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EMERGENCY DEPARTMENT OVERCROWDING: A SYSTEMATIC REVIEW OF CAUSES, CONSEQUENCES, AND INTERVENTIONS

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Abstract

Background

Overcrowding in emergency departments (EDs) is a major problem worldwide, poses a significant and ongoing threat to the quality of healthcare services, as it affects the efficiency of hospital operations on multiple levels. It has been consistently linked with prolong length of stay, increase waiting time and treatment delays, higher patient mortality, and increased burnout among healthcare workers. Although widely recognized, the causes, consequences, and effectiveness of interventions to address ED overcrowding remain variably reported across different healthcare settings, particularly between high-income countries and low- and middle-income countries (LMICs).

Objective

The objective of this study was to critically analyze and synthesize global evidence on the causes, consequences, and effective interventions, related to overcrowding in the emergency department.

Methods

This systematic review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A thorough search was performed across PubMed/MEDLINE, Web of Science, CINAHL and Scopus without restriction on year of publication. Quantitative, qualitative, and mixed-methods studies, as well as systematic reviews conducted in hospital-based emergency departments, were included that reported causes, consequences, or interventions related to ED overcrowding. Study selection and data extraction were performed by two reviewers independently, and methodological quality was assessed using CASP, Joanna Briggs Institute (JBI), and AMSTAR-2 tools. Due to substantial heterogeneity across studies, findings were synthesized narratively.

Results

From 3842 identified studies and175 full text reviews, a total of 63 studies met the inclusion criteria. ED overcrowding was driven primarily by access block related to inpatient bed shortages, delayed hospital discharges, inefficient patient flow, staffing constraints, and high volumes of non-urgent presentations. In LMIC settings, additional contributors included weak primary care systems and inadequate referral pathways. Overcrowding was consistently associated with delays in care, prolonged ED length of stay, adverse patient outcomes, increased

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healthcare provider burnout, and reduced system efficiency. Interventions targeting only the ED demonstrated limited effectiveness, whereas multicomponent hospital-wide and system-level strategies showed more sustained improvements.

Conclusion

Emergency department overcrowding is a complex, system-level problem with significant implications for patients, providers, and health systems. Evidence suggests that sustainable mitigation requires coordinated, multilevel interventions extending beyond the ED to the broader health system. Addressing ED overcrowding should be recognized as a priority for health system strengthening, particularly in resource-constrained settings.

INTRODUCTION

Emergency Departments (EDs) operates 24 hours a day ,7 days a week and 365 days a year and is one of the crowded unit of hospital which provides rapid assessment and high-quality care and management for acute and life-threatening conditions[1]. Overcrowding in emergency department is of a significant concern globally and it has profound effect on patient care, health care providers and hospital[2] .Overcrowding in the ED can be defined as a s circumstances in which demand for emergency services exceeds the ED's handling capacity resulting in prolong waiting times[3], this leads to delay in consultation, investigation ,management and prolong ED stay[2]and delayed admission of patient from ed to hospital inpatient beds [4]

Evidence from developed countries showed that overcrowding in the ED is long standing issue in many hospitals [5]. Emergency department in low- and middle-income countries (LMIC) due to weak referral system, limited primary health care access serve as primary access to health care ,the burden of overcrowding is more noticeable in these countries [6-7]

Overcrowding in ed is not just an operational inconvenience but has direct effect on patients safety and quality of care they receive leading to prolong stay in ED, delays in the treatment of time sensitive conditions ,more complication rates ,patient disatisfaction[8-11] and increased mortality [9,12-13].Ed overcrowding have significant effect on health care providers as well with increase burnout, stress and job dissatisfaction among ED health staff [2,14-15].and recent literature also highlighted work place violence in overcrowded ed [3]

Although there are considerable studies on ED overcrowding .it remains diverse with variation in definitions, measurement tools, outcomes assessed and interventions evaluated [1-2]. Recent reviews have often focused on single dimension such as flow of the patient, boarding, delay in treatment or specific intervention without integrating determinants outcomes and solution in a single frame work.

Additionally, much of the high-quality evidence originates from high income countries while data from LMIC including Pakistan are comparatively limited and fragmented despite high ED volumes and inadequate resource ,limiting their applicability to LMIC context where healthcare delivery structures, behavior of the patients , and resource limitation differ significantly [6.16-17] .This highlights a critical evidence gap for policymakers and hospital administrators looking for context-appropriate solutions.

Therefore, aim of this systematic review is to synthesize up-to date worldwide evidence on the causes or consequences of, or solutions for overcrowding in the emergency department, with particular attention to patient outcomes, healthcare provider well-being, and system-level drivers, and to highlight implications for policy and operational improvement in both high-income and LMIC settings

METHODS

In order to ensure methodological rigor and transparency, this systematic review process followed 2020 Preferred Reporting Items for

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Systematic Reviews and Meta-Analyses (PRISMA) and thorough search was performed across multiple electronic databases, including PubMed/MEDLINE, Web of Science, CINAHL and Scopus using a combination of Medical Subject Headings (MeSH) and free text key words related with ed crowding, ED overcrowding, Extended length of stay, patient flow, Ed boarding, access block along with additional terms related to outcomes and interventions.

Eligible studies included original qualitative, quantitative and mixed-methods studies, as well as systematic reviews conducted in hospital-based EDs that reported causes, consequences, or interventions related to ED overcrowding. publication date restrictions were not applied in order to capture current and foundation evidence. We excluded studies that were opinion pieces, editorials conference abstracts that were lacking full text, and studies exclusively focused on pre-hospital settings and disaster surge . Two reviewers independently screened titles and abstracts and assessed full-text articles for eligibility, disagreements were resolved through discussion. Data were extracted using a standardized form. methodological quality of included studies was assessed using established appraisal tools: for qualitative studies Critical Appraisal Skills Programme (CASP) , for observational studies Joanna Briggs Institute (JBI) and for systematic reviews AMSTAR-2 was used and results were synthesized narratively and organized thematically.

RESULTS

Study Selection

Our initial search found 3842 articles of which 1126 were duplicates and removed. title and abstract of remaining 2716 screened and 2541 were excluded that were irrelevant to overcrowding of emergency department.175 article full text assessed and total of 63 satisfy the inclusion criteria and were then included in final review.

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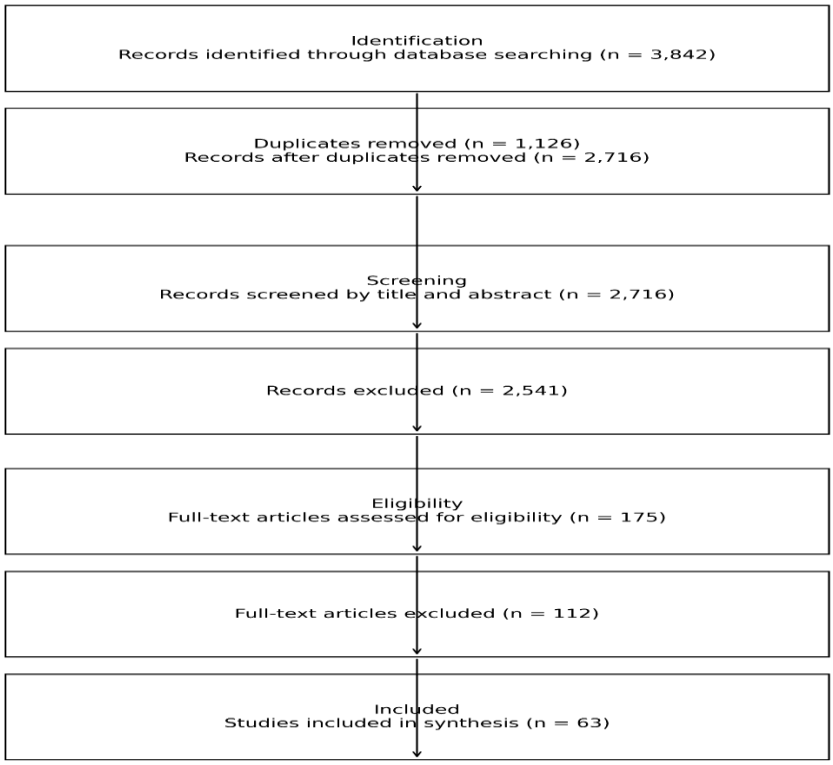
Figure 1 illustrates the study selection process in accordance with the PRISMA 2020 guidelines



Characteristics of Included Studies

63 studies that were included for final review were published between 2000 to 2025 with 65%(n=41) published in last 5 years. majority of the studies were quantitative observational (n=34).11 qualtitative studies ,7 mix method studied and 11 were systematic reviews Studies conducted in high income countries were 38 while in low and middle income countries that including south Asia were 25. definitions and indicators used to evaluate overcrowding in the emergency department showed considerable difference across studies. commonly used indicators include length of stay in ED,waiting time, patient boarding time. Occupancy rate and validated crowding scales.

Table 1. Characteristics of Included Studies (n = 63)

Characteristic	Number (%)
Study design	
Observational quantitative	34 (54%)
Qualitative	11 (17%)
Mixed-methods	7 (11%)
Systematic / umbrella reviews	11 (18%)
Publication period	
2000–2015	12 (19%)
2016–2020	10 (16%)

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Characteristic	Number (%)
2021–2025	41 (65%)
Setting	
High-income countries	38 (60%)
LMICs	25 (40%)

Thematic Synthesis

Findings from included studies were synthesized into three overarching analytical themes:

1. Causes of ED overcrowding
2. Consequences of ED overcrowding
3. Interventions to reduce ED overcrowding.

Theme 1: Causes of Emergency Department Overcrowding

Across settings, ED overcrowding was driven by multilevel factors, with strong consistency between high-income and LMIC studies. The most frequently reported causes included access block due to inpatient bed shortages, delayed hospital discharges, increased ED presentations for non-urgent conditions, staffing shortages, and inefficient internal patient flow.

LMIC-specific drivers included weak primary care systems, limited referral mechanisms, delayed patient presentation with advanced illness, and constrained diagnostic and inpatient capacity.

Table 2. Key Causes of Emergency Department Overcrowding

Level	Contributing factors
Patient-level	Non-urgent ED visits, delayed presentation, complex comorbidities
ED-level	Staffing shortages, limited treatment spaces, diagnostic delays
Hospital-level	Inpatient bed shortages, delayed discharges, access block
System-level	Poor primary care access, weak referral systems, limited post-acute care

Theme 2: Consequences of Emergency Department Overcrowding

ED overcrowding was consistently associated with negative patient, provider, and system outcomes. Patient-related consequences included prolonged waiting times, delayed treatment for time-sensitive conditions, increased adverse events, and higher mortality in selected populations.

Healthcare providers working in overcrowded EDs reported higher levels of stress, burnout, moral distress, and perceived reduction in care quality. Several recent studies also identified an association between ED crowding and workplace violence toward staff.

At the system level, overcrowding resulted in inefficiencies, increased healthcare costs, ambulance off-loading delays, and reduced overall hospital performance.

Table 3. Consequences of Emergency Department Overcrowding

Domain	Reported outcomes
Patient outcomes	Delayed care, increased adverse events, higher mortality
Provider outcomes	Burnout, stress, moral distress, workplace violence
System outcomes	Increased costs, inefficiency, ambulance delays

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Theme 3: Interventions to Reduce Emergency Department Overcrowding

Interventions aimed at reducing ED overcrowding were categorized into ED-based, hospital-wide, and system-level strategies. ED-based interventions included fast-track systems, triage redesign, and senior physician triage. Hospital-wide interventions focused on improving inpatient flow, early discharge planning, and use of short-stay or observation units.

System-level strategies included strengthening primary care access, implementing referral pathways, and expanding post-acute care services. Evidence suggested that single interventions were rarely sufficient, and multicomponent, system-wide approaches demonstrated the greatest effectiveness.

Table 4. Interventions to Address Emergency Department Overcrowding

Intervention type	Examples	Effectiveness
ED-based	Fast-track, triage reform, streaming	Moderate
Hospital-wide	Bed management, early discharge, observation units	High
System-level	Primary care strengthening, referral pathways	High(context-dependent)

Quality Appraisal and Risk of Bias Assessment

Methodological quality of included studies was assessed using design-specific tools. Overall, study quality ranged from moderate to high, with most limitations related to sampling methods, outcome measurement, and control of confounding variables. No study was excluded based on quality alone.

Table 5. Quality Appraisal of Qualitative Studies Using CASP (n=11)

CASP Domain	Adequately Addressed n (%)	Common Limitations
Clear research aims	11 (100%)	—
Appropriate methodology	10 (91%)	Limited justification
Research design	9 (82%)	Limited reflexivity
Recruitment strategy	8 (73%)	Convenience sampling
Data collection	9 (82%)	Limited triangulation
Researcher-participant relationship	6 (55%)	Reflexivity not discussed
Ethical considerations	10 (91%)	Ethics approval unclear
Data analysis rigor	9 (82%)	Coding process unclear
Clear findings	10 (91%)	Limited quotations
Research value	11 (100%)	—

Most qualitative studies demonstrated clear aims and appropriate methodologies; however, limited reflexivity and incomplete reporting of recruitment strategies were common limitations

Table 6. Methodological Quality of Quantitative Studies Using JBI (n=41)

JBI Criterion	Yes n (%)	No/Unclear n (%)
Clear inclusion criteria	36 (88%)	5 (12%)
Valid exposure measurement	34 (83%)	7 (17%)
Objective outcome measurement	32 (78%)	9 (22%)
Confounders identified	29 (71%)	12 (29%)
Confounders addressed	26 (63%)	15 (37%)
Appropriate statistics	35 (85%)	6 (15%)

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Adequate follow-up	30 (73%)	11 (27%)

Most quantitative studies demonstrated appropriate statistical analyses and outcome measurement, though residual confounding was a common methodological limitation

Table 7. Quality Assessment of Systematic Reviews Using AMSTAR-2 (n=11)

AMSTAR-2 Domain	Adequately Addressed n (%)	Key Issues
Protocol registered	7 (64%)	No PROSPERO
Comprehensive search	9 (82%)	Limited grey literature
Duplicate selection	10 (91%)	—
Duplicate extraction	9 (82%)	—
Risk of bias assessed	8 (73%)	Tool justification missing
Bias considered in interpretation	7 (64%)	Incomplete integration
Publication bias assessed	6 (55%)	Not reported
Overall confidence	Moderate–High	—

Most included reviews achieved moderate to high confidence ratings; however, incomplete assessment of publication bias and lack of protocol registration were noted.

DISCUSSION

This systematic review synthesizes global evidence on the causes, consequences, and interventions related to emergency department (ED) overcrowding, highlighting that overcrowding is a multifactorial, system-level problem rather than an isolated ED operational issue. The findings demonstrate consistent patterns across diverse healthcare settings, with variations in magnitude and feasibility of solutions between high-income countries and low- and middle-income countries (LMICs).

Interpretation of Key Findings

Causes of Emergency Department Overcrowding

The review identified access block due to inpatient bed shortages as the most consistently reported driver of ED overcrowding, reinforcing contemporary evidence that overcrowding is largely determined by downstream hospital flow rather than ED inefficiency alone. [12] Recent health-system analyses confirm that delayed discharges, insufficient inpatient capacity, and limited post-acute care services substantially contribute to prolonged ED boarding and congestion. [3–5]

In LMIC settings, additional upstream factors—such as weak primary care infrastructure, poor referral pathways, and delayed presentation of advanced illness—were prominent contributors. [6,7] These findings align with recent global emergency care literature emphasizing that EDs in resource-constrained settings often function as the default entry point into the health system, amplifying crowding pressures. [8]

Consequences for Patients, Providers, and Health Systems

Consistent with recent multicenter studies, ED overcrowding was associated with delays in care, prolonged length of stay, and adverse patient outcomes, including increased mortality in selected high-risk populations. [9,10] Although heterogeneity in outcome definitions limits causal inference, the convergence of findings across settings strengthens the clinical relevance of these associations.

Beyond patient outcomes, the review highlights significant consequences for healthcare providers, including burnout, moral distress, reduced perceived care quality, and increased exposure to workplace violence. [11–13] Recent literature increasingly recognizes provider well-being as a critical dimension of patient safety, underscoring

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the broader impact of overcrowding on healthcare system sustainability.[14]

At the system level, ED overcrowding was associated with ambulance off-loading delays, increased healthcare costs, and reduced overall hospital efficiency. [3,4] These findings support the growing consensus that ED crowding reflects system performance failure, rather than localized inefficiency. [18]

Effectiveness of Interventions

The review demonstrates that single, ED-focused interventions—such as fast-track systems or triage redesign—produce modest and context-dependent improvements. While these interventions may reduce waiting times for low-acuity patients, they are insufficient to address access block and inpatient congestion. [15,16]

In contrast, multicomponent hospital-wide and system-level interventions showed greater and more sustained effectiveness. Strategies such as proactive bed management, early discharge planning, observation units, and escalation protocols during periods of crowding were consistently associated with improved patient flow. [17,18] Recent umbrella reviews emphasize that successful overcrowding mitigation requires coordinated action across EDs, inpatient services, and community care. [19]

For LMICs, system-level strategies—including strengthening primary care access, improving referral mechanisms, and expanding post-acute care capacity—were identified as critical but often under-implemented due to resource constraints. [6,7] These findings highlight the importance of context-specific solutions, rather than direct transplantation of high-income country models.

Implications for Policy and Practice

The findings of this review have important implications for health policy, hospital management, and emergency care leadership. First, overcrowding metrics should be integrated into hospital-wide performance indicators, rather than being viewed solely as ED operational measures. [20] Second, investment in inpatient capacity, discharge efficiency, and community-based care is essential to sustainably reduce ED crowding.

In Pakistan and similar LMIC settings, targeted investments in primary care strengthening, referral system reform, and emergency care workforce development are likely to yield substantial downstream benefits. [6,8] Policy recognition of ED overcrowding as a system-level patient safety issue may facilitate more effective allocation of limited resources.

Strengths and Limitations

A key strength of this review is the inclusion of diverse study designs and settings, allowing for a comprehensive synthesis of causes, consequences, and interventions. The use of validated quality appraisal tools (CASP, JBI, and AMSTAR-2) enhances the credibility of findings.

However, several limitations should be acknowledged. The heterogeneity of overcrowding definitions and outcome measures limited quantitative synthesis. Publication bias and under-representation of LMIC-specific data may also influence findings. Additionally, many intervention studies lacked long-term outcome evaluation, limiting conclusions regarding sustainability.

Future Research Directions

Future research should prioritize standardized definitions and measurement tools for ED overcrowding, enabling better comparison across studies and settings. High-quality intervention studies from LMICs are particularly needed, with emphasis on feasibility, cost-effectiveness, and scalability. Longitudinal evaluations of system-wide interventions would further strengthen the evidence base.

Conclusion

Emergency department overcrowding is a complex, system-driven challenge with significant implications for patient safety, provider well-being, and health-system performance. Evidence from this review indicates that sustainable mitigation requires coordinated, multilevel interventions extending beyond the ED to the broader health system. Addressing overcrowding should therefore

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be recognized as a strategic priority for health systems globally, particularly in resource-constrained settings.

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