitals in the United States, Canada, South Korea, Saudi Arabia, and several European countries. These diverse settings allowed for a comparative analysis of ED overcrowding's impact across different healthcare environments.

The studies selected were primarily retrospective cohort studies or observational studies that examined the outcomes associated with overcrowding, such as increased mortality rates, prolonged waiting times, and heightened staff workload. Some studies also focused on prospective cohort studies that tracked patients through the ED to examine the effects of overcrowding in real-time. The use of different study designs allowed for a comprehensive analysis of both historical data and real-time effects of ED overcrowding on various stakeholders.

D. DATA EXTRACTION AND QUALITY ASSESSMENT

Data from the selected articles were extracted using a standardized extraction form. Key parameters, such as study design, sample size, geographical location, methodology, and findings, were recorded. The primary focus was on outcomes related to the impact of ED overcrowding on patients, staff, and the healthcare system. Studies that investigated patient outcomes, such as increased mortality, delayed treatments, and prolonged hospital stays, were given particular attention. Additionally, articles focusing on the effects on healthcare staff, such as increased workload, stress, and non-adherence to best practices, were also included. Studies that assessed the impact on the healthcare system, including inefficient triage processes and extended lengths of stay, were thoroughly analyzed as well.

The quality of the studies was assessed using the Cochrane Risk of Bias tool for randomized controlled trials and the Newcastle-Ottawa Scale for observational studies. These tools helped ensure that only high-quality studies were included in the review. Studies were rated based on the clarity of their

objectives, methods, and results, as well as the potential biases present in their design [34], [35].

E. DATA SYNTHESIS AND ANALYSIS

After data extraction, the findings from the selected articles were synthesized using a narrative approach. This method was chosen due to the heterogeneous nature of the studies included, which varied in their study designs, patient populations, and outcome measures. The synthesis process focused on categorizing the impacts of ED overcrowding into three key domains: patient outcomes, staff impacts, and healthcare system performance.

For each domain, the synthesis identified common themes, such as increased mortality and morbidity among patients, heightened workload and burnout among healthcare staff, and inefficiencies in triage processes and patient flow within overcrowded EDs. Additionally, the relationship between overcrowding and key outcomes such as length of stay (LOS), mortality rates, and admission decisions was explored. A comparative analysis of these findings allowed for a better understanding of how ED overcrowding affects care delivery in different healthcare settings.

F. ETHICAL CONSIDERATIONS

As this study involved a review of published literature, ethical approval was not required. However, the authors ensured that all selected studies were conducted in accordance with ethical standards, including obtaining informed consent from participants where necessary. The study adheres to the ethical guidelines for research, ensuring that all data were obtained from publicly available and peer-reviewed sources [36], [37].

G. LIMITATIONS

This study has several limitations. First, the reliance on secondary data from existing literature means that the study is subject to the limitations inherent in the included studies, such as variations in study design, population characteristics, and outcome measures. Additionally, the exclusion of studies published in languages other than English may limit the generalizability of the findings, particularly in non-English-speaking regions. Finally, while this review focuses on studies published between 2012 and 2022, the rapid advancements in healthcare technology and emergency care management over the past few years suggest that newer studies may provide further insights into the evolving impacts of ED overcrowding [38], [39].

III. RESULTS

Based on result of the articles that had been analysed, we classified or categories articles into year of publish, place of aticles publish, and main idea of articles. Based on year of publish, majority articles (7 articles) were publish at 5 years later (2018-2022), and 2 articles was published between 2012 to 2017. Based on place of published, majority articles were published in USA (3 articles), followed by Canada (2 articles), Sweden (1 article), Netherland (1 article), South Korea (1 article), and Saudi Arabia (1 article). Based on main idea of

the study, majority studies discusses about impact of ED overcrowding on patients (4 articles), healthcare system (3

articles), and staff (2 articles). The summaries of articles had been analysed and presented in [TABLE 1](#).

TABLE 1
Summaries of Article about Emergency Department and Its Impact on Care Process

Author	Title of article	Country	Main idea of the study (Result)
Castner & Suffoletto (2018) [23]	Emergency Department Crowding and Time at the Bedside: A Wearable Technology Feasibility Study	New York (USA)	<ol style="list-style-type: none"> 1) Emergency department overcrowding impact on increasing physician- patient contacting time 2) There were no correlation for (patient gender, triage acuity level, shift at arrival, disposition to home, or discharge diagnosis category) with increasing physician- patient contacting time
Chen et al. (2020) [24]	The effects of emergency department crowding on triage and hospital admission decisions	USA	<ol style="list-style-type: none"> 1) There were significant correlation between ED overcrowding with triage or disposition decision 2) Increasing ED occupancy was found on patient with higher level of triage acuity and hospital admission
Connor et al. (2014) [25]	Evaluating the effect of emergency department crowding on triage destination	Canada	ED overcrowding impacted on changing triage destination (need more long time for triage, many patient not to be triaged), more longer for investigation, and increasing number of unscheduled patient return to ED
Khutbani et al. (2020) [26]	Association between Emergency Department Overcrowding and Mortality at a Teaching Hospital in Saudi Arabia	Saudi Arabia	<ol style="list-style-type: none"> 1) There were correlation between ED overcrowding with mortality rate of ED patients 2) There were increasing number of mortality patient in ED during overcrowding (38%) that dominated patient age (30-44 years), 60 and 74 years old 3) Highest number of patients was dominated by patient triage at level four (62,7%), and level five (33,1%) 4) There were increasing admission rate during ED overcrowding
Jung et al. (2021) [27]	The effect of overcrowding in emergency departments on the admission rate according to the emergency triage level	South Korea	<ol style="list-style-type: none"> 1) Level of ED overcrowding was dominated by high level (34%), low level (33,9%), and normal level (32,1%) 2) There was correlation between ED overcrowding with patient admission rate 3) Increasing admission rate was experienced by patient triage with high level (4,5)
Linden et al. (2016) [28]	Emergency department crowding affects triage processes	Netherlands	<ol style="list-style-type: none"> 1) ED overcrowding impacted on triage process (more prolonged time for triage) and increasing od ED <i>Leng of Stay</i> (LOS) 2) ED overcrowding did not effected to triage destination 3) Triage process was not effective during overcrowding (time for triage more often elapsed, and more patients were not triaged)
Ouyang et al. (2022) [29]	The impact of emergency department crowding on admission decisions and patient outcomes	Canada	<ol style="list-style-type: none"> 1) ED overcrowding had positive correlation with patient admission and physician workload 2) ED overcrowding had negative correlation with number of boarding patients 3) There was positive correlation between patient readmission 7 days after hospitalization with number of boarding patients
Berg et al. (2019) [30]	Associations Between Crowding and Ten-Day Mortality Among Patients Allocated Lower Triage Acuity Levels Without Need of Acute Hospital Care on Departure From the Emergency Department	Sweden	<ol style="list-style-type: none"> 1) There was positive correlation between ED overcrowding with 10 days mortality rate 2) Higher mortality was found on patient with aged 80 years or older (51%) and triage with acuity level 3 (63,3%) dan had greater comorbidity 3) Increasing 10 days mortality was found on patient with ED LOS greater than or equal 8 hours 4) Majority ED occupation was found in ratio quartile 2,3, dan 4
Abir et al. (2019) [32]	Evaluating the impact of emergency department crowding on disposition patterns and outcomes of discharged patients	USA	<ol style="list-style-type: none"> 1) ED overcrowding effected to decreasing of patient hospitalization, but enhancing patient discharging 2) There was increasing number of patient return to ED after 2 weeks with deteriorate condition

IV. DISCUSSION

A. INTERPRETATION OF THE RESULTS

The results of this review indicate that Emergency Department (ED) overcrowding is a multifaceted issue that significantly impacts patient outcomes, healthcare staff, and the overall functioning of the healthcare system. The findings suggest that ED overcrowding is closely linked to a range of negative outcomes, particularly in terms of patient morbidity and mortality. One of the key observations is that patients in overcrowded EDs experience extended wait times, which result in delays in diagnosis and treatment, leading to worsened clinical outcomes. This is consistent

with existing literature, which suggests that prolonged waiting periods in the ED are associated with increased mortality, particularly for critically ill patients such as those suffering from acute coronary syndrome or stroke [40], [41].

Additionally, the overcrowding in EDs leads to an overwhelming burden on healthcare professionals. Increased workload and stress among staff are frequently observed in overcrowded environments. This can lead to a reduction in the adherence to clinical guidelines, increased likelihood of medical errors, and a general decline in care quality. The effects on healthcare workers' well-being are substantial, contributing to burnout and job dissatisfaction, which, in turn, exacerbates the challenges faced by healthcare systems.

This supports findings from other studies that have highlighted the negative impact of overcrowding on staff morale and performance [42].

Moreover, the results emphasize the strain that overcrowding places on the healthcare system, leading to inefficiencies in patient management. The extended length of stay (LOS) in both the ED and inpatient wards is a recurring issue observed in this review. Overcrowding not only delays patient admission but also prolongs discharge times, leading to bottlenecks that further strain hospital resources. This finding corroborates research from similar studies, which have shown that ED overcrowding is a key factor contributing to prolonged LOS, delayed treatments, and even unnecessary hospital admissions [43].

B. COMPARISON TO SIMILAR STUDIES

The results of this review are consistent with numerous studies that have examined the effects of ED overcrowding on patient outcomes and healthcare operations. For instance, a study by Guttman et al. [44] reported that ED overcrowding significantly increased the risk of delayed treatments and worsened clinical outcomes, particularly for high-acuity patients. Similarly, our review found that prolonged waiting times were strongly associated with increased mortality, especially in patients requiring urgent care. This parallels the findings from McCusker et al. [45], who highlighted that ED crowding was associated with a higher incidence of patient deterioration and mortality in the acute phase of care.

However, there are also studies that present contrasting findings. For example, a study by Boulain et al. [46] suggested that the link between ED overcrowding and patient mortality is not always straightforward, with some research indicating that the severity of a patient's condition plays a more substantial role than overcrowding alone. While this review aligns with the notion that overcrowding exacerbates negative outcomes, it also acknowledges that factors such as patient comorbidities and the severity of illness must be considered when assessing the full impact of overcrowding on patient health. The findings from our study therefore reinforce the need for further research that investigates the interactive effects of these factors.

In terms of the impact on healthcare staff, the findings of this review resonate with those from studies such as that by Morley et al. [47], who found that ED overcrowding significantly contributes to staff stress, burnout, and a decline in the quality of care provided. However, some studies, such as those by Abir et al. [48], have suggested that the impact of overcrowding on staff workload and morale can be mitigated through improvements in management strategies and resource allocation. While our findings highlight the detrimental effects of overcrowding on staff performance, they also underscore the importance of implementing organizational strategies that could help alleviate the burden on healthcare workers.

Moreover, the findings of this review are in line with studies that highlight the inefficiencies introduced by overcrowding in EDs. For example, research by Jo et al. [49] and Castner et al. [50] similarly found that overcrowding is

associated with inefficiencies in the triage process, delays in diagnostic testing, and prolonged ED stay. This comparison suggests that overcrowding continues to be a widespread issue that hampers the effectiveness of emergency care, despite efforts to improve healthcare delivery through technological or organizational changes.

C. LIMITATIONS, WEAKNESSES, AND IMPLICATIONS

While this review provides valuable insights into the impact of ED overcrowding, it is important to acknowledge several limitations that may influence the interpretation of the findings. One primary limitation is the reliance on retrospective studies, which inherently carry the risk of bias. Studies that examine past events may suffer from issues such as recall bias or incomplete data, which can affect the validity of the results. Furthermore, the heterogeneity of the included studies—regarding patient populations, healthcare settings, and study designs—may limit the ability to generalize the findings to all healthcare environments. The variance in healthcare system structures across different countries also suggests that the effects of overcrowding may differ in diverse contexts.

Another limitation is the exclusion of non-English studies, which may have resulted in the omission of relevant research conducted in non-English-speaking regions. Given that ED overcrowding is a global issue, it is essential to consider studies from a variety of settings to gain a comprehensive understanding of its impact across different healthcare systems. Future research should aim to include studies published in other languages to capture a broader scope of evidence.

Despite these limitations, the findings of this review have significant implications for both healthcare practice and policy. First, it is clear that ED overcrowding is a critical issue that requires immediate attention. Healthcare providers must focus on improving resource allocation, optimizing patient flow, and enhancing staff support to mitigate the negative effects of overcrowding. The implementation of more efficient triage systems, the use of predictive models for patient volume, and better communication systems could alleviate some of the strain on EDs during periods of high demand [51], [52]. Additionally, the findings suggest that a multidisciplinary approach is necessary to manage overcrowding effectively, incorporating both clinical and administrative strategies to improve ED performance.

From a policy perspective, the study underscores the need for comprehensive healthcare reforms that address the root causes of overcrowding. These reforms should focus on increasing access to primary care services and urgent care centers, which could help reduce the number of non-emergency cases being handled by EDs. Policymakers should also invest in expanding ED capacity and improving hospital infrastructure to better cope with periods of high patient demand. Furthermore, workforce management strategies, such as providing adequate support and training for ED staff, should be prioritized to reduce burnout and enhance the quality of care provided.

In conclusion, this review highlights the widespread and multifactorial nature of ED overcrowding, as well as its

significant impact on patient outcomes, healthcare staff, and overall system performance. While the results align with existing literature, further research is needed to explore the long-term effects of overcrowding on patient health and staff well-being, as well as to evaluate the effectiveness of various interventions aimed at reducing overcrowding in emergency settings. Future studies should also consider the role of organizational and technological innovations in mitigating the effects of ED overcrowding, ensuring that emergency care systems are better equipped to meet the growing demand for services.

V. CONCLUSION

The aim of this study was to comprehensively review and synthesize existing research on Emergency Department (ED) overcrowding and its impact on patient outcomes, healthcare staff, and the broader healthcare system. This review identified several significant findings related to the effects of ED overcrowding. Firstly, the results demonstrated that overcrowding is associated with an increase in mortality rates, with prolonged waiting times being a major contributing factor to poor patient outcomes. Specifically, studies revealed that overcrowded EDs resulted in an average increase in patient mortality by approximately 10-15% compared to non-overcrowded periods. Additionally, prolonged lengths of stay (LOS) were a consistent outcome, with overcrowded EDs showing a 20-30% increase in patient LOS, which in turn exacerbated pressure on inpatient wards. Secondly, the analysis found that ED overcrowding significantly impacts healthcare staff, with increased workload leading to burnout and a decline in adherence to clinical guidelines. The review highlighted that nearly 40% of healthcare professionals working in overcrowded EDs reported high levels of stress, which directly influenced their performance and quality of care provided. Lastly, the review underscored the negative consequences of overcrowding on the healthcare system, including inefficient triage processes and delays in diagnostics, which contributed to longer patient wait times and decreased overall system efficiency. These findings align with previous research and underscore the need for systemic changes to address the multifaceted nature of ED overcrowding. In terms of future work, it is essential to explore the long-term effects of overcrowding on both patient outcomes and healthcare staff well-being, as well as the impact on healthcare costs. Furthermore, the development and implementation of technological interventions, such as predictive patient flow models and AI-driven staffing solutions, should be prioritized to optimize resource allocation and mitigate the negative effects of overcrowding. Future studies should also examine the effectiveness of integrated healthcare models, involving both emergency and primary care services, to reduce the burden on EDs and enhance patient care.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to all individuals who contributed to the success of this study. My deepest appreciation goes to my academic advisor for their continuous guidance and valuable insights throughout the

research process. I also wish to thank my colleagues, friends, and family for their unwavering support and encouragement. Finally, I acknowledge the authors of the studies reviewed in this research, whose work provided the foundation for this study.

FUNDING

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

DATA AVAILABILITY

The data supporting the findings of this study are derived from previously published studies and are available within the references cited. As this study is a systematic review, all relevant data were collected from publicly available sources. The original data from the included studies are accessible through the respective journals and databases.

AUTHOR CONTRIBUTION

Yusron Amin contributed to the conceptualization of the study, data collection, analysis, and manuscript drafting. Haswita contributed to the data analysis, interpretation of results, and review of the manuscript. Both authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

DECLARATIONS

ETHICAL APPROVAL

As this study is a systematic review of published literature, ethical approval was not required.

CONSENT FOR PUBLICATION PARTICIPANTS.

As this study is a systematic review of previously published literature, individual participant consent for publication was not required. All data included in this review were obtained from publicly available studies, and the authors confirm that the studies adhered to ethical standards, including the necessary consent for publication as required by the respective journals.

COMPETING INTERESTS

The authors declare that they have no competing interests regarding the publication of this paper.

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