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Review Article

Criteria for Patient Admission to the Intensive Care Unit during Mass Casualty Incidents: A Scoping Review

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Abstract

Introduction: Mass casualty incidents (MCI) elevate the demand for ICU admissions. With limited resources and many injured, prioritizing and triaging patients is essential. However, there are no standardized criteria for ICU admissions during MCIs. This study aimed to identify the criteria for ICU admission during mass casualty incidents.

Methods: This study used a scoping review based on the PRISMA 2020 protocol. Searches were conducted in the PubMed, Web of Science, and Scopus databases using specific keywords, applying inclusion and exclusion criteria for relevant references through December 2024. A manual search of Google Scholar, books, and reference lists was also performed. EndNote software version 20 was used for data management.

Results: Of the 298 studies reviewed, 18 were ultimately selected, resulting in the identification of practical criteria for admitting patients to the intensive care unit during mass casualty incidents. These criteria were summarized and categorized into seven components: respiratory disorders, cardiovascular disorders, neurological disorders, injuries and bleeding, multisystem issues, probability of survival, and diagnostic tests.

Conclusions: This scoping review first determines ICU admission criteria from MCI-specific literature within a seven-component framework. It highlights components and criteria of the respiratory (respiratory rate, oxygen saturation, need for mechanical ventilation), cardiovascular (systolic blood pressure, pulse rate, inotropic medications), and nervous systems (Glasgow Coma Scale) as the three most frequently cited areas. These criteria may support faster and more informed ICU admission decisions and may help researchers develop guidelines or triage tools for ICU admission during mass casualty incidents.

Keywords: Intensive Care Unit; ICU Admission; Mass Casualty Incidents; Criteria

Introduction

During disasters or Mass Casualty Incidents (MCIs), the number of patients seeking medical services at hospitals rises significantly. By definition, a mass casualty incident overwhelms the healthcare system in a short time when the number of injured or ill individuals significantly exceeds the available resources and local capacities. The World Health Organization(WHO) defines MCIs as disasters and major events characterized by the severity, number, and variety of casualties.[1] MCIs can result from natural disasters, man-made accidents, terrorist attacks, or traffic accidents. Regardless of the cause, the defining feature of an MCI is the substantial number of casualties.[2]

The disaster management cycle consists of four fundamental stages: mitigation and prevention, preparedness, response, and recovery. These stages represent actions taken pre-disaster, during, and post-disaster to minimize risks and mitigate harmful consequences. The goal is to reduce human, economic, and environmental losses.[3] During the response phase, one of the fundamental needs is to address health and medical demands, as the need for health and medical services significantly increases during disasters.[4] Hospitals and health centers are vital for providing prompt, effective, and timely health services, which can greatly reduce mortality rates and increase survival rates.[5] Hospitals must respond to increased patient demands during incidents while continuing their regular duties.[6] Lack of disaster planning and organization, as well as the unpreparedness of hospitals and medical centers to manage crises resulting from disasters, can lead to irreparable damage.[7,8] Promptly responding to MCIs, effectively communicating information, deploying medical facilities efficiently, performing accurate triage, and providing appropriate treatment can significantly reduce mortality and morbidity rates in such situations.[9]

MCIs led to a higher demand for hospitalization, particularly for admission to Intensive Care Units (ICUs). Between 2008 and 2017, the number of ICU admissions in Australia and New Zealand increased at a faster rate than the availability of ICU beds, according to the Australian and New Zealand Intensive Care Society (ANZICS). This rise is due to the wide variety of injuries and illnesses resulting from accidents and disasters, leading to a growing demand for hospital and ICU admissions. As a result, effectively managing ICU admissions has become a crucial component of MCI management plans.[10]

During mass casualty incidents and pandemics, allocating the right resources in hospitals becomes very challenging, particularly when prioritizing ICU admissions. The influx of critically ill patients into healthcare facilities complicates the decision-making process for allocating available resources and providing necessary medical care. In mass casualty situations, it is often impossible to provide routine and standard medical interventions, which can lead to an increase in the number of deaths. Therefore, adopting the approach of "providing the greatest possible services to the largest number of patients while saving as many lives as possible" necessitates a model that allows for the prioritization of patient admissions to the intensive care unit. This model should also ensure the optimal use of facilities and equipment, making such decisions both defensible and feasible[11].

Various criteria have been proposed for the patient's admission with poor physical conditions into ICUs. However, studies indicate that there is often no universally accepted and standardized tool among experts. Even when such a tool exists, it frequently lacks comprehensive criteria that take all relevant factors into account. Moreover, in routine situations where this tool is not used, it is expected that mass casualty incidents where the number of patients with serious physical conditions significantly increases will further complicate the process of prioritizing and admitting patients to the ICU.[12-16] Therefore, this study aimed to identify the criteria affecting patient admission to the intensive care unit during MCIs.

Methods

A scoping review was conducted following the PRISMA 2020 framework. The steps undertaken include:

Search Strategy: The literature search was performed in PubMed, Web of Science, and Scopus using the keywords "intensive care unit," "ICU admission," "mass casualty incidents," and criteria, along with relevant MeSH terms. In addition, a manual search of Google Scholar, relevant books, and reference lists was conducted to ensure comprehensive coverage.

Inclusion and exclusion criteria: Studies describing criteria influencing ICU admission during mass casualty incidents were included without time restrictions. Studies related to routine ICU admission, articles without full-text access, and non-English publications were excluded.

Study selection and data extraction: Two independent reviewers screened the titles and abstracts. Any disagreements were resolved by a third reviewer. A checklist was developed to extract essential data, including author name, publication year, study title, and identified ICU admission criteria. The study selection process is presented in the PRISMA flow diagram (Figure 1).

Data management: EndNote version 20 was used for reference management and data organization.

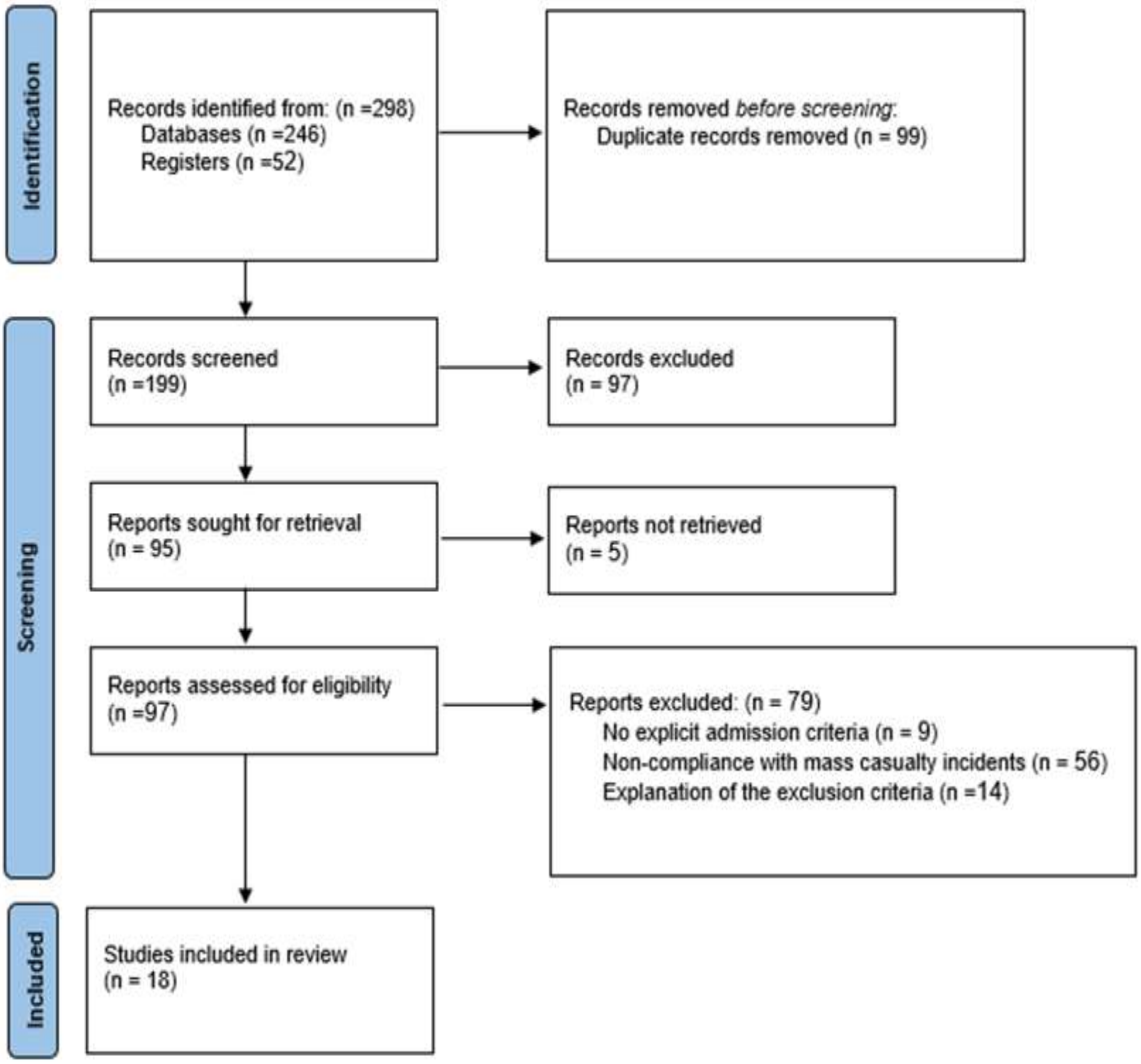

Figure 1. PRISMA diagram

Results

By implementing a systematic search strategy and utilizing relevant keywords, 298 studies were identified, with 99 duplicates excluded. Of the remaining 199 articles, 97 were eliminated after reviewing the titles and abstracts, as they were found irrelevant to the topic. Furthermore, five articles were removed due to a lack of full access. After full-text assessment, seventy-nine articles were excluded from consideration due to their failure to meet the study's objectives and inclusion criteria. In the end, 18 studies that aligned with the inclusion criteria and study objectives were included in the scoping review process. The final 18 studies were published between 2001 and 2022 (Supplementary File: Practical Criteria for Admitting Patients to Intensive Care Units in Mass Casualty Incidents). Upon reviewing these studies, we extracted and analyzed practical criteria for patient admission to the ICU during MCIs. Each study presented distinct criteria for ICU admission, some consistent across the research, while others varied. According to the authors, patients who meet one or more of these criteria may be admitted to the ICU. The criteria primarily focused on the damage and dysfunction of vital organs in patients. Through a comprehensive review of various studies, we identified several key components that outline the criteria for admitting patients to the ICU during such incidents. These components encompass respiratory disorders, cardiovascular disorders, neurological disorders, injuries and bleeding, multisystem involvement, the probability of survival, and the results of diagnostic tests (Table 1). Our analysis of the studies indicates that the criteria related to the respiratory, cardiovascular, and nervous systems are the most prominent. Notably, respiratory criteria were emphasized in 16 of the 18 studies reviewed, cardiovascular criteria in 14, and neurological criteria in 13 (Table 2).

The review of the included studies demonstrated that ICU admission criteria during mass casualty incidents primarily focused on physiological instability, organ dysfunction, injury severity, and survival probability. Respiratory compromise was the most frequently reported indication for ICU admission and included the need for invasive or mechanical ventilation, severe hypoxemia, respiratory failure, respiratory acidosis, airway obstruction, and respiratory distress. These criteria were consistently reported across several studies, particularly those conducted by Christian, Sprung, Downar, and Joynt.[17-20]

Hemodynamic instability was another major determinant of ICU admission. Common indicators included severe hypotension, shock, impaired tissue perfusion, the need for vasopressor or inotropic support, and significant cardiovascular compromise. Several studies also emphasized abnormalities in heart rate and blood pressure as important triage parameters during mass casualty events.[17-22]

Neurological status was frequently incorporated into admission decision-making. Decreased levels of consciousness measured by tools such as the Glasgow Coma Scale (GCS) or AVPU scale, pupillary abnormalities, persistent seizures, lethargy, and increased intracranial pressure were repeatedly identified as indications for intensive care admission.[21,23-26]

Several studies highlighted the importance of organ dysfunction and severity scoring systems. The Sequential Organ Failure Assessment (SOFA) score was the most commonly cited framework and was recommended for assessing neurological, cardiovascular, renal, hepatic, hematologic, and respiratory dysfunction. Other scoring systems, including the Modified Early Warning Score (MEWS), Injury Severity Score (ISS), and Clinical Frailty Scale (CFS), were also used to support triage decisions.[23,27-31]

Trauma-related conditions represented another important category of admission criteria. Patients with severe injuries, life-threatening trauma, major hemorrhage, severe burns, multiple injuries, or injuries involving vital organs were frequently prioritized for ICU care. Likewise, several studies emphasized the need to consider the severity and salvageability of injuries when allocating critical care resources.[25,27,32,33]

Beyond acute physiological parameters, some studies incorporated prognostic considerations into triage decisions. Factors such as the probability of survival, underlying chronic diseases, patient frailty, age, response to initial treatment, and overall disease severity were proposed as additional criteria for prioritizing ICU admission when resources were limited.[11,20,28,30,32,33]

Finally, a smaller number of studies identified laboratory and diagnostic abnormalities, including arterial blood gas disturbances, electrolyte imbalances, abnormal imaging findings, and other clinically significant investigations, as supportive criteria for ICU admission during mass casualty incidents.[11,20,25,26,33]

Table 1. Critical Components and Practical Criteria for Admitting Patients to the ICU During a Mass Casualty Incident

Components	Practical criteria for patient admission
Respiratory system	Disorders of respiratory rate
	Ineffective breathing patterns
	Decreased oxygen saturation (SpO2)
	Need for mechanical ventilation
	Need for intubation
	Pulmonary diseases
	Severe hypoxemia
	Respiratory arrest
	Severe respiratory distress
Cardiovascular system	Severe blood pressure disorders (both hypotension and hypertension)
	Heart rhythm disorders (dysrhythmia)
	Cardiogenic shock
	Heart disease
	Requirement for continuous cardiopulmonary monitoring
	Need for medications to raise or lower blood pressure.
	Cardiac arrest
	Cardiovascular surgery
	Heart attack
Nervous system	Decreased levels of consciousness (GCS, AVPU, etc.)
	Pupillary disorders
	Increased intracranial pressure (ICP)
	Persistent seizures
	Stroke
Trauma and bleeding	Head trauma
	Abdominal and thoracic trauma
	Severe arterial bleeding
	Requirement for major surgery
	Severe limb trauma and multiple fractures
	Trauma to vital organs
Multi-system	Liver failure
	Severe renal failure
	Multiple organ failure
	Severe water and electrolyte imbalances
	Severe acid-base disorders (ABG)
	Severe hyperthermia and hypothermia
	Systemic infections (sepsis)
	Pregnancy-related complications
	Poisoning
	Requirement for high levels of nursing care
	Burns
	Metabolic disorders (hyperglycemia and hypoglycemia)
Survival probability	Chronic diseases
	Response to initial treatment
	Severity and degree of injury
Diagnostic tests	Abnormal paraclinical findings (ultrasound, CT scan, MRI, chest X-ray, etc.)
	Abnormal laboratory findings (blood sample, urine sample, etc.)

Table 2. Importance of Components in Studies

#	Components	Number of studies in which the components are mentioned (N=18)
1	Respiratory system disorders	(88.9%) (n=16)
2	Cardiovascular system disorders	(77.7%) (n=14)
3	Nervous system disorders	(72.2%) (n=13)
4	Multisystem disorders	(72.2%) (n=13)
5	Trauma and bleeding	(44.4%) (n=10)
6	Diagnostic tests	(38.8%) (n=7)
7	Probability of survival	(27.7%) (n=5)

Discussion

Mass casualty incidents and epidemics require an appropriate model for prioritizing patient admission to intensive care units and optimal use of facilities and equipment.[11] Various tools and criteria have been suggested for prioritizing patients for hospitalization and ICU admission. However, research indicates these tools are often inadequate and ineffective, as they do not operate optimally across different conditions and situations.[12-14] Thus, some patients who need ICU admission are not admitted, while others with more suitable conditions are incorrectly admitted.[15,16] The accuracy of admission criteria is often uncertain. For instance, during the COVID-19 pandemic, age was used as a criterion for ICU admissions based on the belief that younger patients were more likely to recover. As a result, elderly individuals were not prioritized for ICU admission due to concerns about their poorer prognosis.[34] Other criteria, including the presence of acute physiological disorders and a history of underlying chronic diseases, were taken into account when considering a patient's admission to the ICU. However, in many instances, the decision to admit a patient to the intensive care unit ultimately relied on the personal judgment of the physicians.[23]

In reviewing reports and research conducted globally, it has been observed that the SOFA (Sequential Organ Failure Assessment) protocol is used to prioritize patient admissions in ICUs. This tool provides the medical team with valuable insights for optimizing care, particularly for patients in more critical conditions. The SOFA score continuously evaluates key parameters related to vital organs, including the lungs, cardiovascular system, liver, blood, kidneys, and central nervous system, throughout the patient's stay in the ICU. Generally, a higher SOFA score indicates a greater probability of mortality. However, there are concerns regarding certain aspects of the SOFA score. These include the assessment of consciousness through the Glasgow Coma Scale (GCS), the measurement of support from blood pressure-raising medications (inotropes), its inapplicability to pediatric patients, and overall concerns about the effectiveness of the score itself[35]. Scoring systems like the SOFA score, Simple Triage Scoring System (STSS), and National Early Warning Score (NEWS) are effective tools for evaluating a patient's condition, particularly when they are used continuously to monitor progress. However, these scoring systems should not be the only factor considered when deciding whether to start, continue, or withdraw intensive care treatment.[36]

Some sources present the Apache II criteria as a standard for admission to intensive care units under typical circumstances.[33] The APACHE scoring system was introduced in 1981 as a method for measuring the severity of illness and was revised to Apache II in 1985. The Apache II score is a widely recognized index used to assess the severity of illness in hospitalized adults. It consists of three main components: acute physiological symptoms, patient age, and pre-existing chronic diseases. The total score for a patient indicates the probability of death; thus, a higher score corresponds to a higher likelihood of mortality. The Apache scale evaluates the severity of risk based on data collected within the first 24 hours of a patient's admission to the ICU, although it does not serve as a specific criterion for ICU admission.[37]

A report published by the World Federation of Societies of Intensive and Critical Care Medicine emphasizes the importance of equitable access to critical care resources when determining how to prioritize ICU admissions. However, it also notes that there are limitations in the algorithms and protocols used for prioritizing ICU patients.[38] When changes in the prioritization process are implemented consciously and correctly, they can significantly impact operational processes, leading to effective results and cost reductions.[39]

The criteria for admission to the ICU generally focus on the extent of damage and dysfunction in patients' vital organs[33,35]. In earlier studies, the most frequently mentioned criteria for ICU admission were based on the "benefits of medical interventions" or the principle of "first come, first served."[20,34]. In recent years, studies have shifted away from traditional criteria and are now highlighting new ones. [7,10,17,21-23,26-28,30,32,33,35,36,40-45]

According to a review of studies in this research, the criteria for admitting patients to the ICU during mass casualty incidents are slightly different from those used in normal circumstances. Researchers and experts note that during mass casualty incidents and disasters, the number of patients increases significantly, which limits the time available for patient assessment and additional diagnostic tests. As a result, there is a heightened need for swift decision-making. In contrast, under normal conditions, where the patient load is lower and there is sufficient time for thorough examination, different criteria can be applied for ICU admission. Generally, the criteria identified in this study align with the standard admission guidelines established for typical situations and do not significantly conflict with them; rather, they tend to overlap.[46-51]

The comparison between the criteria for admitting patients to the ICU under normal conditions and during mass casualty incidents has been expressed in different ways in the sources. In Marino's The ICU Book, the common criteria for admitting patients to the ICU are continuous monitoring of critically ill patients, support of vital organs, and advanced interventions, with respiratory failure and the need for mechanical ventilation being the most important criteria.

Table 3. ICU Admission Criteria (Based on Marino's The ICU Book)

System	ICU Admission Criteria	Examples
Respiratory	Need for advanced respiratory support or continuous monitoring	Mechanical ventilation, ARDS, severe hypoxemia, progressive respiratory distress
Hemodynamic	Circulatory instability or need for vasoactive medications	Septic, cardiogenic, hypovolemic, or obstructive shock; norepinephrine infusion
Cardiac	Life-threatening cardiac disorders	Unstable arrhythmias, ACS with hemodynamic instability, post-cardiac arrest care
Neurologic	Severe CNS dysfunction	GCS $\leq$ 8, status epilepticus, elevated ICP, severe stroke
Renal	Acute kidney failure requiring close monitoring or advanced therapy	Severe AKI, CRRT, hemodialysis
Metabolic	Severe acid-base or electrolyte disturbances	Severe acidosis, life-threatening hyperkalemia, severe DKA, HHS
Infectious	Severe infection with organ dysfunction	Severe sepsis, septic shock
Toxicologic	Poisoning with risk of organ failure or need for intensive monitoring	Drug overdose with respiratory failure or decreased consciousness
Postoperative	Need for invasive monitoring or organ support	Cardiac surgery, neurosurgery, major vascular surgery
Multiple Organ Failure	Simultaneous dysfunction of two or more vital organ systems	MODS, sepsis with multi-organ involvement

Miller's Basic Anesthesia describes the primary purpose of the intensive care unit (ICU) as monitoring and supporting patients with life-threatening conditions and emphasizes respiratory support and the management of multiple organ failure as top priorities.

A key contribution of the present study is the identification of several important components and criteria for ICU admission during mass casualty incidents that are less frequently emphasized in standard reference texts under routine conditions—particularly those related to trauma, hemorrhage, and diagnostic testing. In this review, trauma and bleeding, as well as diagnostic test findings, were identified as relevant components for ICU admission in MCIs. Nevertheless, disorders of the respiratory, cardiovascular, and neurological systems were identified as the most critical criteria, consistent with existing reference texts and established ICU admission practices.

According to the findings of this study, several key components are critical for ICU admission during mass casualty incidents. These components include respiratory disorders, cardiovascular disorders, neurological disorders, injuries and bleeding, multisystem involvement, probability of survival, and diagnostic tests. The reviewed literature suggests that patients presenting with severe impairment in any of these domains should be considered for ICU admission in such circumstances.

Across most studies, the primary criteria for ICU admission focused on the respiratory, cardiovascular, and neurological systems. This emphasis likely reflects the fact that dysfunction in these systems can be rapidly identified through clinical assessment and readily available diagnostic measures. In contrast, evaluating survival probability and conducting comprehensive diagnostic testing often requires additional time and more detailed assessments. Consequently, triage decisions tend to prioritize immediately measurable physiological parameters, whereas survival probability and extended diagnostic findings are generally considered secondary factors in urgent ICU admission decisions.

Table 3 presents the relative importance of each component, as reflected by the frequency with which they were reported across the included studies and their prioritization as key criteria for ICU admission. The majority of studies (n = 16) identified respiratory distress as the most critical criterion for ICU admission. In contrast, diagnostic tests, trauma and bleeding, multisystem disorders, and survival probability were reported in fewer studies, suggesting that these factors were considered less influential in decisions regarding ICU admission during mass casualty incidents.

In most mass casualty incidents (MCIs), trauma and hemorrhage are frequent complications. In this review, trauma and hemorrhage were identified as primary criteria for ICU admission in 44.4% of the studies. However, these factors were cited less frequently than vital sign parameters such as respiratory rate, heart rate, blood pressure, temperature, and level of consciousness, which were more commonly emphasized as indicators for admission. Consequently, the nature of an injury or the type of incident alone was rarely sufficient to justify ICU admission. While recent literature has heavily focused on pandemic-related scenarios, such as COVID-19, due to their profound impact on patient vital signs, trauma, and hemorrhage, particularly when combined with physiological instability, remain critical criteria for ICU admission during MCIs.

As a practical application of these findings, a triage checklist or preliminary guideline may be developed to prioritize ICU admissions during MCIs, though this requires further validation (Table 4). This proposed checklist consists of seven components, each scored on a four-level scale: no impairment (0), mild (1), moderate (2), and severe (3). Component scores are assigned based on the number of criteria met: more than three criteria yield a maximum score of 3; two criteria yield 2; one criterion yields 1; and the absence of impairment yields 0. The total score, ranging from 0 to 21, provides a quantitative basis for triage, with higher scores indicating higher priority for ICU admission.

Table 4. ICU Admission Triage Checklist for Mass Casualty Incidents (MCI)

#	Component	Key Criteria	Score (0-3)
1	Respiratory System	Respiratory rate disorders, ineffective breathing, low SpO2, ventilator need, severe hypoxemia, respiratory arrest, severe distress	☐0 ☐1 ☐2 ☐3
2	Cardiovascular System	BP disorders, dysrhythmia, cardiogenic shock, continuous monitoring, vasoactive meds, cardiac arrest, heart surgery	☐0 ☐1 ☐2 ☐3
3	Nervous System	Decreased consciousness (GCS), pupillary changes, ↑ICP, persistent seizures, stroke	☐0 ☐1 ☐2 ☐3
4	Trauma & Bleeding	Head/chest/abdominal trauma, severe bleeding, major surgery, multiple fractures	☐0 ☐1 ☐2 ☐3
5	Multi-system	Sepsis, pregnancy complications, poisoning, burns, high nursing care, metabolic disorders	☐0 ☐1 ☐2 ☐3
6	Survival Probability	Chronic diseases, response to initial treatment, injury severity	☐0 ☐1 ☐2 ☐3
7	Diagnostic Tests	Interference in lab or para-clinical tests (CT, MRI, US, X-ray, etc.)	☐0 ☐1 ☐2 ☐3

Conclusion

The most important difference between practical criteria for admitting patients in mass casualty situations compared to normal conditions is the increased need for services, time constraints, and lack of facilities, which affect the speed of decision-making and correct response. In this situation, patient admission criteria for ICU admission are of vital importance. The criteria and components derived from this study enable better and faster decision-making, while their use in triage guidelines and forms helps in the correct admission of casualties to the ICU, especially in situations with mass casualties. Based on the results of the present study, the most important components and criteria for admitting patients to the intensive care unit in mass casualty incidents are the respiratory system (respiratory rate - saturation - need for mechanical ventilation), the cardiovascular system (systolic blood pressure - pulse rate - need for inotropic drugs), and the nervous system (level of consciousness based on GCS). If sufficient time and facilities were available, then other criteria obtained from this study could be used to make decisions about patient admission.

Limitations

This review may not have identified all relevant studies in the published and gray literature despite efforts to conduct a comprehensive search. The search strategy included terms commonly used to describe the scoping review process; however, additional relevant terms may exist. Although multidisciplinary databases (PubMed, Web of Science, and Scopus) as well as Google were searched, the strategy may have been biased toward the health and medical sciences. Because the review primarily included English-language studies, language bias may have occurred and relevant non-English research may have been excluded. Furthermore, the methodological quality of the included studies was not assessed, which may affect the strength of the resulting recommendations. Finally, the identified criteria apply to adult ICU admissions, and the criteria for pediatric ICU admission during mass casualty incidents may differ.

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Conflict of Interest Disclosures

The authors declare no conflict of interest.

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Authors' Contributions

KJ and BEB designed the research. BEB collected the data. KJ, BEB, MM, AE, and HJ took part in analyzing the data. All the authors prepared the primary manuscript and then finalized it.

Ethical Statement

This study was approved by Shahid Beheshti University of Medical Sciences, Tehran, Iran, under the code of IR.SBMU.PHNS.REC.1403.125.

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