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DETERMINANTS OF IN-HOSPITAL MORTALITY: A SCOPING REVIEW OF PATIENT- AND HOSPITAL-RELATED FACTORS

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ABSTRAK

Mortalitas rawat inap merupakan indikator penting mutu pelayanan dan keselamatan pasien. Scoping review ini bertujuan memetakan faktor pasien dan faktor rumah sakit yang berkaitan dengan mortalitas selama perawatan. Kajian mengikuti metodologi Joanna Briggs Institute dan PRISMA-ScR dengan kerangka Population–Concept–Context. Penelusuran dilakukan melalui ScienceDirect, ProQuest, dan Google Scholar untuk artikel berbahasa Inggris terbitan 2016–2026. Dari 446 artikel yang ditemukan, 10 studi memenuhi kriteria. Faktor pasien yang sering dilaporkan meliputi usia lanjut, komorbiditas, keparahan penyakit, gangguan fisiologis akut, infeksi, disfungsi organ, komplikasi pascaoperasi, obesitas, dan risiko terkait obat. Faktor rumah sakit meliputi lama tinggal di instalasi gawat darurat, ketersediaan tempat tidur, kapasitas perawatan intensif, operasi emergensi, dan keterlambatan eskalasi pelayanan. Mortalitas rawat inap dipengaruhi oleh interaksi antara kerentanan pasien dan kemampuan rumah sakit memberikan pelayanan yang tepat waktu dan efektif.
Kata kunci: Mortalitas; Keselamatan pasien; Mutu Rumah Sakit

ABSTRACT

Determinants of In-Hospital Mortality: A Scoping Review of Patient- and Hospital-Related Factors. In-hospital mortality is an important indicator of quality of care and patient safety. This scoping review aimed to map patient- and hospital-related factors associated with mortality during hospitalization. The review followed Joanna Briggs Institute methodology and PRISMA-ScR using the Population–Concept–Context framework. ScienceDirect, ProQuest, and Google Scholar were searched for English-language studies published between 2016 and 2026. Of 446 records identified, 10 studies met the eligibility criteria. Frequently reported patient-related factors included older age, comorbidity, disease severity, acute physiological instability, infection, organ dysfunction, postoperative complications, obesity, and medication-related risks. Hospital-related factors included prolonged emergency department stay, staffed-bed availability, critical care capacity, emergency surgery, and delayed escalation of care. In-hospital mortality is shaped by the interaction between patient vulnerability and the hospital's capacity to provide timely and effective care.
Keywords: Mortality, Patient Safety, Hospital Quality

INTRODUCTION

In-hospital mortality is one of the fundamental indicators used to evaluate quality of care and the effectiveness of patient safety systems within healthcare facilities.[1,2] It is a critical outcome because it reflects not only the severity of illness, but also the safety, timeliness, responsiveness,

and effectiveness of hospital care. Mortality during hospitalization provides a measurable endpoint for assessing whether clinical deterioration is recognized early, whether treatment is delivered appropriately, and whether the hospital system is able to prevent avoidable deaths.[3] Hospitals represent a key setting for studying mortality because they provide care for patients with complex clinical needs, including critically ill patients, postoperative cases, individuals with severe infections, multimorbidity, organ dysfunction, and those requiring intensive monitoring or life-support interventions. In contrast to primary care services, hospitals offer more advanced diagnostic, therapeutic, rehabilitative, and emergency care; therefore, the risk of death is more frequently observed during inpatient episodes.[4]

International evidence indicates that hospital mortality remains a major concern for health systems. Hospital mortality has been described as an important but underused source of information for improving quaxlity of care, particularly in low- and middle-income countries where hospital data may provide valuable insight into avoidable deaths and health system performance.[3] At the same time, population-based evidence from high-income settings shows that hospitalized patients have become increasingly complex over time, with rising proportions of older adults, multimorbidity, polypharmacy, emergency admissions, intensive care use, adverse events, and in-hospital death.[4] These trends suggest that contemporary in-hospital mortality cannot be understood only as a disease-specific outcome, but should be examined through a broader framework that considers both patient-level vulnerability and hospital-level care processes.

Discussing the determinants of in-hospital mortality is essential because death during hospitalization is rarely attributable to a single cause. Rather, it usually results from the interaction between patients' clinical vulnerability and the capacity of hospital systems to respond effectively.[5–7] Patient-related factors such as older age, frailty, comorbidity burden, disease severity, infection, organ dysfunction, postoperative complications, obesity in specific clinical contexts, and medication-related problems may increase baseline vulnerability and the risk of clinical deterioration.[6,8–16] Meanwhile, hospital-related factors such as prolonged emergency department length of stay, limited staffed bed availability, emergency department level, intensive care capacity, unplanned Intensive Care Unit (ICU) admission, emergency surgery, and length of stay may reflect care processes, resource readiness, patient flow, and rescue capacity.[6,8,14,15,17,18]

Previous studies and reviews have generally focused on specific diseases, clinical settings, or hospital processes, such as sepsis, emergency department crowding, early warning systems, nurse staffing, antimicrobial therapy, postoperative outcomes, or ICU-related mortality.[5,19–22] Although these studies provide important evidence, their scope is often limited to one disease group, one clinical pathway, or one organizational factor. As a result, there remains a need for a broader evidence mapping that organizes determinants of in-hospital mortality across both patient-related and hospital-related domains. Such mapping is important because inpatient death may be influenced simultaneously by baseline patient vulnerability, acute physiological deterioration, care escalation, staffed bed availability, ICU readiness, medication safety, and other process indicators within the hospital system.

A scoping review approach is appropriate for this topic because the evidence on in-hospital mortality is broad, heterogeneous, and multidisciplinary, involving different patient populations, hospital settings, clinical conditions, outcome definitions, and study designs. Unlike a systematic review or meta-analysis, this review does not aim to estimate a single pooled effect size. Instead, it aims to map the available evidence, categorize key determinants, identify patterns across studies, and clarify areas that may require further investigation.

Based on this background, this scoping review aims to map and synthesize available evidence on patient-related and hospital-related determinants of in-hospital mortality. The findings are

expected to support hospital practitioners, managers, quality committees, medical committees, and policymakers in strengthening strategies for early identification of high-risk patients, timely clinical escalation, ICU optimization, adequate staffing, medication safety, antimicrobial stewardship, and data-driven patient safety improvement.

METHODS

This study was conducted as a scoping review to map patient- and hospital-related factors associated with in-hospital mortality. A scoping review was selected because the evidence is broad and heterogeneous across patient populations, clinical settings, and observational study designs. The review followed the Joanna Briggs Institute methodology for scoping reviews and was reported in accordance with PRISMA-ScR. The review question and eligibility criteria were structured using the Population–Concept–Context framework (Table 1).

Table 1. Population, Concept, and Context Framework

Component	Brief Description
Population	Hospitalized patients
Concept	Factors associated with in-hospital mortality
Context	All hospital setting, ICU, emergency department-to-ICU pathway, postoperative care, and inpatient wards

The literature search was conducted in ScienceDirect, ProQuest, and Google Scholar for articles published between May 16, 2016 and May 16, 2026. The final search was performed on May 16, 2026. The main Boolean search string was: “in-hospital mortality” AND “risk factors” AND “patient safety” AND “determinant”. The search identified 446 records, comprising 144 from ScienceDirect, 255 from ProQuest, and 47 from Google Scholar. Duplicate records were removed, followed by title and abstract screening and full-text eligibility assessment. Reasons for exclusion were documented, and the selection process was presented using a PRISMA-ScR flow diagram. Ten studies met the eligibility criteria and were included in the final synthesis.

Eligible studies were full-text English observational studies published between 2016 and 2026 that involved hospitalized patients and reported factors associated with mortality during hospitalization. General inpatient, ICU-only, postoperative, COVID-19, and disease-specific studies were included when mortality occurred during the hospital admission. Disease-specific findings were interpreted according to their clinical context and were not assumed to have equal generalizability. Systematic reviews, meta-analyses, narrative reviews, editorials, case reports, conference abstracts, non-inpatient studies, and studies reporting only post-discharge mortality were excluded. Data were extracted on author, year, country, study design, population, clinical setting, outcome, and patient- and hospital-related determinants.

DISCUSSION

This scoping review identified and mapped patient- and hospital-related factors associated with in-hospital mortality across ten observational studies conducted in diverse hospital settings. The included studies covered emergency department-to-ICU pathways, general ICU care, surgical and postoperative care, Coronavirus Disease 2019 (COVID-19) hospitalization, acute pulmonary embolism, type 2 diabetes mellitus-related admissions, heart failure hospitalization, and

hospitalized haemodialysis patients. This diversity of settings indicates that in-hospital mortality is not limited to a single disease group or hospital unit, but represents a multifactorial outcome shaped by the interaction between patient vulnerability, acute clinical deterioration, and hospital capacity to provide timely and effective care.[4,6,8,13] The study selection process is presented in Figure 1.

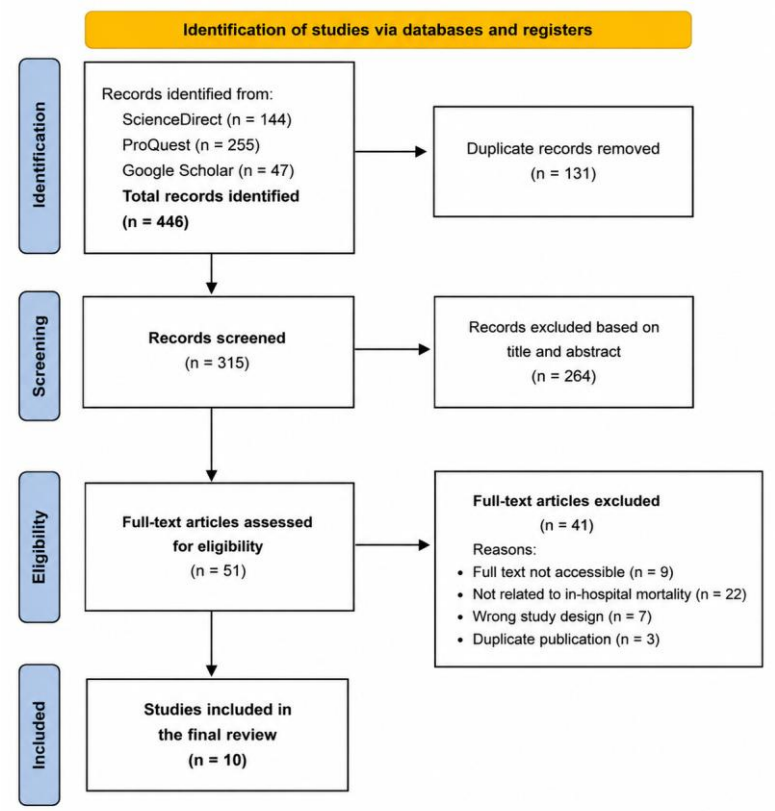

Figure 1. PRISMA-ScR flow diagram of the study selection process

The JBI critical appraisal indicated that all ten included studies were methodologically suitable for inclusion, with overall quality ranging from moderate to good. Most studies applied clear eligibility criteria, standardized outcome measurements, and appropriate multivariable analyses. Several methodological limitations were identified, including the predominance of retrospective and cross-sectional designs, single-center settings, reliance on administrative or routinely collected data, residual confounding, small numbers of mortality events in some studies, and limited temporal assessment. These limitations may have influenced the reported associations and reduced the ability to establish causal relationships. Therefore, the identified factors should be interpreted as being associated with in-hospital mortality rather than as direct causal determinants.

As shown in Table 2, the included studies varied in country, study design, hospital setting, mortality outcome, and the patient- and hospital-related factors reported. The synthesis indicates that patient-related factors were more frequently identified than hospital-related factors. Older age, comorbidity burden, disease severity, acute physiological instability, infection-related conditions, organ dysfunction, postoperative complications, obesity in specific clinical contexts, and medication-related risks emerged as recurring determinants of in-hospital mortality. Hospital-related factors, although reported less consistently, included emergency department length of stay, staffed-bed availability, emergency department level, surgical urgency, procedural complexity, critical care admission, failure-to-rescue, and medication safety. [1–10] These findings suggest that inpatient death is rarely explained by a single determinant, but rather by the accumulation of

chronic vulnerability, acute severity, complications, and the timeliness and effectiveness of hospital response.

Older age was one of the most consistent patient-related factors identified in this review. Lee et al. reported that age ≥65 years was associated with in-hospital mortality among critically ill patients admitted from the emergency department to the ICU, while Lentsck et al. found that age ≥60 years was associated with death among trauma patients admitted to the ICU[1,2] Similar patterns were observed in studies involving COVID-19, acute pulmonary embolism, type 2 diabetes mellitus-related admissions, and heart failure hospitalization.[6–8,10] The significance of this finding lies not only in chronological aging, but also in the biological and clinical consequences of aging. Older patients generally have lower physiological reserve, higher multimorbidity, greater susceptibility to infection and organ dysfunction, and reduced ability to compensate during acute illness. Therefore, age should be interpreted as a marker of vulnerability that may amplify the effects of acute severity, delayed treatment, and complications during hospitalization.

Comorbidity burden also emerged as an important determinant of in-hospital mortality. In the nationwide Korean study by Lee et al., a higher Charlson Comorbidity Index was associated with mortality among critically ill patients admitted from the emergency department to the ICU.[1] Lentsck et al. similarly identified comorbidity burden as a risk factor for death among trauma ICU patients.[2] In acute pulmonary embolism, Akolbire et al. reported that several comorbid and clinical conditions, including congestive heart failure, arrhythmia, liver disease, metastatic cancer, coagulopathy, weight loss, and acidosis, were associated with in-hospital mortality.[7] These findings indicate that comorbidities may worsen outcomes through reduced organ reserve, increased treatment complexity, higher risk of complications, and greater difficulty in achieving rapid clinical stabilization.

Table 2. The characteristics and synthesis of patient- and hospital-related factors from the included studies

No.	Author(s), year	Country	Study design	Hospital setting	Patient-related factors	Hospital-related factors
1	Lee et al., 2022	South Korea	Retrospective cohort study	Emergency department (ED), ICU	Age ≥65 years; Arrival via emergency ambulance Transfer from other hospitals Night-time presentation Higher Initial Triage score Artificial ventilation in the ED Charlson comorbidity index: >1	Staffed-bed availability Level of ED: Level 3 Prolonged ED LOS
2	Lentsck et al., 2020	Brazil	Retrospective cohort study	General ICU	Age: Age ≥60 years Comorbidity burden; CCI Greater trauma severity; Severe circulatory complications; Renal dysfunction; Higher APACHE II score.	Vasoactive drug use; Mechanical ventilation; Failure to perform blood culture at ICU admission
3	Ma et al., 2019	China	Retrospective cohort study	Surgical inpatient	Type II Diabetes Mellitus	Postoperative pneumonia

No.	Author(s), year	Country	Study design	Hospital setting	Patient-related factors	Hospital-related factors
4	Hădăreanu et al., 2025	Romania	Retrospective cohort study	Cardiac surgery department	No baseline demographic or comorbidity factor was consistently retained as an independent mortality predictor in the final model.	Emergency surgery Prolonged AXCT Prolonged cardiopulmonary bypass time
5	Osinaike et al., 2019	Nigeria	Prospective cohort study	Surgical department	Infective Cardiovascular and pulmonary complications.	Hepatobiliary procedures;
6	Palaiodimos et al., 2020	United States, New York	Retrospective cohort study	Medical ward and ICU setting	Age Sex: male Severe obesity, defined as BMI ≥35 kg/m²	No specific hospital-level factor was formally assessed as an independent determinant of mortality.
7	Akolbire et al., 2026	United States	Cross-sectional study	Hospital	Age Race and ethnicity (Asian or Pacific Islander) Primary insurance status (self pay) Comorbidities: hypotension, congestive heart failure, arrhythmia, liver disease, metastatic cancer, coagulopathy, weight loss, acidosis	Hospital type (teaching hospital)
8	Samsudin et al., 2026	Malaysia, Kuala Lumpur	Retrospective cross-sectional study	Tertiary teaching hospital	Age Sex Severity level 3	Casemix main group (central nervous system, hepatobiliary and pancreatic system, Respiratory system, infection and parasitic disease)
9	Raya Ortega et al., 2025	Spain	Retrospective cross-sectional study	Hospital	Age ≥ 75 Country of birth Area of origin Severity level (high) Mortality level (high) Admission service Treatment ACEI/ARB More than 10 diagnoses	Admission service (other units Discharge service (internal medicine)
10	Alrifady et al., 2024	Libya	Retrospective cross-sectional study	Hospital	tient-related factors were identified that focused on drug–drug interactions among hospitalized haemodialysis patients	Drug-drug interaction

Evidence from Indonesia also supports the importance of age, comorbidity, and complications in predicting inpatient mortality. Darmawan et al., using Indonesian National Health Insurance claim sample data from 2017–2022, reported that hospitalized patients with type 2 diabetes mellitus had

an in-hospital mortality rate of 6.6%, with higher mortality risk among older patients, patients with comorbidities, and patients with severe complications.[11] This national evidence is consistent with findings from Malaysia by Samsudin et al., which showed that age, sex, disease severity, and diagnostic groups involving the central nervous system, hepatobiliary and pancreatic system, respiratory system, and infectious or parasitic diseases were associated with mortality among type 2 diabetes mellitus-related admissions.[8] Together, these findings suggest that chronic disease burden and complication severity are important mortality pathways in Southeast Asian hospital settings.

Disease severity and acute physiological instability were also central pathways leading to mortality. Higher triage urgency, artificial ventilation in the emergency department, higher APACHE II score, circulatory complications, renal dysfunction, hypotension, acidosis, and high severity levels were repeatedly reported across the included studies.[1,2,7,8,10] These factors reflect the acute burden of illness at presentation or during inpatient care. Their presence suggests that mortality risk is shaped not only by pre-existing vulnerability but also by the degree of physiological disturbance occurring during hospitalization. Therefore, triage categories, severity scores, and markers of organ dysfunction are clinically important because they may support early identification of high-risk patients and guide timely escalation of care.

Infection-related conditions were important across several clinical contexts. Ma et al. found that postoperative pneumonia increased mortality among surgical inpatients, and mortality increased further when type 2 diabetes mellitus and postoperative pneumonia occurred together.[3] This finding is clinically meaningful because it illustrates the interaction between chronic vulnerability and hospital-related or postoperative complications. Patients with diabetes may have impaired immune response, poorer wound healing, higher risk of infection, and greater vulnerability to metabolic instability. When postoperative pneumonia occurs in this population, the combined burden may increase the risk of respiratory failure, sepsis, prolonged hospitalization, and death.[3,8,11]

Surgical and postoperative studies highlighted the importance of procedural urgency, surgical complexity, postoperative complications, and rescue capacity. Hădăreanu et al. identified emergency surgery, prolonged aortic cross-clamp time, and prolonged cardiopulmonary bypass time as predictors of prolonged ICU stay and in-hospital mortality after cardiac surgery.[4] Osinaike et al. emphasized postoperative complications, critical care admission, failure-to-rescue, and postoperative mortality among surgical patients in Nigeria. [5]These findings suggest that perioperative mortality is influenced by both patient condition and the quality of perioperative systems. Emergency procedures often allow less time for preoperative optimization, while complex procedures increase the risk of hemodynamic instability, bleeding, infection, and organ dysfunction. Therefore, prevention of surgical mortality requires risk stratification, perioperative optimization, postoperative monitoring, early complication detection, and timely escalation to critical care.[5,12]

Hospital-related factors were less consistently reported across the included studies, but they are important because they represent potentially modifiable targets for quality improvement. Lee et al. found that prolonged emergency department length of stay, emergency department level, and staffed-bed availability were associated with in-hospital mortality among critically ill patients admitted from the emergency department to the ICU.[1] These findings indicate that hospital mortality is influenced not only by patient condition but also by care processes and system capacity. Prolonged emergency department length of stay should not be interpreted only as waiting time; it may also reflect emergency department crowding, limited staffed beds, delayed ICU admission, restricted access to definitive care, and strain on hospital resources. In critically ill patients, such delays may prolong the period before optimal monitoring, organ support, or specialist management is provided.[1,13,14]

Several ICU-related variables, including mechanical ventilation, vasoactive drug use, blood transfusion, advanced respiratory support, and advanced circulatory support, were reported in trauma and postoperative populations.[2,4] These factors require cautious interpretation. They should not be understood as direct causes of mortality because patients requiring these interventions are usually more severely ill. This reflects potential confounding by indication, in which an intervention appears associated with mortality because it is given to patients with greater physiological instability. The practical implication is not to avoid such interventions, but to strengthen early detection, appropriate timing, adequate monitoring, and standardized protocols for critical care support.

Medication-related risk was identified in one included study among hospitalized haemodialysis patients. Alrifady et al. examined drug–drug interactions and reported their prevalence, predictors, and impact on in-hospital mortality.[9] Although medication-related determinants were less frequently reported than age, comorbidity, or disease severity, they remain important in high-risk inpatient populations. Haemodialysis patients often have multimorbidity, altered pharmacokinetics, impaired renal clearance, and polypharmacy, which increase the risk of adverse drug events, toxicity, therapeutic failure, and drug–drug interactions. This finding suggests that medication safety should be integrated into mortality reduction strategies, particularly among patients with renal disease, multimorbidity, and complex treatment regimens.

Comparison across studies shows both similarities and differences in mortality determinants. Similarities were observed in the repeated influence of age, comorbidity, severity of illness, organ dysfunction, infection, and complications across different settings. [1–11] These recurring factors suggest that patient vulnerability and clinical deterioration are common pathways to in-hospital death regardless of disease category. Differences between studies were mainly related to clinical context. In surgical populations, procedural urgency, operative complexity, postoperative pneumonia, and failure-to-rescue were more prominent.[3–5,12] In medical populations, disease-specific severity, obesity, comorbidity patterns, and socioeconomic factors were more visible.[6–8,10,11] In emergency and ICU pathways, patient flow, emergency department length of stay, ventilatory support, vasoactive drug use, and ICU-level care were more frequently reported.[1,2,13,14] These differences emphasize that mortality prevention strategies should be adapted to the clinical setting rather than applied as a single uniform intervention.

The strength of evidence varied across the included studies. Large nationwide or national database studies, such as those by Lee et al., Akolbire et al.provide broader generalizability because of their large sample sizes and wider population coverage.[1,7] Cohort studies, including those by Lentsck et al., Ma et al., Hădăreanu et al., Osinaike et al., and Palaiodimos et al., provide useful clinical and temporal information, although some were limited to specific patient groups or hospital settings.[2–6] Retrospective cross-sectional studies, such as those by Samsudin et al., Raya Ortega et al., and Alrifady et al., are useful for mapping associations but have more limited ability to establish temporality or causality.[8–10] Therefore, the included studies should not be interpreted as having equal evidentiary weight. Consistent patterns across different designs and settings should be emphasized, while disease-specific, single-center, and cross-sectional findings should be interpreted within their clinical context.

From a clinical and managerial perspective, the findings of this review suggest that in-hospital mortality should be understood as a chain involving vulnerability, deterioration, detection, response, and rescue. Patient-related determinants such as older age, comorbidity, disease severity, infection, organ dysfunction, postoperative complications, and medication-related risks create or intensify clinical vulnerability. Hospital-related determinants such as emergency department length of stay, staffed-bed availability, ICU access, surgical urgency, procedural complexity, and failure-to-

rescue influence whether deterioration is detected and managed in time.[5,12–16] Therefore, hospital mortality reduction requires an integrated approach that combines patient-level risk stratification and system-level improvement.

Several practical implications can be drawn from this review. First, hospitals should strengthen early identification of high-risk patients at admission, especially older patients, patients with multimorbidity, patients with high triage urgency, and those with evidence of organ dysfunction or infection. Second, structured monitoring systems, such as early warning scores and standardized escalation pathways, may help detect deterioration before irreversible clinical decline occurs.[16] Third, patient flow management should be improved to reduce emergency department boarding and delays in ICU transfer.[1,13,14] Fourth, surgical services should emphasize perioperative risk assessment, prevention of postoperative complications, and failure-to-rescue reduction.[5,12] Fifth, medication safety review should be prioritized in patients with renal disease, polypharmacy, and complex comorbidities.[9] Finally, continuous mortality audit should be used not only to count deaths but also to identify preventable factors, delays, communication failures, and system gaps.

This scoping review has several limitations. First, the included studies were heterogeneous in terms of study design, patient population, clinical setting, outcome definition, and statistical analysis; therefore, the findings were synthesized descriptively rather than quantitatively. Second, most included studies were observational, so the reported factors should be interpreted as associations rather than causal determinants. Third, several factors, particularly ICU-related interventions and care-intensity markers, may reflect severity of illness or confounding by indication rather than direct causal effects of hospital care. Fourth, disease-specific and single-center studies may have limited generalizability to broader inpatient populations. Fifth, hospital-related factors were less frequently examined than patient-related factors, limiting the ability of this review to fully compare the relative contribution of patient vulnerability and hospital system performance.

Despite these limitations, this scoping review provides an integrated map of patient- and hospital-related factors associated with in-hospital mortality. The findings show that mortality among hospitalized patients is shaped by the interaction between baseline vulnerability, acute clinical deterioration, complications, and hospital capacity for timely detection and rescue. Future research should develop and validate integrated prediction models that combine patient-level clinical risk factors with hospital process indicators. Such models may support early risk identification, resource allocation, quality improvement, and targeted mortality reduction strategies across different hospital settings.

CONCLUSION

In-hospital mortality is a multifactorial outcome shaped by the interaction between patient-related vulnerability and hospital-related processes. The findings highlight the importance of early risk identification, timely clinical escalation, and adequate hospital capacity to support safe and effective care. Future studies should develop and validate integrated mortality prediction models combining patient-level vulnerability and hospital-level process indicators.

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