Review

TRAUMA CARE IN EMERGENCY SITUATIONS: ORGANISATION OF MEDICAL RESPONSE AND LOCAL COMMUNITY RESILIENCE

Matejić, T.[1], Kaštelan, S.[2], Lovrić, I.[3], Kaštelan Brumen, U.[4], Car, A.[5]

[1] Surgery Clinic, Clinical Hospital Sveti Duh, Zagreb, Croatia;
[2] Clinical Hospital Dubrava, Department of Ophthalmology, University of Applied Science Velika Gorica, Velika Gorica, School of Medicine, University of Zagreb, Croatia;
[3] Health Center Zagreb East, Zagreb, Croatia;
[4] University of Zagreb, Faculty of Economics & Business, Zagreb, Croatia;
[5] School of Medicine, University of Zagreb, Croatia

Abstract: Emergencies such as natural disasters, industrial accidents, and mass trauma events demand a rapid, coordinated medical response to minimise morbidity and mortality. Effective trauma care hinges on structured protocols, accurate triage, resource optimisation, and interdisciplinary collaboration. Triage systems, including the Advanced Trauma Life Support (ATLS) protocol and Simple Triage and Rapid Treatment (START), prioritise patients based on injury severity, ensuring timely intervention. Haemorrhage control with tourniquets and haemostatic dressings is critical for survival. Immediate access to diagnostic imaging, point-of-care testing and early blood transfusions enhances outcomes. Hospital emergency plans must account for surge capacity, patient diversion, and intensive care unit preparedness. Trauma centres should implement damage control strategies, including resuscitative thoracotomy and early goal-directed therapy. The integration of telemedicine allows specialists to provide real-time guidance, improving diagnostic accuracy and treatment efficiency. Artificial intelligence (AI) and digital health tools enhance emergency response by optimising triage, predicting patient deterioration, and streamlining workflows. Cloud-based electronic health records and geographic information systems enable the real-time sharing of data and the rapid deployment of medical teams. Lessons from past crises highlight the need for systematic training, simulation exercises, and multi-agency collaboration. Disaster medicine courses equip healthcare providers with essential trauma management skills, and regular disaster drills enhance the resilience and preparedness of the healthcare system. Sustainable emergency care requires adaptable response models, continuous resource monitoring, and refinement of strategies based on evidence-based practices. Investment in healthcare infrastructure, including trauma centres, mobile field hospitals, and helicopter emergency medical services, is crucial for managing large-scale emergencies. In conclusion, timely emergency trauma care depends on well-coordinated medical responses, advanced technologies, and continuous training. Strengthening local community resilience through systematic preparedness is essential for mitigating the impact of future crises and safeguarding public health.

Keywords: mass casualty incidents, crisis management, medical logistics, triage systems, healthcare system resilience

1. INTRODUCTION

Emergencies, ranging from industrial accidents and mass casualty incidents to natural disasters and traffic collisions, pose significant challenges to healthcare systems worldwide. These high-stakes events demand a rapid and coordinated medical response to reduce mortality and long-term morbidity. As trauma remains one of the leading and preventable causes of death, particularly among younger populations, the effective management of trauma during crises is a critical public health priority (Suda, Franke, Hertwig, & Gooßen, 2025).

Timely trauma care hinges on rapid diagnostics, efficient resource planning, and the implementation of structured triage protocols. Systems such as Advanced Trauma Life Support (ATLS) and Simple Triage and Rapid Treatment (START) enable the prioritisation of care based on injury severity, ensuring that limited medical resources are allocated where they are most needed (Bazyar, Farrokhi, & Khankeh, 2019). In resource-limited or high-volume environments, the integration of digital tools such as geographic information systems (GIS), electronic health records (EHRs), and artificial intelligence-assisted (AI-assisted) triage systems has significantly enhanced clinical decision-making and operational efficiency (Tahernejad, et al., 2024; Ventura, Denton, & David, 2024). Equally important to clinical readiness is the resilience of the local community. Early response capacity is greatly improved through organised volunteer engagement and public education in bleeding control techniques. Initiatives such as “Stop the Bleed” and regular disaster simulation exercises facilitate faster and more effective care delivery during emergencies by strengthening coordination and empowering lay responders (Greenwald, Kelly, & Thomas, 2023). Special emphasis is placed on coordinating multiple services, communication systems and evacuation logistics, which is crucial in situations where the number of victims exceeds available resources.

2. TRIAGE AND IMMEDIATE RESPONSE

In large-scale mass casualty incidents, where the number of injured individuals often exceeds available medical resources, rapid and accurate assessment of victims' conditions is essential. Efficient triage ensures that limited resources are directed toward those with the highest likelihood of survival. Understanding and executing proper triage protocols is, therefore, critical in chaotic environments with multiple casualties.

The START system is widely used for its speed and simplicity. It classifies patients into four urgency categories within 60 seconds, based on walking ability, respiratory rate, capillary refill, and mental status (Wisnesky et al., 2022). In addition to START, the ATLS approach is used for the systematic assessment and initial management of trauma patients, following the well-established “ABCDE” algorithm: Airway, Breathing, Circulation, Disability (neurological status), and Exposure, while also considering patient dignity and preventing hypothermia (Søreide, 2008).

Despite their widespread use, triage accuracy may be compromised under conditions of extreme stress, fatigue, noise, or psychological pressure (Suda et al., 2025). Errors in classification can result in sub-triage, failure to identify patients who require urgent care, or over-triage, inefficient use of limited resources. To mitigate these risks, regular simulation-based mass casualty training is considered one of the most effective methods for preparing both individuals and healthcare systems (Wisnesky et al., 2022).

Given the growing complexity of emergency scenarios, alternative triage systems such as Sort–Assess–Lifesaving Interventions–Treatment (SALT) have been developed. SALT offers a more comprehensive approach by integrating immediate life-saving interventions during the triage process. In parallel, digital and automated tools, particularly those powered by AI, including machine learning and deep learning, are being implemented to support and refine triage decisions. These AI-driven tools have demonstrated high accuracy in patient categorisation and significantly reduced decision-making time. However, challenges remain regarding clinical validation, system integration, and ethical and trust concerns (Tahernejad et al., 2024; Ventura et al., 2024).

Another vital aspect of immediate trauma care is early haemorrhage control, as uncontrolled bleeding is a leading cause of preventable death in mass casualty events (Kragh et al., 2009). Rapid interventions such as applying direct pressure, haemostatic dressings, or correctly using tourniquets can be life-saving, particularly in prehospital settings where delays in medical assistance are common. Protocols such as Stop the Bleed further emphasise the importance of educating and preparing laypeople and professionals to act swiftly and effectively in managing severe bleeding (Goralnick et al., 2018).

3. CRITICAL INTERVENTIONS AND DIAGNOSTIC SUPPORT

Following initial patient stabilisation using the ABCDE algorithm, rapid diagnostic assessment becomes essential. One of the most valuable tools in this phase is the Focused Assessment with Sonography for Trauma (FAST), which enables quick identification of free fluid in the abdominal and pericardial cavities. This bedside procedure avoids unnecessary patient transfers and saves crucial time determining the need for surgical intervention. The extended version, e-FAST, further facilitates detection of pneumothorax, haemothorax, and haemopericardium, supporting urgent surgical decision-making (Savoia, Jayanthi, & Chammas, 2023).

Where available, point-of-care testing (POCT) should be utilised early in the treatment process. As a decentralised form of laboratory diagnostics performed at or near the site of care, POCT allows for rapid evaluation of haemodynamic parameters, oxygen saturation, and perfusion status, which are essential in guiding timely clinical interventions (Dirkmann, Britten, & Frey, 2018).

In parallel, trauma care often requires the implementation of damage control strategies, particularly in unstable patients with life-threatening injuries. Key techniques include:

1. Permissive hypotension: Controlled reduction of blood pressure to minimise ongoing haemorrhage while preserving cerebral perfusion (Kobayashi, Costantini, & Coimbra, 2012)
2. Tranexamic acid administration: An antifibrinolytic agent that significantly reduces mortality when given within three hours of injury (Olldashi et al., 2010) .
3. Resuscitative thoracotomy: A high-risk, life-saving procedure indicated in cases of major thoracic trauma with imminent cardiac arrest (ATLS® Course Manual, 2018).

In addition to clinical interventions, the structural preparedness of hospitals is paramount. This includes immediate availability of operating rooms, specialised surgical teams experienced in trauma care, and intensive care units equipped to manage critically injured patients (Hick et al., 2004).

In scenarios where local resources are overwhelmed, mobile surgical units should be rapidly deployed to expand care capacity. Furthermore, the use of telemedicine platforms enables remote access to trauma specialists, enhancing diagnostic accuracy and decision-making in under-resourced or geographically isolated settings (Ventura et al., 2024).

4. SYSTEM PREPAREDNESS AND INFRASTRUCTURE

An effective response to mass casualty incidents requires a health system that is both flexible and scalable, capable of rapidly accommodating a sudden influx of patients. This requires pre-established protocols for surge capacity expansion, strategic patient diversion to less burdened facilities, and immediate Intensive Care Unit (ICU) readiness for critically injured individuals (Montán et al., 2023). Trauma centres should be strategically positioned according to geographic accessibility and clinical capability, forming part of a multi-tiered healthcare network that facilitates timely patient transfer from peripheral institutions to highly specialised centres. This model enables efficient resource allocation based on patient acuity and institutional capacity (Emergency Medical Teams, 2016). Modern technologies are increasingly integral to crisis management. AI significantly improves triage accuracy, predicts clinical deterioration, and optimises resource deployment and logistics (Tahernejad et al., 2024). The key components of a comprehensive trauma response system are outlined in Table 1.

Table 1. Key Components of Effective Emergency Trauma Response

Component	Description	Examples/Protocols or Tools
Triage	Rapid classification of patients based on injury severity	START, SALT, ATLS, AI-based triage algorithms
Haemorrhage Control	Techniques for stopping life-threatening bleeding	Tourniquets, haemostatic dressings, Stop the Bleed initiative
Rapid Diagnostics Tools	Rapid tools to assess internal injury and perfusion status	FAST, e-FAST ultrasound, point-of-care tests
Critical Interventions	Life-saving procedures performed in the early phases of trauma care.	Tranexamic acid, permissive hypotension, resuscitative thoracotomy
Infrastructure and Surge Capacity	Organisational strategies to expand capacity and redistribute patients.	Trauma networks, mobile units, ICU preparedness
Technology Integration	Digital solutions that enhance decision-making, tracking, and communication.	AI, cloud-based EHR, GIS, drones, wearable monitors
Training and Simulation	Regular interprofessional training to prepare staff for MCI conditions.	Simulation drills, VR/AR, tabletop exercises
Community Resilience	Engaging the public and volunteers in prehospital care and preparedness.	First aid training, Stop the Bleed, Medical Reserve Corps

START: Simple Triage and Rapid Treatment: SALT: Sort-Assess-Lifesaving Interventions-Treatment; ATLS: Advanced Trauma Life Support; AI: Artificial Intelligence; FAST: Focused Assessment with Sonography for Trauma; e-FAST – Extended Focused Assessment with Sonography for Trauma; EHR: Electronic Health Record; GIS: Geographic Information System; VR: Virtual Reality; AR: Augmented Reality; ICU: Intensive Care Unit; MCI: Mass Casualty Incident

In addition, GIS enable real-time monitoring of patient flow, hospital bed availability, and the location of emergency medical teams, thereby improving coordination between pre-hospital and hospital-based services (Ventura et al., 2024). Cloud-based EHRs further facilitate the secure and seamless transfer of patient data across healthcare levels, which is particularly crucial during inter-institutional transfers in large-scale emergencies (Lin, Jha, & Adler-Milstein, 2018).

4.1. Multi-agency Coordination, Communication Systems, and Patient Evacuation

Effective emergency response depends not only on clinical preparedness but also on rapid coordination between medical teams, police, fire departments, civil protection units, and other public safety agencies. Multi-agency cooperation ensures that resources are quickly mobilised and that command responsibilities are clear from the earliest phase of the incident. Many countries adopt integrated command frameworks such as the Incident Command System. This allows representatives from different services to establish shared priorities, coordinate resource deployment, and communicate operational decisions in real time (Colling & York, 2010; Kamga et al., 2025).

Fast and reliable communication channels are critical for locating victims, assessing environmental risks, and ensuring safe access for rescue teams. Digital radio systems, satellite connections, GIS, and shared electronic platforms support real-time information exchange between stakeholders. These technologies enable responders to identify patient location, monitor scene conditions, and determine optimal evacuation routes (Kurkurina et al., 2025; Rosanowski et al., 2025).

When the number of casualties exceeds available resources, on-site triage teams prioritise treatment and transport according to injury severity and survivability. Rapid evacuation planning includes identifying trauma-receiving hospitals, implementing diversion protocols when facilities reach capacity, and organising ground or air medical transport. Helicopter emergency medical services and mobile field hospitals are crucial when road networks are congested or damaged. Experience from disaster drills shows that joint multi-agency exercises substantially reduce evacuation time and improve patient outcomes (Gooding et al., 2022; Kamga et al., 2025).

4.2. Economic Challenges and Sustainable Solutions in Emergency Trauma Care

Despite advances in trauma infrastructure and technology, economic constraints remain a persistent barrier to effective preparedness and response, especially in low-resource or rural regions. The costs associated with building and maintaining scalable systems—including trauma centres, mobile field units, telemedicine platforms, and workforce training—can strain healthcare budgets and limit equitable access to timely emergency care (Okyere et al, 2024).

A critical part of system-level preparedness involves aligning financial planning with emergency response goals. Cost-effective strategies such as establishing regional trauma networks, leveraging public–private partnerships, and implementing modular or mobile facilities may improve response capacity while optimising resource use (Goniewicz, Burkle, & Khorram-Manesh, 2025). Additionally, investment in simulation-based training has been shown to reduce medical errors and improve team coordination, resulting in long-term economic and clinical benefits (Toner et al., 2006).

Incorporating health economics into national preparedness policies ensures more resilient trauma systems. Policymakers should prioritise funding mechanisms that support not only physical infrastructure but also operational flexibility, digital interoperability, and equitable service delivery during mass casualty events.

5. TRAINING AND SIMULATION

Maintaining the readiness of healthcare professionals and associated emergency personnel is essential for effective response during mass casualty incidents. System performance in crises depends not only on infrastructure and resource availability but also on the preparedness, coordination, and competence of the response teams.

Regular training programmes are key to ensuring system resilience. These include simulation-based exercises, interdisciplinary tabletop drills, and cross-sectoral training, which together expose organisational weaknesses and enhance inter-agency communication and coordination (Subbarao et al., 2008). Simulation scenarios enable a practical environment to validate existing protocols, clarify team roles, and integrate emergency services, including civil protection, police, and fire departments.

Beyond technical readiness, such exercises also cultivate ethical decision-making and emotional resilience by simulating high-pressure situations where resources are limited (Newton & Smith, 2024). Training curricula in the medical domain often encompass psychological first aid, infection control, public health surveillance, and both basic and advanced trauma management procedures (Ashcroft, Byrne, Brennan, & Davies, 2021). Modern educational technologies, particularly virtual simulations and augmented reality, offer safe, immersive platforms for rehearsing rare or complex emergency scenarios. These tools enable experiential learning that strengthens both cognitive and procedural competencies without exposing patients to risk (Alshowair, et al., 2024).

In addition to skill acquisition, effective training must include evaluation metrics that objectively measure knowledge retention, response time, decision accuracy, and teamwork dynamics. Structured performance assessments allow organisations to identify deficits and provide targeted education before a real mass casualty event occurs. International models, such as the Disaster Medical Assistance Teams (DMAT) in the United States and the Major Incident Medical Management and Support (MIMMS) courses in Europe, demonstrate that standardised curricula significantly improve interdisciplinary coordination and consistency in communication across agencies (Way et al., 2024; Wexler et al., 2023).

Sustainability of training programs is equally important. Evidence suggests that skills deteriorate when simulation exercises are infrequent; therefore, many countries have adopted mandatory annual or semi-annual drills, combined with digital refresher modules. Integrating psychological resilience training, including stress inoculation exercises and crisis leadership development, strengthens the mental preparedness of responders and reduces burnout following high-mortality events. By embedding structured training into national healthcare strategies, emergency systems remain adaptable, skilled, and operationally prepared for large-scale crises (Kman et al., 2024; Way et al., 2024).

6. COMMUNITY RESILIENCE AND PUBLIC ENGAGEMENT

Educating the general public in basic first aid and haemorrhage control significantly enhances laypeople's ability to respond effectively before emergency medical services arrive. Initiatives such as "Stop the Bleed" have demonstrated measurable improvements in the recognition and management of life-threatening bleeding events (Jacobs et al., 2016). These programs contribute to stronger community resilience by empowering individuals to act decisively when professional resources are delayed, overwhelmed, or inaccessible (Goralnick et al., 2018)

Evidence suggests that trained citizens intervene more frequently, both in simulated and real-life emergencies, leading to reduced time to initial care and improved patient outcomes (Hedberg, et al., 2024). Beyond individual preparedness, comprehensive community readiness involves coordinated planning, establishing networks of trained volunteers, pre-positioning medical supplies, and maintaining efficient communication between emergency services and civil society actors.

One successful model is the "U.S. Medical Reserve Corps", which integrates local communities into structured emergency preparedness plans and interagency exercises (Subbarao et al., 2008). Importantly, community engagement strategies must also account for vulnerable populations, such as the elderly and persons with disabilities, ensuring equitable access to assistance and resources during emergencies (Fernandez, et al., 2002).

Community resilience extends beyond first-aid education. Effective systems include coordinated communication strategies, multilingual risk messaging, and real-time information sharing through mobile alert applications or social media platforms. During previous mass-casualty situations, rapid dissemination of public safety instructions has been shown to reduce panic, improve evacuation efficiency, and direct injured individuals to the nearest medical resources (Hinata et al., 2024; Purohit et al., 2025).

Local governments can further support resilience by conducting community-based disaster planning workshops and partnering with schools, workplaces, religious organisations, and non-governmental agencies. Establishing neighbourhood "first responder hubs" equipped with bleeding-control kits, AEDs, and trained volunteers ensures immediate access to lifesaving resources even before emergency teams arrive. When implemented broadly, these strategies transform civilians from passive witnesses into active participants in emergency response, ultimately reducing mortality and strengthening societal recovery (Dé et al., 2024; Siriwardena et al., 2024; Vandrevala et al., 2024).

7. TECHNOLOGY AND INNOVATION

Technological advancements are profoundly reshaping emergency trauma care, offering new tools that enhance both prehospital and in-hospital interventions. AI-assisted systems are increasingly being integrated into prehospital triage, supporting clinical decision-making and accelerating patient classification by improving the accuracy and efficiency of frontline assessments (Toy et al., 2024)

Drones have emerged as valuable assets in emergency logistics, particularly for delivering automated external defibrillators (AEDs) and other critical medical supplies to remote or inaccessible locations. A prospective study from Sweden demonstrated that in approximately 67% of cases, drones arrived before ambulances, with an average reduction in response time of 3 minutes and 14 seconds. In 33% of these cases, the timely delivery of an AED enabled early defibrillation, potentially saving lives (Schierbeck et al., 2023).

Wearable devices connected to AI algorithms offer continuous, real-time monitoring of vital signs, enhancing patient care in both prehospital and outpatient settings by allowing rapid detection of clinical deterioration (van Melzen et al., 2024).

Additionally, virtual reality (VR) and augmented reality (AR) technologies have become indispensable in trauma training. These tools enable high-fidelity simulations of rare and complex scenarios, fostering experiential learning that improves clinical knowledge, decision-making confidence, and overall performance of healthcare professionals. (Kaim et al., 2024).

Despite the rapidly growing adoption of digital tools, several challenges persist. Ethical considerations regarding patient data privacy, cybersecurity threats, interoperability, and fairness in AI-assisted clinical decision-making must be addressed before widespread implementation. Equitable access remains another limitation: high-income regions integrate advanced systems more quickly, while resource-limited areas may lack reliable internet connectivity, maintenance capacity, or skilled personnel (Rossi & Rehman, 2025; Ventura et al., 2024).

Nevertheless, international experience demonstrates that cost-effective digital solutions such as low-bandwidth telemedicine platforms, open-source triage software, and portable ultrasound devices can substantially improve outcomes even in low-resource settings. Future innovation will likely combine robotics, remote surgical support, and fully automated supply chains, transforming trauma care from reactive to predictive medicine. By strategically integrating technology with ethical oversight, emergency systems can become faster, safer, and more resilient (Abualenain, 2024; Elendu et al., 2024).

8. CONCLUSION

Mass casualty incidents place extraordinary pressure on healthcare systems, making rapid triage, haemorrhage control, and early stabilisation essential determinants of survival. The evidence demonstrates that outcomes improve most when clinical interventions are supported by scalable infrastructure, clearly defined protocols, and seamless cooperation between prehospital and hospital teams.

Modern technologies such as AI-supported triage, wearable monitoring devices, telemedicine, drones, and cloud-based data systems enhance situational awareness, decision-making, and operational efficiency. However, technology alone is not sufficient. The success of an emergency response depends on the preparedness and psychological resilience of healthcare workers, reinforced through regular simulation-based training and cross-agency drills.

Equally important is community engagement. Educating the public in bleeding control and first response bridges the critical time gap before professional teams arrive and strengthens collective resilience. When healthcare organisations, government authorities, and civilians act together, trauma systems are faster, safer, and more adaptable.

Sustainable trauma preparedness requires continuous investment in workforce training, emergency infrastructure, digital innovation, and inclusive community programs. By integrating medical readiness with public engagement, health systems will be better equipped to manage future crises and protect population health.

9. REFERENCES

Abualenain, J. (2024). Use of Technology in Disaster Medicine. *Eurasian Journal of Emergency Medicine*. https://doi.org/10.4274/eajem.galenos.2024.45452

Alshowair, A., Bail, J., AlSuwailem, F., Mostafa, A., & Abdel-Azeem, A. (2024). Use of virtual reality exercises in disaster preparedness training: A scoping review. *SAGE Open Medicine*, *12*, 20503121241241936. https://doi.org/10.1177/20503121241241936

Ashcroft, J., Byrne, M. H. V, Brennan, P. A., & Davies, R. J. (2021). Preparing medical students for a pandemic: a systematic review of student disaster training programmes. *Postgrad Med J*, *97*, 368–379. https://doi.org/10.1136/postgradmedj-2020-137906

Bazyar, J., Farrokhi, M., & Khankeh, H. (2019). Triage systems in mass casualty incidents and disasters: A review study with a worldwide approach. *Open Access Macedonian Journal of Medical Sciences*, *7*(3), 482–494. https://doi.org/10.3889/OAMJMS.2019.119.

Colling, R. L., & York, T. W. (2010). Emergency Preparedness—Planning and Management. *Hospital and Healthcare Security*, 591. https://doi.org/10.1016/b978-1-85617-613-2.00024-0

Dé, L. L., Ronoh, S., Kyu, E. M. T., & Rive, B. (2024). How Can Practitioners Support Citizen Volunteers in Disaster Risk Reduction? Insight from “Good and Ready” in Aotearoa New Zealand. *International Journal of Disaster Risk Science*, *15*(3), 374. https://doi.org/10.1007/s13753-024-00563-9

Dirkmann, D., Britten, M. W., & Frey, U. H. (2018). Point-of-Care Testing in Trauma Patients - Methods and Evidence. *Anasthesiologie Intensivmedizin Notfallmedizin Schmerztherapie*, *53*(6), 440–457. https://doi.org/10.1055/S-0043-107753.

Elendu, C., Omeludike, E. K., Oloyede, P. O., Obidigbo, B. T., & Omeludike, J. C. (2024). Legal implications for clinicians in cybersecurity incidents: A review. *Medicine*, *103*(39), 0. https://doi.org/10.1097/md.0000000000039887

Emergency Medical Teams MINIMUM TECHNICAL STANDARDS AND RECOMMENDATIONS FOR REHABILITATION. (2016). Retrieved from http://apps.who.int/bookorders.

Fernandez, L. S., Byard, D., Lin, C. C., Benson, S., & Barbera, J. A. (2002). Frail elderly as disaster victims: Emergency management strategies. *Prehospital and Disaster Medicine*, *17*(2), 67–74. https://doi.org/10.1017/S1049023X00000200.

Goniewicz, K., Burkle, F.M., Khorram-Manesh, A. (2025). Transforming global public health: Climate collaboration, political challenges, and systemic change. Journal of Infection and Public Health, 18(1):102615. doi: 10.1016/j.jiph.2024.102615.

Gooding, K., Bertone, M. P., Loffreda, G., & Witter, S. (2022). How can we strengthen partnership and coordination for health system emergency preparedness and response? Findings from a synthesis of experience across countries facing shocks. *BMC Health Services Research*, *22*(1). https://doi.org/10.1186/s12913-022-08859-6

Goralnick, E., Chaudhary, M. A., McCarty, J. C., Caterson, E. J., Goldberg, S. A., Herrera-Escobar, J. P., … Haider, A. H. (2018). Effectiveness of instructional interventions for hemorrhage control readiness for laypersons in the public access and tourniquet training study (PATTS) a randomized clinical trial. *JAMA Surgery*, *153*(9), 791–799. https://doi.org/10.1001/JAMASURG.2018.1099.

Greenwald, A., Kelly, A., & Thomas, L. (2023). Trauma-informed care in the emergency department: concepts and recommendations for integrating practices into emergency medicine. *Medical Education Online*, *28*(1). https://doi.org/10.1080/10872981.2023.2178366.

Hedberg, H., Hedberg, P., Aléx, J., Karlsson, S., & Haney, M. (2024). Effects of an advanced first aid course or real-time video communication with ambulance personnel on layperson first response for building-site severe injury events: a simulation study. *BMC Emergency Medicine*, *24*(1), 1–9. https://doi.org/10.1186/S12873-023-00917-4.

Hick, J. L., Hanfling, D., Burstein, J. L., Deatley, C., Barbisch, D., Bogdan, G. M., & Cantrill, S. (2004). Health care facility and community strategies for patient care surge capacity. *Annals of Emergency Medicine*, *44*(3), 253–261. https://doi.org/10.1016/j.annemergmed.2004.04.011.

Hinata, S., Rohde, H., & Templeton, A. (2024). Communicating with the public in emergencies: A systematic review of communication approaches in emergency response [Review of *Communicating with the public in emergencies: A systematic review of* *communication approaches in emergency response*]. *International Journal of Disaster Risk Reduction*, *111*, 104719. Elsevier BV. https://doi.org/10.1016/j.ijdrr.2024.104719

Jacobs, L. M., Burns, K. J., Langer, G., & Kiewiet De Jonge, C. (2016). The Hartford Consensus: A National Survey of the Public Regarding Bleeding Control Presented at the Hartford Consensus IV meeting sponsored by the American College of Surgeons, Dallas, TX, January 2016. *Journal of the American College of Surgeons*, *222*(5), 948–955. https://doi.org/10.1016/J.JAMCOLLSURG.2016.02.013.

Kaim, A., Milman, E., Zehavi, E., Harel, A., Mazor, I., Jaffe, E., & Adini, B. (2024). Augmented reality- virtual reality wartime training of reserve prehospital teams: a pilot study. *Israel Journal of Health Policy Research*, *13*(1), 1–6. https://doi.org/10.1186/S13584-024-00634-8.

Kamga, L. S. K., Voordouw, A. C. G., Vries, M. C. de, Koopmans, M., & Timen, A. (2025). Which sectors should be involved in public health emergency preparedness, response, and recovery decision-making? A RAND-modified consensus procedure among European Union country experts. *BMC Public Health*, *25*(1), 2359. https://doi.org/10.1186/s12889-025-23557-8

Kman, N., McGrath, J., Panchal, A. R., Malone, M., Sharkey-Toppen, T., & Way, D. P. (2024). Implementation of a workshop for mass casualty incident triage training using an immersive virtual reality simulation. *AEM Education and Training*, *8*. https://doi.org/10.1002/aet2.10939

Kobayashi, L., Costantini, T. W., & Coimbra, R. (2012). Hypovolemic Shock Resuscitation. *Surgical Clinics of North America*, *92*(6), 1403–1423. https://doi.org/10.1016/j.suc.2012.08.006.

Kragh, J. F., Walters, T. J., Baer, D. G., Fox, C. J., Wade, C. E., Salinas, J., & Holcomb, J. B. (2009). Survival with emergency tourniquet use to stop bleeding in major limb trauma. *Annals of Surgery*, *249*(1), 1–7. https://doi.org/10.1097/SLA.0B013E31818842BA.

Kurkurina, E., Rothenberg, C., Couturier, K., Breyre, A., Yang, D. Y., Nelson, A. R., Cordone, A., Venkatesh, A. K., & Gettel, C. J. (2025). Emergency Medical Services Time on Scene and Non-Transport: Role of Communication Barriers. *Western Journal of Emergency Medicine*. https://doi.org/10.5811/westjem.41212

Lin, S. C., Jha, A. K., & Adler-Milstein, J. (2018). Electronic health records associated with lower hospital mortality after systems have time to mature. *Health Affairs*, *37*(7), 1128–1135. https://doi.org/10.1377/HLTHAFF.2017.1658.

Montán, K. L., Örtenwall, P., Blimark, M., Montán, C., & Lennquist, S. (2023). A method for detailed determination of hospital surge capacity: a prerequisite for optimal preparedness for mass-casualty incidents. *European Journal of Trauma and Emergency Surgery*, *49*(2), 619–632. https://doi.org/10.1007/S00068-022-02081-Z.

Newton, J., & Smith, A. D. A. C. (2024). Developing emotional preparedness and mental resilience through high-fidelity simulation: a 'bridge too far' for institutions teaching major trauma management and mass-casualty medicine? *BMC Medical Education*, *24*(1), 544. https://doi.org/10.1186/S12909-024-05526-8.

Okyere, D. O., Lomazzi, M., Peri, K., & Moore, M. (2024). Investing in health system resilience: A scoping review to identify strategies for enhancing preparedness and response capacity. *Population Medicine*, *6*, 1-21. doi: 10.18332/popmed/183661

Purohit, H., Buntain, C., Hughes, A., Peterson, S., Lorini, V., & Castillo, C. (2025). Engage and Mobilize! Understanding Evolving Patterns of Social Media Usage in Emergency Management. *Proceedings of the ACM on Human-Computer Interaction*, *9*(2), 1. https://doi.org/10.1145/3710965

Rosanowski, S. M., Milne, H., Pearce, P., McDonald, N., Zobel, G., & McFadden, A. (2025). A national equine identification and traceability system for emergency preparedness and response in New Zealand. *New Zealand Veterinary Journal*, 1. https://doi.org/10.1080/00480169.2025.2567646

Rossi, M., & Rehman, S. (2025). Integrating Artificial Intelligence Into Telemedicine: Evidence, Challenges, and Future Directions [Review of *Integrating Artificial Intelligence Into Telemedicine: Evidence, Challenges, and Future Directions*]. *Cureus*. Cureus, Inc. https://doi.org/10.7759/cureus.90829

Savoia, P., Jayanthi, S., & Chammas, M. (2023). Focused assessment with sonography for trauma (FAST). *Journal of Medical Ultrasound*, *31*(2), 101–106. https://doi.org/10.4103/jmu.jmu_12_23.

Schierbeck, S., Nord, A., Svensson, L., Ringh, M., Nordberg, P., Hollenberg, J., … Claesson, A. (2023). Drone delivery of automated external defibrillators compared with ambulance arrival in real-life suspected out-of-hospital cardiac arrests: a prospective observational study in Sweden. *The Lancet Digital Health*, *5*(12), e862–e871. https://doi.org/10.1016/S2589-7500(23)00161-9.

Siriwardena, A. N., Patel, G., Botan, V., Smith, M., Phung, V., Pattinson, J., Trueman, I., Ridyard, C., Hosseini, S. M. P., Asghar, Z., Orner, R., Brewster, A., Mountain, P., Rowan, E., & Spaight, R. (2024). Community First Responders' role in the current and future rural health and care workforce: a mixed-methods study. *Health and Social Care Delivery Research*, *12*(18), 1. https://doi.org/10.3310/jyrt8674

Søreide, K. (2008). Three decades (1978-2008) of Advanced Trauma Life Support (ATLS™) practice revised and evidence revisited. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *16*(1), 1–3. https://doi.org/10.1186/1757-7241-16-19.

Student Course Manual ATLS ® Advanced Trauma Life Support ®. (2018).

Subbarao, I., Lyznicki, J. M., Hsu, E. B., Gebbie, K. M., Markenson, D., Barzansky, B., … James, J. J. (2008). A consensus-based educational framework and competency set for the discipline of disaster medicine and public health preparedness. *Disaster Medicine and Public Health Preparedness*, *2*(1), 57–68. https://doi.org/10.1097/DMP.0B013E31816564AF.

Suda, A. J., Franke, A., Hertwig, M., & Gooßen, K. (2025). Management of mass casualty incidents: a systematic review and clinical practice guideline update. *European Journal of Trauma and Emergency Surgery*, *51*(1), 5. https://doi.org/10.1007/S00068-024-02727-0

Tahernejad, A., Sahebi, A., Abadi, A. S. S., & Safari, M. (2024). Application of artificial intelligence in triage in emergencies and disasters: a systematic review. *BMC Public Health*, *24*(1), 1–18. https://doi.org/10.1186/S12889-024-20447-3.

Toner, E., Waldhorn, R., Maldin, B., Borio, L., Nuzzo, J. B., Lam, C., ... & O'Toole, T. (2006). Hospital preparedness for pandemic influenza. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, *4*(2), 207-217. https://doi.org/10.1089/bsp.2006.4.207

Toy, J., Warren, J., Wilhelm, K., Putnam, B., Whitfield, D., Gausche-Hill, M., … Goolsby, C. (2024). Use of artificial intelligence to support prehospital traumatic injury care: A scoping review. *JACEP Open*, *5*(5). https://doi.org/10.1002/emp2.13251.

van Melzen, R., Haveman, M. E., Schuurmann, R. C. L., van Amsterdam, K., El Moumni, M., Tabak, M., … de Vries, J. P. P. M. (2024). Validity and Reliability of Wearable Sensors for Continuous Postoperative Vital Signs Monitoring in Patients Recovering from Trauma Surgery. *Sensors 2024, Vol. 24, Page 6379*, *24*(19), 6379. https://doi.org/10.3390/S24196379.

Vandrevala, T., Morrow, E., Coates, T., Boulton, R., Crawshaw, A. F., O'Dwyer, E., & Heitmeyer, C. (2024). Strengthening the relationship between community resilience and health emergency communication: a systematic review. *BMC Global and Public Health*, *2*(1), 79. https://doi.org/10.1186/s44263-024-00112-y

Ventura, C. A. I., Denton, E. E., & David, J. A. (2024). Artificial Intelligence in Emergency Trauma Care: A Preliminary Scoping Review. *Medical Devices (Auckland, N.Z.)*, *17*, 191-211. https://doi.org/10.2147/MDER.S467146.

Way, D. P., Panchal, A. R., Price, A. R., Berezina-Blackburn, V., Patterson, J., McGrath, J., Danforth, D. R., & Kman, N. (2024). Learner evaluation of an immersive virtual reality mass casualty incident simulator for triage training. *BMC Digital Health*, *2*(1), 56. https://doi.org/10.1186/s44247-024-00117-5

Wexler, B., Schultz, C. H., Biddinger, P. D., Ciottone, G. R., Cornelius, A., Fuller, R. G., Lefort, R., Milsten, A., Phillips, J. P., & Nemeth, I. (2023). The 2023 Model Core Content of Disaster Medicine. *Prehospital and Disaster Medicine*, *38*(6), 699. https://doi.org/10.1017/s1049023x23006556

Wisnesky, U. D., Kirkland, S. W., Rowe, B. H., Campbell, S., & Franc, J. M. (2022). A Qualitative Assessment of Studies Evaluating the Classification Accuracy of Personnel Using START in Disaster Triage: A Scoping Review. *Frontiers in Public Health*, *10*, 676704. https://doi.org/10.3389/FPUBH.2022.676704.