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REVIEW / DERLEME

Overcrowding in Emergency Departments: A Scoping Literature Review

Acil Servislerde Aşırı Kalabalıklık: Kapsayıcı Bir Literatür İncelemesi

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ABSTRACT

Emergency department (ED) overcrowding occurs when healthcare demand exceeds available resources, significantly impairing the quality of patient care and the efficiency of the healthcare system. This review comprehensively analyzes the definition, causes, measurement methods, consequences, and proposed solutions of ED overcrowding. ED crowding is marked by prolonged waiting times, disrupted patient flow, interrupted medical service delivery, and risks to patient and staff safety. Patient-related factors include the preference for EDs for non-emergent conditions, complicated health issues in the elderly, low health literacy, and frequent visits by individuals with chronic illnesses. Systemic factors involve access block, staff shortages, inefficiencies in discharge processes, and delays in diagnostic tests and consultations. External factors include inadequate primary care services, socioeconomic disparities, seasonal fluctuations, epidemics, and natural disasters. To evaluate ED crowding, measurement tools such as the National Emergency Department Overcrowding Scale and the Emergency Department Work Index are utilized; however, the lack of standardization and variability across different hospital types remains a point of contention. Overcrowding compromises patient safety, leading to treatment delays, increased medical errors, staff burnout, and escalating healthcare costs. Proposed solutions include short-term measures (fast-track units, early discharge planning, patient redirection), long-term strategies (enhancing primary care, establishment of acute care centers, management of inpatient bed capacity, and planning to reduce the burden of chronic illnesses), and technological approaches (artificial intelligence, simulation models, telemedicine, and patient tracking technologies). Gaps in the literature include issues related to the validity and reliability of measurement tools, limited data on the economic and clinical impacts of interventions, insufficient research in low- and middle-income countries, and inadequate examination of patient behaviors and the psychological effects on healthcare personnel. The effective management of ED crowding requires the coordinated implementation of systemic reforms, innovative technologies, and collaborative efforts across clinical, academic, and policy-making domains. This is a critical step toward enhancing patient safety, improving clinical outcomes, and ensuring the sustainability of the healthcare system.

Keywords: Access block, emergency department, patient flow, overcrowding

ÖZ

Acil servis (AS) kalabalıklığı, sağlık hizmeti talebinin mevcut kaynakları aşmasıyla ortaya çıkan ve hasta bakım kalitesini, sağlık sisteminin verimliliğini olumsuz etkileyen ciddi bir sorundur. Bu derleme, AS kalabalıklığının tanımını, nedenlerini, ölçüm yöntemlerini, sonuçlarını ve çözüm önerilerini ayrıntılı bir şekilde ele almaktadır. AS kalabalıklığı, uzun bekleme süreleri, hasta akışında aksamalar, tıbbi hizmet sunumunda kesintiler ve hasta ile sağlık çalışanlarının güvenliğine yönelik risklerle karakterizedir. Hasta kaynaklı faktörler arasında acil olmayan durumlar için AS'yi tercih etme, yaşlı nüfusun komplike sağlık sorunları, düşük sağlık okuryazarlığı ve kronik hastalıklara sahip bireylerin sık ziyaretleri yer alır. Sistemsel faktörler, yatış bloğu, personel eksikliği, taburculuk süreçlerindeki verimsizlik ile tetkik ve konsültasyon gecikmelerini içerir. Dış faktörler ise yetersiz birincil bakım hizmetleri, sosyoekonomik eşitsizlikler, mevsimsel dalgalanmalar, salgınlar ve doğal afetlerdir. AS kalabalıklığını değerlendirmek için National Emergency Department Overcrowding Scale ve Emergency Department Work Index gibi ölçüm araçları kullanılır; ancak bu araçların standartlaşma eksikliği ve hastane türlerine göre değişkenliği tartışmalıdır. AS kalabalıklığı, hasta güvenliğini tehdit eder, tedavi gecikmelerine, tıbbi hatalarda artışa, personel tükenmişliğine ve sağlık maliyetlerinde artışa neden olur. Çözüm önerileri; kısa vadeli (hızlı bakı, erken taburculuk planları, hasta yönlendirmeler), uzun vadeli (birinci basamak hizmetlerinin geliştirilmesi, akut bakım merkezlerinin kurulması, yatak kapasitesinin yönetilmesi, kronik hasta yükünü azaltmaya yönelik planlamalar) ve teknolojik (yapay zeka, simülasyon, tele-tıp, hasta takip teknolojileri) yaklaşımları kapsar. Literatürdeki boşluklar, ölçüm araçlarının geçerlilik ve tutarlılık sorunları, müdahalelerin ekonomik ve klinik etkilerine dair sınırlı veri, düşük ve orta gelirli ülkelerdeki araştırma eksiklikleri ile hasta davranışları ve personel üzerindeki psikolojik etkilerin yeterince incelenmemesini içerir. AS kalabalıklığının etkili yönetimi, sistemik reformların, yenilikçi teknolojilerin ve klinik, akademik ve politik iş birliğinin koordineli bir şekilde uygulanmasını gerektirir. Bu, hasta güvenliğini artırmak, klinik sonuçları iyileştirmek ve sağlık sisteminin sürdürülebilirliğini sağlamak için kritik bir adımdır.

Anahtar Kelimeler: Yatış bloğu, acil servis, kalabalıklık, hasta akışı

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Introduction

Emergency department (ED) overcrowding occurs when the demand for emergency healthcare services exceeds the available resources, including the physical, human, and structural capacities of the ED, resulting in a critical issue that adversely impacts both patient care quality and the overall efficiency of the healthcare system (1). ED overcrowding, defined as an excessive volume of patients, is characterized by prolonged waiting times, inadequate availability of stretchers or examination space, disruptions in the delivery of medical services, and impaired patient flow, thereby posing significant risks to the safety of both patients and healthcare professionals (2).

Contributing Factors

ED overcrowding results from a complex interplay of patient-related and operational factors. This phenomenon is typically analyzed within the framework of "input" (patient inflow), "throughput" (process management), and "output" (patient outflow) factors, a classification that represents an internationally recognized standard. Input encompasses the increase in the number of patients presenting to the ED and the urgency and complexity of their conditions; throughput refers to delays in the process from patient admission to discharge, hospitalization, or transfer, including issues such as staff shortages, diagnostic delays, and consultation bottlenecks; output involves barriers to patients' departure from the ED (3–6).

Patient-Related Factors

Patient-related factors contributing to ED overcrowding encompass a wide range of dynamics stemming from individuals' healthcare utilization behaviors and health conditions. A primary factor is patients' preference for EDs to address non-emergent conditions that could be managed in primary care settings. This tendency is driven by expectations of rapid service delivery (e.g., laboratory tests, imaging, or prompt access to specialists), difficulties in securing appointments, or the unavailability of primary care services outside regular hours (7,8). This issue manifests as both a patient-related and an external factor.

The inclination to use the ED as a primary care source, particularly among individuals with chronic illnesses, limited social support, or restricted access to alternative healthcare services (often termed "frequent flyers"), leads to recurrent visits, significantly exacerbating ED overcrowding (6,9).

The aging population, a consequence of demographic shifts, is another key parameter directly influencing ED demand. Older adults typically present with more complex health issues and multiple comorbidities, resulting in longer ED stays (10). Low health literacy, which leads patients to perceive their health conditions as urgent even when they are not medically necessary, further increases ED visits (7). Additionally, some sources suggest that the high number of accompanying persons brought by patients can negatively impact ED workflow; crowded waiting areas may hinder staff-patient communication and disrupt patient flow processes (11).

Systemic Factors

Systemic factors contributing to ED overcrowding stem from structural and operational challenges within the healthcare system's hospital operations, playing a critical role in directly affecting patient flow and resource management. Bed access issues, commonly referred to as "access block," are a primary contributor. Patients who require hospitalization often remain in the ED due to the unavailability of suitable inpatient beds, resulting in the extended use of ED beds and limiting the department's ability to accept new patients (1, 9, 12–14). Access block is often directly linked to inadequate bed turnover within the hospital. Insufficient bed capacity represents a broader systemic issue, particularly in intensive care units and inpatient wards, where the number of available beds fails to meet demand, disrupting patient flow (13).

Staff shortages and suboptimal staff distribution further complicate ED operations, constituting a fundamental factor. The lack of sufficient personnel with the appropriate skill levels in the ED and related units (e.g., consulting physicians, nurses) impairs patient management and flow (2,15,16). Misalignment between staff allocation and patient volume results in service delivery disruptions, reflecting strategic deficiencies in workforce planning (7). Diagnostic and consultation delays represent another dimension of systemic bottlenecks. Delays in diagnostic services, such as laboratory and radiology, are coupled with challenges in accessing specialist consultations, slow patient flow, and extended treatment timelines (3,12,17).

Triage inefficiencies manifest as disruptions and delays in patient prioritization processes, often associated with inadequate staff training or the lack of standardized triage protocols (4,18). Inadequate information systems hinder patient tracking and resource management, with outdated electronic health records potentially disrupting decision-making processes (1,6,19). Hospital policies and protocols constitute additional systemic factors; inflexible or inadequate policies regarding discharge, hospitalization, and patient transfers impede the optimization of patient flow (15).

External Factors

External factors contributing to ED overcrowding originate from healthcare system operations beyond the hospital or from non-healthcare-related elements, indirectly shaping overcrowding by increasing demand on the ED. Deficiencies in public health and preventive services are a significant contributor; shortcomings in the management and prevention of chronic diseases lead to worsening health conditions among individuals, increasing the frequency of ED visits (20). This is particularly evident in populations where conditions such as diabetes or hypertension are inadequately managed, elevating the preventable burden on EDs.

Socioeconomic factors play a critical role among external contributors; low income levels and lack of health insurance may drive certain populations to rely on EDs instead of regular primary care services. This is directly linked to inequities in healthcare access, with uninsured individuals or those facing financial constraints often perceiving the ED as a source of free care (21). Demographic shifts also

significantly influence ED demand. For instance, migration can strain healthcare infrastructure in newly settled areas, where services may not keep pace with demand (20,22). Seasonal variations, epidemics, and natural disasters introduce predictable yet challenging periods of increased ED utilization. Influenza outbreaks, heatwaves, pandemics such as COVID-19, and post-disaster surges following earthquakes or floods overwhelm system capacity, exacerbating overcrowding and highlighting its ties to both societal and systemic dynamics (5,9,16).

Weekends and holiday periods, when non-ED healthcare services are closed or less accessible, often see an increase in ED visits due to a lack of alternative care options. This reflects a lack of continuity in the healthcare system, intensifying pressure on EDs, particularly during public holidays (10). Additionally, the closure or reduced capacity of other hospitals or EDs in a region is a critical external factor; such reductions redirect patient loads to remaining EDs, concentrating demand (2,7). Environmental factors also play a significant role; for example, inadequate transportation infrastructure may limit access to primary care, leading patients to EDs, which are often more geographically accessible (9).

Factors contributing to ED overcrowding are summarized in Table 1.

Measurement Methods and Scoring Systems

The objective assessment of ED overcrowding has been made possible through various scoring systems developed internationally, designed to support clinical decision-making processes and evaluate the effectiveness of intervention strategies (14). The most widely used tool, the National Emergency Department Overcrowding Scale (NEDOCS), calculates a score by integrating multiple parameters, including the number of patients in the ED, waiting times, the number of boarded patients awaiting hospitalization, the number of patients requiring ventilators, and available bed capacity. NEDOCS translates clinicians' subjective perceptions into a quantitative framework, enabling standardized analysis of ED performance (14).

The Emergency Department Work Index (EDWIN) is another index that measures workload within the ED. EDWIN calculates workload per unit of time by considering factors such as patient volume, staff capacity, and the distribution of patients across triage categories (16,19). Additionally, alternative approaches are also available in the literature. The Community Emergency Department Overcrowding Score (CEDOCS) is a tool designed to measure overcrowding in community-based EDs, incorporating parameters specific to local contexts (23). The Severely Overcrowded-Overcrowded-Not Overcrowded Estimation Tool (SONET) offers a simplified estimation method, categorizing overcrowding levels into three tiers for rapid situational assessment (23).

These measurement methods are indispensable for understanding this complex issue in EDs, developing effective interventions, and ultimately improving patient care and the overall quality of healthcare services. For instance, the NEDOCS score is particularly sensitive in assessing the contribution of patient outflow factors, such as boarding, to overcrowding, while EDWIN is more effective in evaluating staff-focused throughput processes (23). However, these systems have limitations in providing a standardized "gold standard"; their variability based on hospital volume, patient population, and local healthcare system dynamics raises questions about their universal applicability.

Importance and Consequences of ED Overcrowding

ED overcrowding extends beyond compromising patient care quality, presenting a multifaceted challenge to the healthcare system with severe consequences. It threatens patient safety, staff well-being, and overall system efficiency, making it a global crisis that requires urgent intervention (11,14). The impact on patient care is among the most striking manifestations of overcrowding. Prolonged waiting times increase the "left without being seen" rate by up to 10% (24) and cause delays in treatment for emergent conditions, elevating mortality and morbidity rates. For example, in overcrowded EDs, antibiotic administration for sepsis cases is delayed by 5 minutes for every 10% increase in patient volume, increasing mortality risk (17,25). In critical conditions such as myocardial infarction, a 30-minute delay in treatment can increase mortality risk by up to 7.5% (26). Furthermore, medical errors more than double due to ED overcrowding (27), while patient satisfaction significantly declines (5).

The impact on staff represents another critical dimension of overcrowding. Excessive workload and stress contribute to burnout among ED staff (5). In overcrowded EDs, staff job satisfaction decreases, which leads to higher turnover rates (7,8,28). These conditions create a vicious cycle that indirectly affects patient care quality; stressed staff are more prone to errors, further worsening clinical outcomes. At the system level, ED overcrowding results in inefficient resource utilization and a 10–15% increase in healthcare costs (7), as well as delays in ambulance offloading (1). These disruptions hinder patients' access to healthcare services and jeopardize system functionality. Consequently, the multifaceted threats to patient safety, staff well-being, and healthcare system efficiency underscore the need to understand the causes of overcrowding, measure its effects, and develop effective mitigation strategies. In this context, a deeper examination of the clinical and financial consequences of ED overcrowding emerges as a critical step in reshaping healthcare policies.

Proposed Solutions and Intervention Strategies

Solutions to address ED overcrowding can be categorized under three main headings: short-term, long-term, and technologically innovative approaches. These strategies aim to reduce overcrowding and improve patient care across a broad spectrum, from optimizing existing resources to addressing systemic challenges.

Short-Term Strategies

Short-term strategies focus on rapidly implementable interventions to alleviate immediate or short-term pressure on the ED. Fast-track systems streamline the evaluation and treatment of low-acuity patients (e.g., green-coded cases) in a dedicated area, staffed by experienced professionals such as emergency medical technicians, nurses, general

Factor category	Subcategories	Description
Patient-related	Non-emergent conditions	Patients seek ED care over primary care due to expectations of rapid service delivery
	Frequent ED use	Patients with chronic conditions or limited social support regularly utilize the ED
	Older population and comorbidities	Demographic shifts increase complex health issues, leading to prolonged ED stays
	Patient perception of urgency	Low health literacy prompts ED visits for low-acuity conditions
Systemic	Bed access issues	Boarding occupies ED beds, limiting space for new patients
	Staff shortages	Insufficient staff disrupts patient management, particularly during peak hours
	Inefficient discharge processes	Delayed discharges hinder bed turnover, interrupting patient flow
	Diagnostic and consultation delays	Challenges in accessing laboratory services and specialists slow patient flow
External	Limited primary care access	Lack of timely access drives patients to the ED, exacerbated by after-hours restrictions
	Socioeconomic factors	Low income and lack of insurance make the ED a primary care option
	Seasonal factors and epidemics	Influenza, COVID-19, and similar outbreaks cause sudden surges
	Lack of specialist appointments	Difficulty accessing specialists redirects patients to the ED

Table 1. Summary of factors contributing to ED overcrowding

practitioners, or specialists, thereby reducing waiting times and improving patient flow (3,9,12,13). This approach minimizes unnecessary delays. Similarly, team triage, which involves a collaborative assessment by a physician and a nurse, improves the accuracy and speed of patient evaluations (3). Empowering triage nurses to initiate diagnostic tests (e.g., X-rays, laboratory tests, ECGs) further supports this process (4). Day units, designed for outpatients requiring only short-term observation or treatment, prevent these patients from being directed to the ED, thus reducing the ED's burden and preserving beds for critical cases (4). Early discharge protocols, which encourage discharges during morning hours, free up inpatient ward beds, facilitating the transfer of ED patients awaiting hospitalization. When combined with full-capacity protocols, redirecting boarded patients to alternative areas temporarily further alleviates ED pressure (2).

Long-Term Strategies

Long-term strategies target the root causes of overcrowding to provide sustainable relief. Improving access to primary care services, particularly by strengthening after-hours care, encourages patients to seek family physicians for non-emergency conditions instead of the ED (7,9). As an extension of this effort, urgent care centers offer an alternative for acute but non-emergent health issues, naturally reducing ED demand (29). Effective bed capacity management optimizes hospital-wide bed allocation, while specialty observation units separate patients requiring short-term stays from the ED, mitigating boarding (8,12,13). However, increasing ED bed numbers alone does not resolve this issue (8,12,13). Strengthening long-term care services ensures regular follow-up for patients with chronic diseases, reducing ED dependency (7). An integrated healthcare system establishes seamless coordination between the ED, primary care, specialists, and public health services, facilitating patient transfers and follow-up (4,7). Integrating social services accelerates the discharge of patients with complex social issues (1). Regional healthcare planning balances the distribution of resources (e.g., staff, beds, equipment) based on need, while staff training enhances overcrowding management and communication skills, supporting this system (4,7). Policy reforms, driven by national goals and incentives, guide hospitals toward long-term improvement (1,9,11). Collectively, these systemic reforms strengthen the ED and establish lasting equilibrium.

Technological and Innovative Approaches

Technological and innovative approaches leverage modern tools to reduce overcrowding and enhance efficiency. Predictive and simulation models, powered by machine learning and artificial intelligence, forecast patient flow, enabling more effective resource planning (8,14). Telemedicine provides remote consultations for non-emergent conditions and facilitates post-discharge follow-up, which reduces the number of ED visits (9,15,16). Patient flow management centers coordinate bed allocation through real-time monitoring, maintaining oversight of system dynamics (9,15). Technologies such as Radio Frequency Identification (RFID) streamline patient and equipment tracking, identify overcrowded areas, and enable targeted solutions, thus indirectly alleviating pressure (2,5,19). These innovations highlight the potential of technology in ED management. The success of all these

strategies depends on their adaptation to the unique conditions of each ED; sustained improvement requires the consistent implementation of this holistic framework. Proposed solutions and intervention strategies are summarized in Table 2.

Strategy type	Interventions	Objective
Short-term	Fast-track	Reduce waiting times
	Early discharge	Free up inpatient ward beds
	Improved ambulance turnaround	Shorten ambulance return-to-service times
	Patient Redirection	Divert non-emergent cases to primary care
Long-term	Enhanced primary care access	Reduce non-emergent ED visits
	Urgent care centers	Address acute but non-emergent demand
	Bed capacity management	Mitigate boarding
	Long-term care services	Reduce chronic patient burden
Technological and innovative	Telemedicine	Alleviate non-emergent visits
	Artificial intelligence and simulation models	Optimize patient flow
	Tracking technologies	Develop solutions for overcrowded areas
	Mobile applications	Prevent unnecessary visits

Table 2. Summary of proposed solutions and intervention strategies

Literature Gaps and Future Research Directions

The applicability of scoring systems used to measure ED overcrowding is frequently debated, with conflicting findings regarding the consistency and validity of tools such as the NEDOCS and the EDWIN. Altun et al. (14) note that NEDOCS is strongly influenced by prolonged hospitalization times, which complicates its standardization, while Ilhan et al. (28) report that it is unsuitable for university hospitals. Wang et al. (30) highlight NEDOCS's limitations in high-volume EDs, and Phillips et al. (23) point to its inadequacy in low-volume EDs. Conversely, Improta et al. (19) suggest that NEDOCS may outperform EDWIN in severe overcrowding scenarios. These discrepancies underscore the absence of a universal gold standard and the variability of these scores based on factors such as hospital volume, patient population, and external conditions (e.g., pandemics). This highlights the need for standardized, validated measurement tools tailored to diverse ED types and contexts. Multicenter validation studies and research examining the correlation of NEDOCS, EDWIN, and other scoring systems with clinical outcomes are warranted.

The economic and clinical impacts of interventions targeting ED overcrowding remain underexplored. Oredsson et al., in their systematic review, indicate that studies provide limited data on patient safety or cost-benefit analyses (3), while Darraj et al. emphasize that existing reviews focus primarily on causes and solutions, with insufficient examination of the clinical consequences of treatment delays, particularly in emergent conditions such as sepsis or myocardial infarction (17). Additionally, Butun et al. report that research on reasons for ED utilization is predominantly conducted in high-income countries, with low- and middle-income countries underexplored due to differences in healthcare systems and cultural norms (7). Furthermore, while reasons for patients' preference for EDs (e.g., perceived urgency, 24-hour access, expectations of rapid service) are noted, behavioral factors and the influence of social networks on overcrowding have not been thoroughly investigated. Similarly, the psychological effects of ED overcrowding on staff (e.g., burnout, stress, job satisfaction) and the effectiveness of interventions to mitigate these impacts remain inadequately studied. Future research designed to address these gaps is essential (Table 3).

Gap area	Description	Research recommendation
Applicability of scoring systems	Lack of a gold standard and variability based on hospital conditions	Multicenter validation and correlation with clinical outcomes
Lack of cost-benefit analyses	Uncertain economic and safety impacts of interventions	Cost-effectiveness and patient safety analyses
Research addressing inequities	Perspectives of vulnerable groups are overlooked	Evaluations of interventions to reduce inequities
Examination of treatment delays	Insufficient emphasis on the clinical outcomes of delays	Systematic review of causes and consequences of delays
Low- and middle-income countries	Research focuses on high-income countries.	Contextual and actionable solution exploration
Behavioral and social influences	Patient preferences and societal factors are underexplored	Demand management strategies informed by behavioral sciences

Table 3. Literature gaps and research recommendations

Conclusion

ED overcrowding is not merely a healthcare delivery issue but a global crisis with multidimensional impacts on patient safety, clinical outcomes, staff well-being, and healthcare system sustainability. Its causes span a broad spectrum, from individual patient behaviors to systemic operational inefficiencies, external societal conditions, and resource constraints, with these dynamics mutually influencing one another. Analyses clearly demonstrate the contributions of patient-related, systemic, and environmental factors to overcrowding. Proposed solutions range from short-term interventions (e.g., fast track, early discharge) to long-term strategies (e.g., improved primary care access, bed management) and technological innovations (e.g., artificial intelligence, telemedicine). Notable gaps include inconsistencies in scoring systems used to assess overcrowding, a lack of cost analyses, and a scarcity of research in low-income countries.

Effectively managing ED overcrowding, enhancing patient safety, and ensuring the sustainability of the healthcare system require concerted efforts from clinical, academic, and policy sectors. This can be achieved not only by optimizing existing resources but also through the coordinated implementation of systemic reforms and innovative strategies.

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Ethical Approval: This is an invited scoping review and does not involve human or animal subjects. Therefore, ethical approval was not required.

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