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Systematic review

Assessment of Emergency Medical Technician (EMT) Preparedness and Confidence in Managing Out of Hospital Mass Casualty Incidents: A Systematic Review

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Abstract

Background: Mass casualty incidents (MCIs) place significant stress on Emergency Medical Services (EMS) and frontline Emergency Medical Technicians (EMTs) due to high patient demand and resource constraints. Effective prehospital MCI management is dependent on EMT preparedness, which includes the necessary knowledge, skills, and organizational structures. In addition to objective skills, professional self-confidence is critical for performance under high stress. The purpose of this systematic review was to analyze current literature regarding the preparedness levels and self-reported confidence of EMTs in managing out-of-hospital MCIs. **Methods**: This systematic review was conducted in accordance with PRISMA guidelines, searching databases including PubMed, MEDLINE, and Scopus for original articles from 2010 to the present. The research focused on EMTs and other prehospital providers concerning preparedness (knowledge, training, drills) and confidence. Study selection and quality assessment were performed by two independent reviewers, and the data was analyzed using a qualitative synthesis. **Results**: Ten original studies were included in the review. Findings indicated significant gaps in system preparedness, mainly concerning interagency coordination, surge capacity, and role-specific training. A national assessment in Saudi Arabia showed a median benchmark score of 60% for prehospital MCI preparedness. Simulation studies highlighted the decline in triage skills over time, which suggest the need for annual refresher training. Training interventions, mainly

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scenario-based methods like gamification and immersive virtual reality (VR), were shown to increase perceived preparedness and self-reported confidence of participants. **Conclusion**: EMTs and EMS systems show moderate levels of MCI preparedness, but deficiencies still in coordination, surge capacity, and sustained skill retention. Active, scenario based training, especially using innovative technologies like VR, is effective in improvement of objective performance and professional confidence in managing prehospital MCIs.

Keywords: Emergency Medical Technician (EMT), Mass Casualty Incident (MCI), Preparedness, Confidence, Triage, Simulation, Training.

Introduction

Mass casualty incidents (MCIs), defined by the World Health Organization as events in which patient demand exceeds locally available resources under routine procedures (1,2). These events, whether stemming from natural disasters, traffic accidents, or intentional acts, place the Emergency Medical Services (EMS) system, and frontline EMTs, at the epicenter of the initial response (2,3). Effective MCI response depends on pre hospital provider performance, incident command, and resource management (4). Studies found that typical, day to day protocols are insufficient for managing the surge capacity, resource constraints, and uncertainty inherent in MCIs (3,5).

EMT preparedness is central to effective prehospital MCI management. It includes the knowledge, skills, and organizational structures needed for an effective response (1). Studies shows that training, drills, and post incident reviews strengthen system resilience and improve outcomes (3,6). For example, a systematic review of MCI management recommended targeted training to improve triage quality and regular exercises to test emergency response plans (7). Studies report that many first responders still perceive their preparedness as inadequate despite scenario based training (8). This is often linked to the greater complexity of real incidents than training scenarios, weak interagency coordination, and exercises that do not prepare responders for the sustained demands of real events (9). A key qualitative study defined EMS preparedness components and grouped them into five categories, including individual and group empowerment and operational response measures (10).

In addition to objective preparedness, professional confidence affects performance under high stress (11). Several studies report that targeted training, including gamification and simulation or virtual reality (VR), improves learner knowledge and self reported confidence to manage MCIs (6,12,13). In addition, more than five years of experience is associated with higher triage accuracy, which suggest a key role for experience in performance and confidence. The literature indicates that personal preparation should include mental readiness and professional self confidence to function effectively as a prehospital incident commander (9). The purpose of this systematic review is to analyze studies about the preparedness levels and self reported confidence of EMTs in managing out of hospital MCIs.

Focused Research Question (PICO)

The research question is formulated using the PICO framework, Population: Emergency Medical

Technicians (EMT B, EMT A, Paramedics, and other prehospital care providers); Intervention: Preparedness (knowledge, training, drills, resources) and Confidence (self efficacy, self assessment); Comparison: Not applicable for a descriptive prevalence and assessment review. Comparison in different training types or experience levels, if data is available; Outcome: Measured levels of Preparedness and Confidence in managing prehospital MCI tasks (triage, command, communication).

Method

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and reported in line with PRISMA 2020 (Fig 1). We conducted electronic search for original articles addressed emergency medical technician (EMT) preparedness and confidence in managing out of hospital MCIs, including real incident and simulation based contexts.

Eligibility Criteria and Search Strategy

A comprehensive search was conducted in multiple electronic databases, including PubMed, MEDLINE, CINAHL, Embase, Scopus and Google Scholar. The search strategy combine Medical Subject Headings (MeSH) and text word terms for the three key concepts (EMT, Preparedness, and MCI). LIMIT: English, 2010 Present. Additionally, reference lists of included articles and relevant systematic reviews were hand searched to identify additional sources.

Study Selection and Data Extraction

Two reviewers screen titles and abstracts based on the inclusion and exclusion criteria. The same two reviewers assess the full text of relevant articles. Any disagreements resolved through discussion or by a third reviewer. A PRISMA flow diagram was used to document the study selection process. A standardized, pilot tested data extraction form was used to collect the information from each included study (first author and publication year. Study design and country, sample size and participant demographics, specific outcome measures for preparedness, specific outcome measures for confidence, and key findings related to preparedness and confidence.

Quality Assessment

The methodological quality and risk of bias of the included studies assessed by two independent reviewers using appropriate tools based on the study design. For quantitative studies Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Observational Studies or the Cochrane Risk of Bias Tool (for intervention studies). For qualitative studies: JBI Critical Appraisal Checklist for Qualitative Research.

Data Synthesis

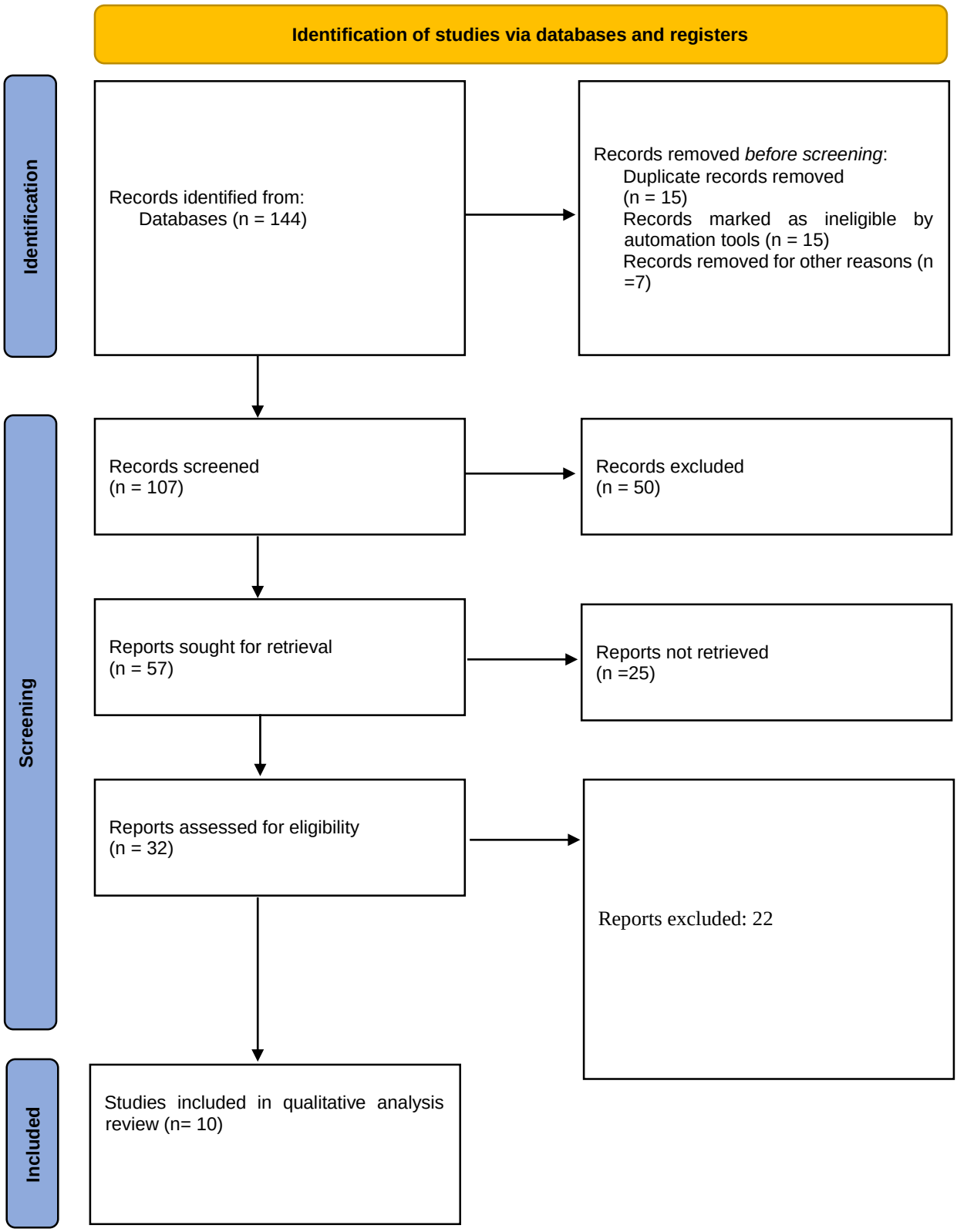
A qualitative synthesis was the primary method of analysis. This involve grouping studies by key outcomes, describing and comparing the results in studies, paying attention to the risk of bias assessment.

Ethical Considerations

Ethical exemption was obtained from the King Saud University Institutional Review Board (KSU IRB), Health Sciences Colleges Research on Human Subjects, Riyadh, Saudi Arabia, for the project titled *"Assessment of Emergency Medical Technician (EMT) Preparedness and Confidence in Managing Out-of-Hospital Mass Casualty Incidents: A*

Systematic Review" (Project No. **R26-IRB-205**; Ref. No. **26/0326/IRB**; dated **27 April 2026**). The IRB determined that the study did not constitute human-subject research, posed no more than minimal risk, and was exempt from further IRB review. Because this review used previously published data and did not involve direct contact with participants or collection of identifiable personal information, informed consent was not required. The study was conducted in accordance with applicable ethical guidelines and KSU IRB policies.

Fig 1: PRISMA consort chart



Result

EMT preparedness and confidence in MCIs

This systematic review included 10 original articles published between 2012 and 2025 that focused on EMT preparedness and confidence in managing out of hospital MCIs. The included studies utilized a mix of quantitative (simulation studies, cross-sectional surveys) and qualitative designs (interviews, content analysis).

Preparedness and training gaps

A common theme in the studies was the identification of gaps in system preparedness and training. A national assessment of pre hospital MCI preparedness in Saudi Arabia reported a median overall benchmark score of 60%, with preparedness at 76% and response at 52%, which found a regional variation. Another assessment of EMS facilities in Iran indicated a moderate level of disaster preparedness, with weaker performance noted in coordination, cooperation, and surge capacity. A survey of major incident medical response personnel in Norway reported common gaps, including a lack of local guidelines and limited role specific training.

Simulation studies indicate the perishable nature of preparedness skills. One study on triage performance in Germany found that accuracy declined one year after initial training, although brief retraining successfully improved accuracy and decreased under triage. Qualitative research involving prehospital incident commanders in Sweden also found that exercises were helpful but did not fully reflect the complexity of incident.

Confidence and training modalities

Training interventions and experience were linked to improved confidence and performance. The literature found that scenario-based methods are effective for increasing perceived preparedness and supporting the use of standardized triage algorithms. Specific training modalities, immersive virtual reality (iVR) and gamification, were shown to be highly engaging and positively impact self reported confidence. A quasi-experimental study using iVR MCI scenarios found that triage accuracy and speed differentiate expertise levels. A gamified MCI triage activity reported that 93% of participants felt better prepared and 98% felt strong motivation to learn START triage, describing the session as more challenging than other learning methods.

These findings show that training improves knowledge and self confidence, there is a need to address systemic issues, and improve coordination. Characteristics of the include studies and main findings were presented in Table 1.

Table 1: characteristics of the included studies

Study (year)	Country, setting	Design	Participants, sample	Key measures and main results
Hugelius et al. (2021) (9)	Sweden (prehospital incident commanders)	Qualitative (semi structured interviews, qualitative content analysis)	15 prehospital incident commanders	Preparedness and real major incident experience, exercises helpful but not fully reflecting real incident complexity
Ugelvik Thomassen et al. (2024) (14)	Norway (major incident medical response personnel)	Web based cross sectional survey (59 questions)	151 respondents	Described organization, working methods, commonly reported gaps (lack of local guidelines, limited role specific training)
Saadatmand et al. (2024) (15)	Iran (EMS preparedness model development)	Explanatory sequential mixed methods (5 stages)	Systematic review (10 articles), qualitative interviews (36), expert panel (15), Delphi (22)	Developed and validated an EMS preparedness model for mass casualty incidents using evidence + expert consensus
Dittmar et al. (2018) (16)	Germany (EMS, disaster response, Schwandorf, Bavaria)	Simulation study with follow up after initial training, ASAV triage	990 triage procedures by 51 providers analyzed	Triage performance declined at 1 year, brief re training improved accuracy, performance, under triage decreased after re training
Wolf et al. (2014) (17)	Germany (EMS, Schwandorf, Bavaria)	Simulation evaluation of ASAV algorithm during implementation, training	76 EMS providers, 780 triage sequences analyzed	Correct classification 83.9%, sensitivity (red) 87.4%, specificity 91.0%, under triage 9.7%, over triage 6.4%
Fattah et al. (2012) (18)	Norway (rescue and emergency workers)	Cross sectional questionnaire survey (30 questions)	918 participants	Assessed self reported competence in major incident management, highlighted training, competence gaps among responders
Saadatmand et al. (2023) (10)	Iran (EMS managers, incident command)	Qualitative (conventional content analysis, semi structured interviews)	36 participants (30–90 min interviews)	Identified components, categories describing EMS preparedness for mass casualty incidents
Baetzner et al. (2025) (13)	Germany (University Hospital Heidelberg, iVR)	Quasi experimental, multimethod iVR MCI scenarios (randomized scenario order)	76 participants (39 mass casualty first responders, 37 non first	Performance indicators (triage accuracy, speed, information transmission, eye tracking) differentiated expertise levels

			responders), 5 scenarios	
Alotaibi et al. (2019) (19)	Saudi Arabia (13 regions)	Benchmark assessment of prehospital MCI preparedness, response using EIRRA	Regional assessments (benchmark scoring across regions)	Median benchmark score 60% overall, preparedness 76%, response 52%, substantial regional variation
Javid et al. (2025) (3)	Pakistan (simulated MCI scenarios)	Retrospective descriptive analytical study using simulated dataset	300 simulated MCI scenarios (2010–2024)	Outcomes: mortality, morbidity, time to definitive care, LOS, policy change implementation, predictors included incident type, location, protocol, infrastructure, command structure

Discussion

The included studies indicates that EMT and EMS preparedness and confidence for MCIs reflect individual readiness and system capability. A national assessment of EMS facilities in Iran reported a moderate level of disaster preparedness, and showed weaker performance in coordination and cooperation and surge capacity, which suggest that critical gaps is more apparent when demand escalates and multiagency synchronization is required (20). In Saudi Arabia, EMS providers supporting mass gatherings indicate the importance of structured education and continuing development: respondents identified disasters as a common information source, and they show the need for targeted disaster management training, pairing novice providers with experienced personnel, and simulated drilling to introduce the stress of MCIs response (21).

Operational exposure and interprofessional communication are key determinants of effective response. In a Norwegian national survey, HEMS and SAR crew members reported limited exposure to major incident management and described poor communication prior to arrival, while cooperation on scene was rated more favorably; respondents called for more interdisciplinary exercises focusing on cooperation and communication (22).

Training interventions in the included studies found that active, scenario based methods increase perceived preparedness and support use of standardized triage algorithms. Gamified MCI triage activity reported improved perceived readiness (93% felt better prepared) and strong motivation to learn START triage (98%), with most participants describing the session as more challenging than other learning activities (23). Immersive simulation complement field drills when logistics, cost, or safety limit full scale exercises. In a 360° VR pediatric MCI module, participants rated the experience highly engaging and immersive, and performance differed by experience and age groups (24). A virtual reality learning module for paramedics was developed to address practical barriers of tactical exercises, positioning VR as a feasible supplement for refresher training (25).

Strengthening preparedness requires evaluation and reporting so lessons learned can be compared in exercises and real incidents. A systematic review of templates for reporting pre-hospital major incident medical management found several approaches but concluded that none were designed for prehospital major incident medical management, this reinforce the need for a field friendly standardized template to support quality improvement (26).

Conclusion

This systematic review found that EMT preparedness for out of hospital MCIs is moderate, but significant gaps exist. Deficiencies are noted in system level capabilities, which include interagency coordination, cooperation, and surge capacity. Simulation studies confirm that triage performance skills decline over time, indicating the necessity of continuous, yearly brief retraining. To effectively bridge the gap between training and the complexity of incidents, advanced scenario based methods are important. The use of Virtual Reality (VR) and gamification show effectiveness in improving EMTs' objective performance and self-reported confidence in managing these high-stress situations.

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