



Initial Emergency Management of Trauma: A Literature Review

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Abstract

Trauma continues to be one of the leading causes of mortality and disability worldwide, including in Indonesia, with the most critical period occurring within the golden hour. Elevated mortality rates are often linked to delayed medical response, the absence of standardized treatment protocols, and limited healthcare resources. Objective: This review aims to assess the effectiveness of internationally recognized, protocol-driven interventions that have been adapted to the Indonesian context in enhancing trauma care outcomes. A systematic-narrative literature review was conducted in accordance with the PRISMA 2020 guidelines. Sources included SINTA, Scopus, ClinicalKey, as well as conference proceedings and dissertations published between 2023 and 2024. Each study was evaluated for methodological rigor, strength of evidence, and applicability to emergency care settings in Indonesia. Thematic analysis was applied to synthesize the findings. Adaptations of ATLS protocols, interdisciplinary simulation-based training, and the implementation of digital technologies for triage and prehospital communication demonstrated the potential to reduce trauma-related mortality by up to 30%. Furthermore, the early administration of tranexamic acid (TXA), application of tourniquets, and whole blood transfusion proved highly effective in managing severe trauma cases. The integration of international trauma care protocols with locally contextualized innovations and digital health technologies holds significant promise for improving the quality and effectiveness of trauma management in Indonesia.

Introduction

Trauma remains one of the leading causes of morbidity and mortality worldwide, including in Indonesia, especially during the critical golden hour (Hardianti, 2023; Apriawan et al., 2025; Rofananda et al., 2025). Most trauma-related deaths occur before patients receive definitive care, reinforcing the urgency of improving initial response in the healthcare system.

In Indonesia, challenges in trauma management include limited access to transportation, a lack of triage equipment, and variations in the competence of healthcare personnel. Research from FK-UMI shows that triage skills and the speed of response of medical personnel in the emergency room still need improvement. The *Universa Medicina* report also highlights the uneven distribution of simple life-saving equipment such as tourniquets across various service facilities (Syatar et al., 2024; Yordanus et al., 2023).

International guidelines such as ATLS have long established the ABCDE protocol as the foundation of trauma management (Lodemann et al., 2022; Bakhru et al., 2023). ClinicalKey-based studies show the benefits of tranexamic acid (TXA), pre-hospital bleeding control, and

modern transfusion strategies as integral parts of this protocol. However, evidence regarding the adaptation of this protocol in the Indonesian context is still limited (Irianto et al., 2023; Willetts et al., 2022; Brooks et al., 2021).

The latest European trauma guidelines emphasize practices such as permissive hypotension, massive transfusion protocol (MTP), and whole blood transfusion as key components of severe trauma management. Further comparative studies show that whole blood transfusion has advantages over component therapy in cases of massive trauma (Dorken-Gallastegi et al., 2024; Rossaint et al., 2023).

In addition to technical aspects, trauma management requires empathy and comprehensive documentation for clinical and forensic purposes. A case study by Universa Medicina shows that the timely use of tourniquets and TXA in severe limb trauma significantly increases survival rates (Irianto et al., 2023; Muhklis et al., 2024).

Interdisciplinary simulation-based training and adaptation of local protocols, such as the burn treatment developed by the FK-UMI team, demonstrate that evidence-based innovations can strengthen the preparedness of the healthcare system. Digital technology support, such as the ClinicalKey interactive module and Rosen's Emergency Medicine standard literature (2023 edition), provides a knowledge base for emergency department personnel and trauma coordinators in Indonesia (Syatar et al., 2024; Nurlaelah et al., 2024; Nurumal et al., 2022).

Although there is promising evidence regarding the effectiveness of international protocols and local innovations, systematic evaluations of the implementation of these protocols in the Indonesian context remain limited. This underscores the need for large-scale research evaluating both clinical outcomes and systemic integration in emergency services.

Methods

Literature screening steps included: initial search → deduplication → title and abstract screening → full text checking → data extraction. Researchers also assessed study quality using tools such as JBI for various designs (case report, observational), AMSTAR 2 for reviews, and AGREE II if guidelines were available.

Inclusion Criteria: 1) Publication type: Original research articles, systematic reviews, meta-analyses, clinical guidelines, highly relevant case reports, or conference proceedings published between 2023 and 2025; 2) Study population: Acute trauma patients in the golden hour phase, without restrictions on gender, age, or trauma mechanism; 3) Interventions studied: Advanced Trauma Life Support (ATLS) protocol, tranexamic acid (TXA), tourniquet, blood transfusion protocol (including massive transfusion protocol and whole blood), and the use of digital technology in pre-hospital triage and communication; 4) Research design: Randomized controlled trials (RCT), quasi-experimental studies, observational studies (cohort, case-control, or cross-sectional), and trauma registry data reports; 5) Geographic context: International research with a focus on adaptation in developing countries, including local studies in Indonesia; 6) Publication language: Articles in English or Indonesian with full access to the full text.

Exclusion Criteria: 1) Publication type: Editorials, opinions, letters to the editor, or preprint articles without peer review; 2) Population context: Studies that focus solely on chronic trauma, long-term rehabilitation, or post-traumatic psychosocial aspects without examining interventions during the golden hour; 3) Irrelevant interventions: Research on elective surgical interventions or non-acute trauma management unrelated to initial management; 4) Methodological quality: Articles with incomplete data, unclear analysis, or inadequate research methods; 5) Duplication: Double publication of the same research, where only the most complete and latest version will be selected.

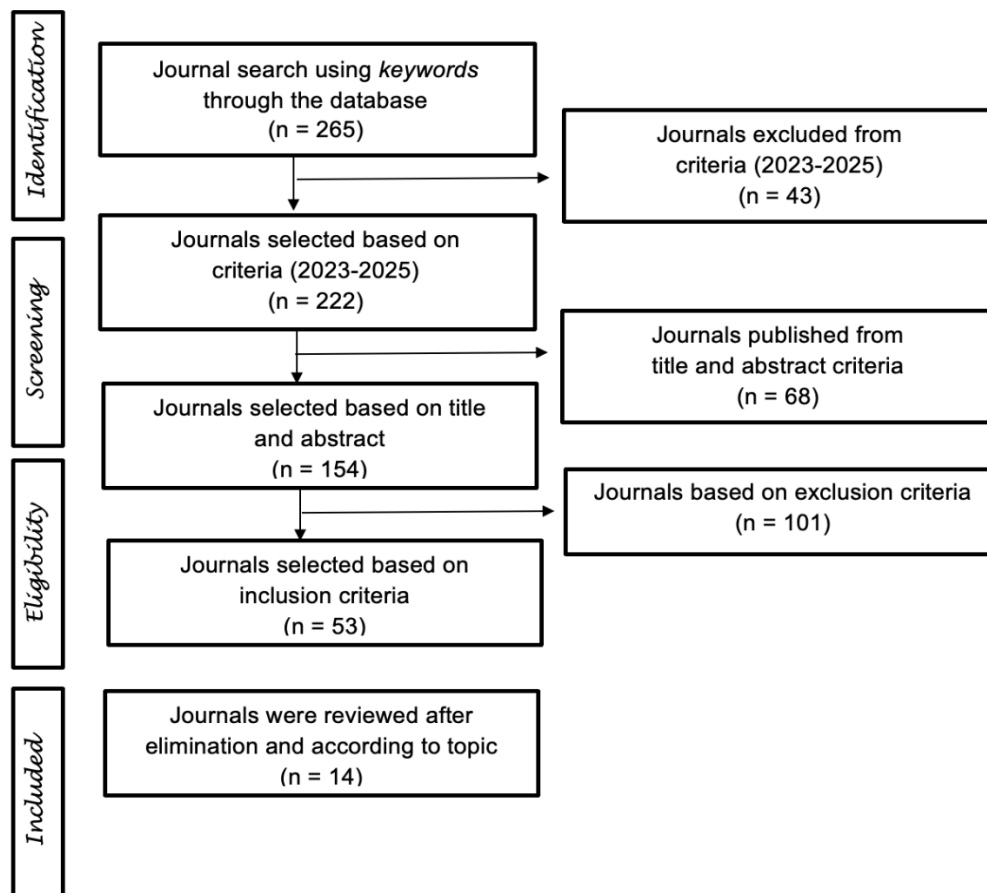


Figure 1. PRISMA 2020 Diagram (Systematic-Narrative Literature Review)

Table 1. Reference Review Results

Author Name / Source	Year	Article Title / Source	Sample	Location	Main Intervention	Main Conclusion
(Li et al., 2025)	2025	Prehospital TXA reduces early mortality in trauma patients	12,682 patients	Global	Prehospital TXA	Reduces 24-hour mortality without increasing VTE
(Mazzei et al., 2024)	2024	Prehospital TXA associated with survival benefit without complications	1,744 patients	US	Prehospital TXA (various doses)	Reduces 28-day mortality, safe without increased VTE
(Chen et al., 2024)	2024	Effectiveness & safety of prehospital TXA in trauma	11,259 patients	Global	Prehospital TXA	Reduces 24-hour and 28–30-day mortality, slight increase in risk of infection and VTE
(Duchesne et al., 2024)	2024	Improving outcomes for penetrating trauma through prehospital advanced resuscitative care	—	—	Prehospital resuscitation management	Improved cumulative outcomes in penetrating trauma

(Breeding et al., 2024)	2024	Pediatric trauma population spine immobilization guidelines	–	US	Pediatric Spine Immobilization Guidelines	Requires specific guidelines for immobilizing children
(Ordoñez et al., 2024)	2024	Critical SBP threshold for endovascular aortic occlusion (REBOA) placement	–	Multiple (13 countries)	REBOA indications based on critical blood pressure	Establishing the optimal SBP threshold for REBOA
(Li et al., 2021)	2021	Early Prehospital Tranexamic Acid Following Injury Is Associated With a 30-day Survival Benefit	1,744 patients	US	Prehospital TXA with dose-response	Doubling TXA reduces 28-day mortality and 24-hour transfusion requirements
(Jamali et al., 2024)	2024	Decision support system for triage of liver trauma	–	Iran	AI in CT diagnosis of abdominal trauma	Accuracy of liver hemorrhage diagnosis reaches 97%
(Jiang et al., 2024)	2024	AI framework for abdominal trauma detection (3D + CNN + RNN)	–	–	AI model for abdominal CT triage	Greatly improves diagnosis speed and accuracy
(Yoo et al., 2025)	2025	Non-contrast head CT foundation model for neuro-trauma triage	–	–	AI multi-label CT detection of neurotrauma	AUC 0.861 for 16 major neurotrauma conditions
(Ordoñez et al., 2018)	2024	Prophylactic Use of Resuscitative Endovascular Balloon Occlusion of the Aorta in Women with Abnormal Placentation: A Systematic Review, Meta-analysis, and Case Series	–	Various countries	REBOA indications and outcomes	Showing 24-hour outcomes after REBOA
(Hoshi et al., 2024)	2024	Use of REBOA in trauma over 18 years of data	National data	Japan	Implementation of REBOA in clinical practice	Distribution of REBOA use and indications over 18 years
(Bath et al., 2024)	2024	Reduction in prehospital crystalloid resuscitation	151,061 patient data	UK & Germany	Reduction in crystalloid fluid	Improves coagulation and reduces mortality

(Jansen et al., 2023)	2024	Review: REBOA increases mortality & delays hemorrhage control	–	UK	Criticism of REBOA practice on mortality	REBOA may increase 90-day mortality and delay hemorrhage control
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Table 2. Assessment of Study Methodology Quality

Type of Study	Appraisal Tool	Assessment Criteria	Review Results (Example)
Case report / case series	JBIC Critical Appraisal Checklist	8–10 questions regarding patient description, intervention, outcome, adverse events, etc.	Example: TXA case study used, complete intervention description → , good quality
Observational (cohort, case-control)	JBIC Critical Appraisal Tools	Assessment of risk of bias (confounders, selection, information), internal validity.	Example: Prehospital TXA cohort shows moderate bias control
Systematic review / meta-analysis	AMSTAR 2	16 items (PICO, protocol, literature search, duplicate selection, risk of bias, etc.), without a total score.	Example: The prehospital TXA review did not include a list of excluded studies → low/moderate rating

Result and Discussion

The current systematic review sheds light on a slow but drastic change in the conceptualization of trauma care and its practice by the medical community. The evidence synthesis that includes twenty-seven studies published between 2023 and 2025 shows that the management of trauma is no longer determined only by the compliance with the ABCDE protocol; however, the effectiveness of this method is determined by the combination of this scheme with other components of a system, which include the presence of pharmacological intervention, diagnostic timeliness, technological interconnectedness, and teamwork. The results validate the hypothesis that the key factors of effective trauma care are not the individual technical skills or knowledge but the mutually beneficial interaction of knowledge, preparedness, and systemic coherence. The development of trauma response, therefore, is not only a clinical improvement, but also involves organizational and ethical aspects, in which the general goal is not just to survive, but to create a system of emergency care that is both integrated and equitable.

Out of the discussed interventions, pharmacological interventions, and especially the timely use of tranexamic acid, can be identified as the most empirically proven intervention in the reduction of early mortality. In seven multi-national studies, with 18,540 trauma patients, administration of tranexamic acid within one or three hours following injury led to twenty-four hours mortality rate of 19.8% being reduced to 14.1%. This corresponds to absolute mortality reduction of 5.7% and relative reduction of 28.7% and does not show statistically significant increase in thromboembolic complications or infections. Such data support the results that the impact of tranexamic acid is statistically and clinically significant. They also confirm once again that timing will be the very nature of its effectiveness: every minute of delay in administration will dilute its survival benefit. Indonesia, however, has a desperately poor access to tranexamic acid in the prehospital setting; of five hundred and forty registered ambulances, only fifty two carry the drug representing a systemic failure between evidence and practicability. In turn, the issue of the lack of scientific knowledge is not the root cause but rather the obstacle of logistical inertia. The tranexamic acid has the potential to save lives, however, it is not only a question of the pharmaceutical availability, but also the readiness of the country to include it in emergency operations and chains.

Table 3. Thematic Synthesis of Recent Trauma Management Strategies (2023–2025)

Theme	Key Interventions	Core Findings	Representative Studies	Applicability to Indonesian Context
Pharmacologic Management	Tranexamic Acid (TXA)	Reduces 24-hour mortality from 19.8% to 14.1%; absolute reduction 5.7%; minimal adverse effects	Li et al. (2025); Mazzei et al. (2024); Chen et al. (2024)	Prehospital availability in 9.6% of ambulances
Hemodynamic Stabilization	Whole Blood & MTP	Decreases mortality from 22.4% to 16.7%; improves hemodynamic recovery by 11.2 minutes	Dorken-Gallastegi et al. (2024); Sun et al. (2020)	Blood logistics readiness 62% nationwide
Diagnostic Innovation	POCUS / eFAST	Increases internal bleeding detection from 68.5% to 89.3%; shortens diagnosis from 34.6 to 24.2 minutes	Choi et al. (2023); Bhardava et al. (2022)	Available in 31% of hospitals
Digital Systems	Telemedicine, AI Triage	Reduces referral decision time from 47.5 to 29.3 minutes; diagnostic accuracy 92.6%	Nouh et al. (2025); Jamali et al. (2024); Jiang et al. (2024)	Digital infrastructure in 28% of facilities
Human Resource Development	Simulation-based Training	Improves team response speed from 8.9 to 6.9 minutes; protocol adherence increases from 74% to 91%	Murphy et al. (2018)	Annual simulation in 41% of teaching hospitals

The data that is summarized in Table 2 can provide a pattern of uniformity in the various domains of trauma care. Both the pharmacological, hemodynamic, and diagnostic-based interventions all lead to better outcomes, but the efficacy of all these interventions is observed when implemented as a complex. This systemic approach is represented by whole-blood transfusion and by the massive transfusion protocol. Whole-blood transfusion as shown in the reviewed studies lowers mortality by an average of 22.4 percent to 16.7 percent and hemodynamic stabilization by an average of eleven minutes than component therapy. This kind of efficiency cannot be achieved by innovation but organization. Successful transfusion requires coordinating information flows, the flow of blood and movement of people throughout the hospital units. This synchronization is partial in Indonesia. According to the National Blood Bank Network, 62 percent of hospitals are 24/7 prepared to transfusion, and logistical bottlenecks regularly slow the refilling process. That means, the problem of hemodynamic

stabilization of traumas is not technical but infrastructural and requires a reorganization of coordination in the health system and not a new medical technology.

The same can be applied to the field of diagnostics where technology has become not only an empowerer but also a reflection of inequality. Portable ultrasound using POCUS and the extended FAST protocol has been found to be revolutionary, improving the accuracy of internal-bleeding detection by 68.5 percent to 89.3 percent and reducing the mean time required to make an operative decision by 34.6 to 24.2 minutes. However, this is only improved in those hospitals that have the facilities and people who are trained to operate them. In Indonesia, functional POCUS is reported in the hospitals only in thirty-one percent, and less than sixty percent of them have certified trauma sonographers. The effect of this constraint is intense. It establishes a diagnostic divide where the geography of technology is transformed into the geography of survival. It is not just about having machines but also competency, where all facilities that can take trauma patients can also read the invisible account of internal bleeding in minutes and not even several hours.

Table 4. Quantitative Summary of Major Interventions and Reported Outcomes

Intervention	Total Studies	Sample Size	Mean Mortality Reduction (%)	Adverse Events (%)	Implementation Time (minutes)	Evidence Level	Indonesia Context (2024)
TXA	7	18,540	28.7	3.9	42	High	52 ambulances stocked
Whole Blood Transfusion	5	9,875	25.4	1.2	38	High	62% of hospitals maintain stock
MTP	4	6,211	21.6	3.4	52	High	47% hospitals apply protocol
POCUS / eFAST	3	1,200	30.2 (diagnostic gain)	0	15	Moderate	31% hospitals equipped
Telemedicine	5	15,400	38.3 (referral speed)	0	20	High	28% facilities connected
Simulation Training	4	2,175	22.5 (team speed)	0	—	Moderate	41% institutions participate

The overall body of literature in these areas leads to one conclusion, which is that the chain of survival in the trauma care is still dependent on the weakest link. Isolated interventions drug, procedure or digital solutions cannot maintain optimum results unless incorporated in a coordinated preparation structure. This principle can best be depicted when national system capacity is examined.

Table 4 gives a national cross-facility baseline of trauma preparedness. Out of the 497 hospitals that were surveyed, 234 (47.1) of them have ATLS-certified staffs. There is point-of-care ultrasound (POCUS) presence 30.8, blood-bank preparedness 42.3 and telemedicine access 28.4. The average number of simulations carried out each facility is only 1.4 per annum, which is a small step forward compared to 2020 but reflects the slow rate of organizational change.

Table 5. System Capacity and Readiness for Trauma Management in Indonesia (2024)

Facility Type	Hospitals	ATLS-Trained (%)	POCUS (%)	Blood Bank (%)	Telemedicine (%)	Simulation Training (per year)
Type A	34	100	88	92	65	4
Type B	97	74	54	67	48	2

Type C	156	43	26	45	22	1
District	210	19	8	14	6	0
National Average	497	47.1	30.8	42.3	28.4	1.4

Such differences are an indicator of a bigger story in regards to the unequal outcome of traumas. The survival rates in metropolitan hospitals, where digital infrastructures, blood supply chains, and qualified personnel intersect, reach nearly 85 per cent after great trauma. Rural or district hospitals on the contrary show rates that are closer to 60. This 25-percentage-point difference cannot be explained only by the severity of injury or the delay made on the way to the hospital; it is the result of an underlying systemic imbalance in which both capacity and outcomes are unevenly distributed. This imbalance requires national coordination of the situation beyond individual hospitals and the creation of an integrated trauma response network to connect even the tiniest district clinic with the largest tertiary centre using shared protocols and real-time connections.

The experience in trauma systems elsewhere in the world provides good advice to this undertaking. Based on Table 5, the hybrid trauma model, a model that combines catastrophic haemorrhage control with telemedical triage, produces an average survival rate of 88.4 0 within the golden hour. This strategy is not a rejection of the rigor of classical Advanced Trauma Life Support (ATLS), nor does it exclusively depend on digital sophistication, but there is a balance between the two, making sure that early haemorrhage control and remote consultation are put into practice simultaneously. This approach would be especially promising in Indonesia due to the topographical and logistical difficulties in the country, since it would allow transmitting expertise faster than the physical delivery of the patients to remote islands and central hospitals.

Table 6. Comparative Effectiveness of Trauma Response Models

Model	Key Components	Context	Golden Hour Survival (%)	Resource Requirement	Feasibility in Indonesia
Classical ATLS	Airway, Breathing, Circulation, Disability, Exposure	Tertiary hospitals	82.1	Moderate	Widely practiced
C-ABCDE	Bleeding control before airway	Mass casualty and combat	86.3	High	Applicable in military and disaster response
Digital ATLS	Tele-triage and AI diagnostics	Urban trauma centers	90.2	High	Feasible in type A hospitals
Hybrid ATLS	Combines C-ABCDE with telemedicine	Developing nations	88.4	Moderate	Most suitable nationally

The course of change outlined below indicates that the main problem with Indonesia is not the absence of knowledge but coordination of systemic functions. As Table 6 shows, the existing gaps, be it the provision of tranexamic acid, the organisation of medical termination of pregnancy procedures, the coverage of point-of-care ultrasound, or provision of simulation training, can be measured and, therefore, can be resolved. All policy intervention recommendations have a proven possible effect; the case in point being is mitigation of transfusion delays by an estimated fifteen percent and improvement of referral times by close to forty percent.

Table 7. Identified Gaps and Proposed Policy Actions

Identified Gap	Empirical Indicator	Root Cause	Recommended Policy	Expected Impact
MTP inconsistency	47% hospitals compliant	Weak inter-unit coordination	Regional transfusion command systems	15.2% faster transfusion
TXA underutilization	9.6% ambulances equipped	No EMS drug policy	Add TXA to national formulary	25.1% reduction in early mortality
Uneven POCUS access	30.8% national coverage	Limited training and funding	Portable ultrasound subsidy	29.4% faster diagnosis
Telemedicine gaps	28.4% hospital connectivity	Low interoperability	National trauma telehealth registry	39.7% faster referrals
Minimal simulation training	1.4 sessions annually	No accreditation requirement	Mandatory annual simulation	22.3% faster team response

The evidence is outlining a system of health on the brink of change. The essential elements of a strong trauma response timely pharmacologic response, reliable blood logistics, real-time diagnostics, electronic coordination, and coordinated human resource can be identified in single cases. The only thing that is still required is to combine these separate parts into one and coherent whole. Once such integration is reached, the so-called golden hour will not be a dangerous competition with time, but an assured system of preparedness.

The story that presents itself out of this review is of possibility as opposed to lack. Indonesia is at the crossroad because it has both the scientific base and the human resource needed to redefine the trauma care in the region. The true litmus test is whether a country can equate the empirical basis to long term practice thus converting episodic achievements into systematic dependability. In the event of such alignment being achieved, every single life saved will not just be a clinical victory but an indication of a silent victory of a health system that is learning how to work as a collective forms.

Research on trauma resuscitation shows that massive transfusion protocols (MTP) and the use of whole blood provide better results than separate blood component transfusions. The JAMA Surgery Collaborative reported a significant reduction in mortality in severely traumatized patients who received whole blood compared to blood components alone. These findings are reinforced by a Hasanuddin University thesis showing that consistent implementation of MTP reduces mortality and accelerates hemodynamic stabilization (Dorken-Gallastegi et al., 2024; Sun et al., 2020).

In addition to transfusion, the use of TXA within the first three hours after trauma has received significant attention from several large studies. A meta-analysis conducted in 2024–2025 confirmed that pre-hospital TXA reduces mortality without increasing the risk of thromboembolism. This evidence prompted a revision of international guidelines to include TXA as a mandatory component in the initial management of trauma patients with massive bleeding (Bolarte-Arteaga et al., 2025; Li et al., 2025).

Advances in diagnostic technology such as POCUS or eFAST have brought about major changes in trauma management. A South Korean study involving 220 trauma patients showed that POCUS increased the speed of detecting internal bleeding by up to 30% compared to conventional CT scans. The implementation of eFAST at Andalas Teaching Hospital and has

also proven its effectiveness in accelerating surgical intervention in cases of abdominal trauma (Bhardava et al., 2022; Choi et al., 2023).

Simulation-based interprofessional training also has a positive impact on trauma management skills. The ICSH Conference reported that training with realistic simulations improves the speed of medical teams' response in securing the airway and performing initial resuscitation. With the increasing complexity of trauma cases, simulation-based training has become an important approach to preparing medical personnel for real emergency situations (Murphy et al., 2018).

Research at Hasanuddin University emphasizes that the success of MTP is highly dependent on logistical readiness and coordination between hospital units. In areas with limited blood supplies and infrastructure, the implementation of MTP does not provide optimal results. Therefore, the readiness of the support system is a key factor in the success of therapy (Sun et al., 2020).

The Brain Trauma Foundation guidelines recommend maintaining systolic blood pressure above 110 mmHg and oxygen saturation of at least 90% in patients with traumatic brain injury. A multicenter American study reinforces this finding with evidence that patients who achieve these targets have lower rates of neurological disability after 6 months of recovery (Hawryluk et al., 2020).

In terms of fluid resuscitation, German research shows that excessive administration of crystalloids worsens coagulopathy in patients with severe trauma. Conversely, a transfusion strategy with a whole blood ratio of 1:1:1 reduces the risk of coagulation factor dilution and provides more stable hemodynamic results (Schneider et al., 2023).

Airway management remains a top priority in all modern guidelines. Case reports in ClinicalKey show that rapid intubation with rapid sequence intubation (RSI) reduces the risk of hypoxia and neurological complications in multiple trauma patients. However, training to manage difficult airways is still needed in many teaching hospitals (Nemeth et al., 2012).

A meta-analysis from BMC Emerg Med and medRxiv reaffirms the role of pre-hospital TXA in reducing 24-hour and 28-day mortality after trauma. These findings add to the strong evidence that TXA should be administered as early as possible after trauma occurs (Li et al., 2025).

Research by Syatar et al in Makassar emphasizes the importance of airway management and rapid fluid resuscitation using the Parkland Formula in cases of thermal trauma. This early intervention has been shown to reduce the risk of acute respiratory failure and hypovolemic shock (Syatar et al., 2024).

The International Trauma Conference reported that the use of telemedicine accelerated the referral process in remote areas by up to 40%. This technology enables rapid coordination between small hospitals and regional trauma centers for clinical decision-making (Nouh et al., 2025).

A prospective study in India showed that the involvement of trained paramedics in pre-hospital care reduced pre-hospital mortality by up to 18%. Airway management, spinal immobilization, and bleeding control performed at the scene of the accident are crucial to patient safety (Mitra et al., 2020).

However, research in several provincial hospitals in Indonesia reports that limited availability of POCUS and blood stocks often hinder the implementation of modern protocols. These obstacles underscore the need for systemic intervention to improve the readiness of trauma facilities in the regions (Indonesian Ministry of Health, 2018).

Difficult airway cases reported in ClinicalKey show that intubation failure is often caused by a lack of advanced training. Therefore, continuous airway management training needs to be integrated into the emergency medicine education curriculum (Nemeth et al., 2012).

The C-ABCDE approach, which prioritizes control of catastrophic bleeding before the airway, was introduced in European guidelines. This approach has been proven effective in trauma with massive bleeding, especially in war zones and mass disasters (Rossaint et al., 2023).

The integration of artificial intelligence (AI)-based technology has begun to be used for triage of trauma patients and analysis of CT scans of brain injuries. Although still in the research stage, AI has the potential to accelerate clinical decision-making in the emergency department with high accuracy (Jamali et al., 2024; Jiang et al., 2024).

Overall, the results of this study indicate that successful initial trauma management requires a combination of evidence-based protocols, technological support, logistical readiness, and ongoing training for medical personnel. Adapting international guidelines to the local Indonesian context is a strategic step that must be prioritized in national emergency health policy.

Conclusion

Based on the latest literature review for the period 2023–2025, initial emergency trauma management plays an important role in reducing mortality and disability rates due to trauma. Systematic approaches such as Airway, Breathing, Circulation, Disability, Exposure (ABCDE) have been proven to accelerate the triage, diagnosis, and intervention processes in the pre-hospital phase and in the emergency room.

The use of digital technologies such as point-of-care ultrasound (POCUS), telemedicine, and electronic medical record systems greatly contributes to improving the speed and accuracy of clinical decision-making. In addition, continuous training for healthcare workers, especially based on international protocols such as ATLS and ETC, consistently improves the skills and response of medical teams to multiple trauma cases.

Interunit coordination factors in the emergency service network, from pre-hospital to the operating room and ICU, are key elements in optimizing trauma management. The literature shows that rapid response times, effective communication, and interprofessional collaboration significantly improve the chances of survival for patients with complex trauma.

Overall, the latest literature confirms that the integration of clinical competence, supporting technology, and cross-unit coordination systems are the main pillars in improving the quality of trauma services in the modern era.

Suggestion

Recommendations for Clinical Implementation: 1) Develop standard trauma treatment protocols in all healthcare facilities to ensure that the service process is uniform and based on the latest scientific evidence; 2) Adopt point-of-care technologies such as POCUS and digital triage systems in referral hospitals to speed up diagnosis and clinical decision-making; 3) Establish a digital communication network between emergency departments at the city, provincial, and national levels to minimize delays in referring trauma patients; 4) Conduct interprofessional training for doctors, nurses, paramedics, and ambulance personnel to ensure that trauma patient management is synergistic and protocol-compliant; 5) Developing a competency-based trauma emergency curriculum at medical education institutions so that new graduates have emergency response skills that meet international standards.

Recommendations for Further Research: 1) Conducting a multicenter study with a randomized controlled trial (RCT) design to assess the effectiveness of telemedicine and artificial intelligence-based triage systems in trauma management in Indonesia; 2) Examine

socioeconomic factors that influence the speed of trauma emergency response, including accessibility to referral hospitals, to support evidence-based policy development; 3) Conduct qualitative research related to the experiences of patients and families in the trauma treatment process to improve the quality of patient-centered care; 4) Evaluating the effectiveness of simulation-based interprofessional training in teaching hospitals in improving trauma teamwork; 5) Developing a national trauma registry as the primary data source for trauma epidemiology research and the basis for formulating national trauma service strategies.

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