

Systematic Review

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Disaster Management Education and Training for Paramedics: A Scoping Review

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Abstract

Objectives: The aim of the present scoping review is to provide a comprehensive description and classification of the published research studies on education and training of paramedics and paramedic students in the context of disaster management with emphasis on educational/training techniques and their efficacy and the recent trends in this evolving field. The review is also designed to identify the main research gaps and to suggest recommendations for future research plans.

Methods: PubMed, Web of Science Core Collection, Scopus, Google Scholar, and ProQuest Dissertations and Theses were searched. Studies were included in the final analysis if they studied any aspect of paramedics or paramedic students' education or training in the context of disaster management.

Results: Forty-three studies fulfilled the selection criteria. Three themes were identified: 1) Conventional disaster education/training techniques; 2) Smart technology-based disaster education/training techniques; and 3) Development of and/or assessment of disaster education/training courses, programs, packages, or curricula.

Conclusions: While disaster triage training is the focus of many studies, a new trend is emerging that integrates smart technology into educational and training programs. Also, there is increasing international interest in developing disaster training programs and curricula.

The Sendai Framework for Disaster Risk Reduction asserts that minimizing the loss and damage from disasters requires building resilience through an all-of-society engagement and integrated efforts of all stakeholders at international, national, and local levels, including the health sector.¹ This approach emphasizes that disaster risk management must start well before a disaster strikes, and continue during and after the event.² However, studies show that medical facilities, health workers, and support staff are insufficiently prepared to handle major emergencies and disasters.^{3–7} Factors affecting disaster preparedness may include governmental efficiency, standardized guidelines and plans, sufficient resources, adequate communication systems, and education and training. The latter is the cornerstone of competent emergency services and is a proven approach to enhance disaster preparedness.^{4,5}

Paramedics are traditionally involved in the primary assessment of the incident scene, triage, providing essential care and transport of victims.⁸ They are required to enhance their knowledge and skills in disaster risk management process for an optimal performance in such highly demanding conditions.⁹ However, little is known about specific and standardized disaster training programs for paramedics, and the extant educational and training plans show many variations and inconsistencies.⁸

The objectives of the present review are to provide a comprehensive description and classification of the published research on education and training of paramedics and paramedic students in the context of disaster management with emphasis on educational/training techniques and their efficacy and the recent trends in this evolving field, to identify the main research gaps, and to suggest recommendations for future research plans.

Methods

The present review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist.¹⁰

Search Strategy

Five databases were searched for relevant studies, including PubMed, Web of Science Core Collection, Scopus, Google Scholar, and ProQuest Dissertations and Theses. Search terms were

Table 1. Search concepts and terms

Concept	Search terms/phrases
Paramedic	Paramedic/Ambulance/Air Ambulance/Emergency service/Emergency medical service/Helicopter emergency medical service/Emergency treatment/Emergency medicine/Frontline provider/First responder
Disaster	Disaster/Natural disaster/Disaster medicine/Disaster planning/Disaster training/Disaster triage/Disaster preparedness/Mass casualty incident
Education/training	Education/Teaching/Training/Simulation training

developed using keywords combinations and Medical Subject Headings (Mesh) terms for the concepts of paramedics, disaster, and education/training. Search concepts and relevant search terms are listed in Table 1.

Search was limited to studies published in English language from January 2010–August 2024. Journal articles, conference papers, and non-peer reviewed theses and dissertations were included. Search strategies used in different databases are shown in Table 2. All obtained results were imported to Endnote and duplicates were identified and removed using automated function and manual screening. Considering the large number of results obtained by

Google Scholar, we imported only the first 500 results to the reference manager. Haddaway et al.¹¹ recommended to focus on the first 200–300 results in Google Scholar search for grey literature.

Inclusion and exclusion criteria

Studies were included in the final analysis if they studied any aspect of paramedics or paramedic students' education or training in the context of disaster management. In addition, they should be published in English with available full text. Studies were excluded if paramedics were not explicitly stated in the study sample, if they described training or educational interventions not specifically practiced during disaster management, or if they studied general aspects of paramedic education and training not specific for disaster management scenarios.

Data charting, analysis, and synthesis of results

The first author initially developed a preliminary data-charting form that was used to extract data from included studies. The form and the extracted data were then shared with the other 2 authors who independently reviewed the chart and the extracted data. The reviewers' recommendations were discussed collaboratively until a consensus was reached. Then, both the chart and extracted data were refined and updated. Extracted data included general descriptive data (first author, year of publication, type of publication, country of origin), methodological data (design, scenario/context, sample), and main outcome findings. Data were thematically

Table 2. Search strategies, keywords, and number of results retrieved from each database for the scoping review (2010–2024).

Database	Search Strategy/Syntax	Results
Pubmed	(((((Paramedic[Title/Abstract] OR Ambulance[Title/Abstract] OR "Air Ambulance"[Title/Abstract] OR "Emergency service"[Title/Abstract] OR "Emergency medical service"[Title/Abstract] OR "Helicopter emergency medical service"[Title/Abstract] OR "Emergency treatment"[Title/Abstract] OR "Emergency medicine"[Title/Abstract] OR "Frontline provider"[Title/Abstract] OR "First responder"[Title/Abstract]) AND (Disaster[Title/Abstract] OR "Natural disaster"[Title/Abstract] OR "Disaster medicine"[Title/Abstract] OR "Disaster planning"[Title/Abstract] OR "Disaster training"[Title/Abstract] OR "Disaster triage"[Title/Abstract] OR "Disaster preparedness"[Title/Abstract] OR "Mass casualty incident"[Title/Abstract])) AND (Education[Title/Abstract] OR Teaching[Title/Abstract] OR Training[Title/Abstract] OR "Simulation training"[Title/Abstract])) AND (English[Language])) AND ("2010/01/01"[Date - Publication] : "2024/08/31"[Date - Publication]))	299
Web of Science	((((TS=(Paramedic OR Ambulance OR "Air Ambulance" OR "Emergency service" OR "Emergency medical service" OR "Helicopter emergency medical service" OR "Emergency treatment" OR "Emergency medicine" OR "Frontline provider" OR "First responder")) AND TS=(Disaster OR "Natural disaster" OR "Disaster medicine" OR "Disaster planning" OR "Disaster training" OR "Disaster triage" OR "Disaster preparedness" OR "Mass casualty incident")) AND TS=(Education OR Teaching OR Training OR "Simulation training")) AND LA=(English)) AND DOP=(2010–01–01/2024–08–31)	418
Scopus	(TITLE-ABS-KEY (paramedic OR ambulance OR "Air Ambulance" OR "Emergency service" OR "Emergency medical service" OR "Helicopter emergency medical service" OR "Emergency treatment" OR "Emergency medicine" OR "Frontline provider" OR "First responder") AND TITLE-ABS-KEY (disaster OR "Natural disaster" OR "Disaster medicine" OR "Disaster planning" OR "Disaster training" OR "Disaster triage" OR "Disaster preparedness" OR "Mass casualty incident") AND TITLE-ABS-KEY (education OR teaching OR training OR "Simulation training")) AND PUBYEAR > 2009 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE, "English"))	1819
Google Scholar	https://scholar.google.com/eg/scholar?q=Paramedic+OR+Ambulance+OR+%22Air+Ambulance%22+OR+%22Emergency+service%22+OR+%22Emergency+medical+service%22+OR+%22Helicopter+e+mergency+medical+service%22+OR+%22Emergency+treatment%22+OR+%22Emergency+medicine%22+OR+%22Frontline+provider%22+OR+%22First+responder%22+AND+Disaster+OR+%22Natur+al+disaster%22+OR+%22Disaster+medicine%22+OR+%22Disaster+planning%22+OR+%22Disaster+training%22+OR+%22Disaster+triage%22+OR+%22Disaster+preparedness%22+OR+%22Mass+casualty+incident%22+AND+Education+OR+Teaching+OR+Training+OR+%22Simulation+training%22&hl=en&as_sdt=0%2C5&as_ylo=2010&as_yhi=2024	21 600 (500*)
Proquest	summary(Paramedic OR Ambulance OR "Air Ambulance" OR "Emergency service" OR "Emergency medical service" OR "Helicopter emergency medical service" OR "Emergency treatment" OR "Emergency medicine" OR "Frontline provider" OR "First responder") AND summary(Disaster OR "Natural disaster" OR "Disaster medicine" OR "Disaster planning" OR "Disaster training" OR "Disaster triage" OR "Disaster preparedness" OR "Mass casualty incident") AND summary(Education OR Teaching OR Training OR "Simulation training") Limited by: Date: From January 01 2010 to December 31 2024 Language: English	71

*First 500 results included in identification of new studies via databases.

analyzed to identify themes and subthemes. Finally, results were qualitatively synthesized, summarized, and presented.

Results

Search Results

Search identified 3107 records from all databases which were reduced to 2459 records after electronic and manual removal of duplicates. Application of inclusion and exclusion criteria on titles and abstracts of these records identified 99 records that required further screening of full texts. Forty-three studies were included in the final analysis (Figure 1). The included studies were published as journal articles (90.7 %) and conference papers (9.3 %).

General Characteristics of Included Studies

The studies belonged to 19 countries including the US (41.9 %), Saudi Arabia (11.6 %), Germany (7.0 %), and others. The study

design widely varied according to the study purpose and context. Quasi-experimental design using pretest-posttest or within-subjects analysis was used in 37.2 % of studies while mixed methods were used in 32.6 % and randomized design was used in 20.9 %. The study sample in only 37.1 % of studies exclusively included paramedics and/or paramedic students, while in other studies, they were recruited among other professionals.

Identified Themes and Subthemes

Studies were categorized under 3 themes: 1) Conventional disaster education/training techniques; 2) Smart technology-based disaster education/training techniques; and 3) Development of and/or assessment of disaster education/training courses, programs, packages, or curricula.

Theme 1: conventional disaster education/training techniques

This theme included 25 studies investigating the value of various types of education/training techniques on knowledge and

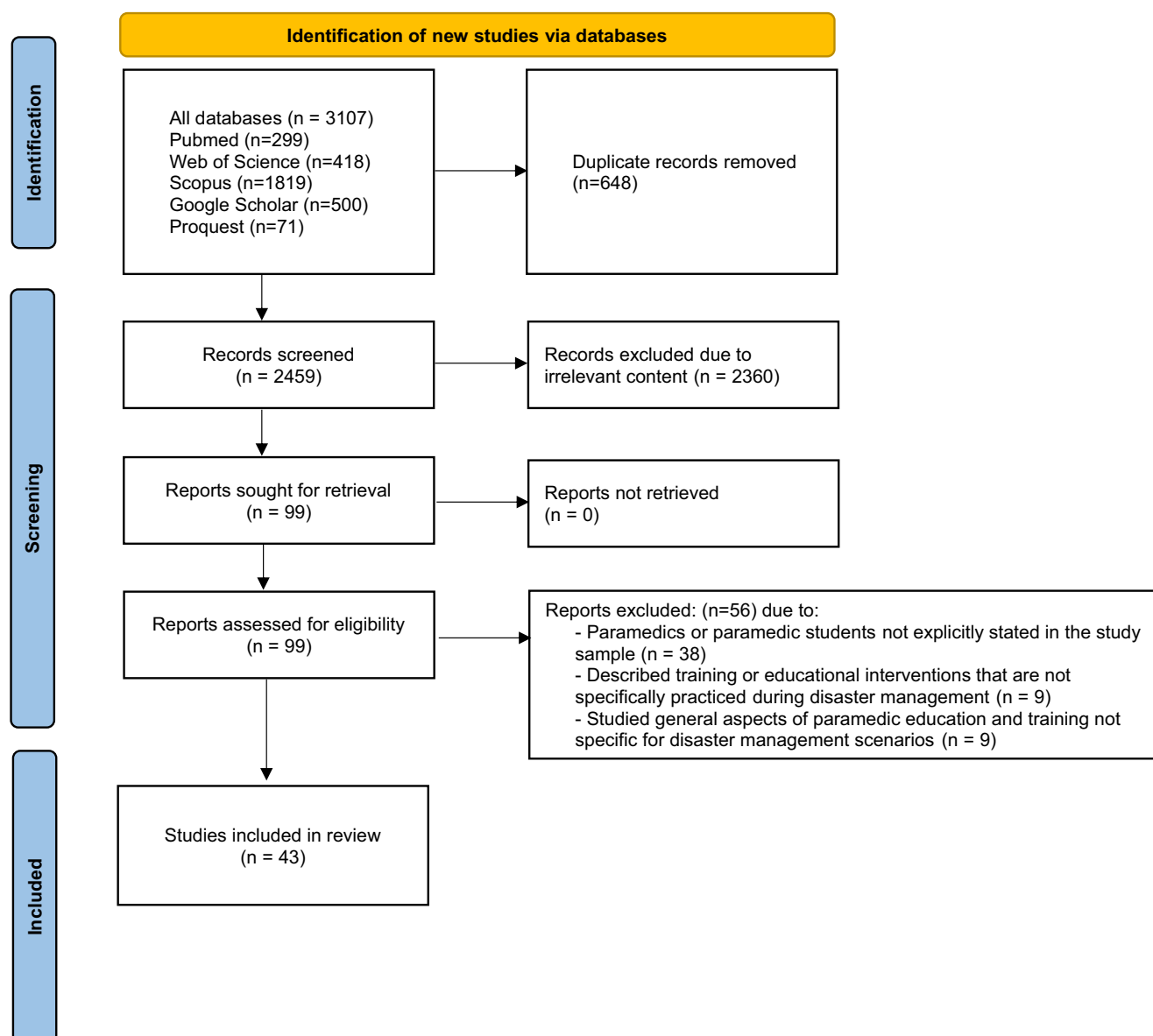


Figure 1. PRISMA flow diagram illustrating the process of study selection for the scoping review on disaster management education and training for paramedics (2010–2024).

performance of participants. The theme was subdivided into 2 subthemes:

Subtheme 1A: disaster triage education/training techniques. Fifteen studies were categorized under this subtheme. The studied techniques included role playing and educational video,¹² mixed-methods simulations,¹³ video game,¹⁴ screen-based simulation,^{15,16} educational review session and/or aide-memoir,¹⁷ brief lecture,¹⁸ visually enhanced mental simulation,¹⁹ serious gaming and card-sort exercise,²⁰ and others. Generally, use of these techniques resulted in improved triage accuracy. However, in comparative studies, the difference between techniques varied. Importantly, Ghazanfar et al.²¹ highlighted the decline of knowledge retention 60 days after triage training. Dittmar et al.²² emphasized the value of yearly refresh training in improving triage accuracy. More details of these studies are shown in Table 3.

Subtheme 1B: other types of disaster education/training interventions. Ten types of interventions were discussed in the studies that belonged to this subtheme. They included in situ simulation for Covid-19 pandemic preparedness,²³ multimedia cholinergic crisis management training,²⁴ drills for pediatric disaster preparedness,²⁵ stadium patient evacuation simulation,²⁶ hazardous area response team training,²⁷ interprofessional disaster training,²⁸ active shooter incidents training,²⁹ mass destruction weapons events training,³⁰ ultrasound simulator for FAST skills training,³¹ and incident command training.³² These interventions resulted in improved knowledge, performance, or collaboration among participants (Table 3).

Theme 2: smart technology-based disaster training techniques

Eleven studies documented various aspects of smart technology applications in disaster training. These applications included virtual reality (VR),^{33–41,73} smartphone-based training,⁴² and Google Glass telesimulation.⁴³ Authors of these studies generally warned that while use of these technologies proved to be useful, they can't replace real-world training, and they need further improvement and enhancement (Table 3).

Theme 3: development of and/or assessment of disaster education/training courses, programs, or curricula

The third theme included 7 studies that described the development of detailed disaster education/training courses, programs, or curricula, or assessed the performance and gaps in existing ones. Alnoaimi et al.⁴⁴ assessed the expatriate prehospital provider training curricula in Bahrain. They showed that these curricula lacked coverage of many core competencies (e.g., critical thinking and decision-making skills) as compared to national curricula.

Bajow et al.⁴⁵ described the development of a major incident management course, while Bajow et al.⁴⁶ reported their experience with development of a humanitarian health emergency and relief course. Sultan et al.⁴⁷ identified multiple gaps in disaster and emergency medicine curriculum in Saudi Arabia. Bhattacharya et al.⁴⁸ documented details and implementation of a training program for disaster preparedness in India. Caviglia et al.⁴⁹ described the development of a prehospital disaster training package in Sierra Leone.

Discussion

Studies included in this review were conducted in 19 countries across the globe. However, 41.9% of these studies were conducted in the US. This may be related to the continuously rising threat of some disastrous events in the country, including catastrophic

tropical cyclones⁵⁰ and mass shootings.⁵¹ The US also provides multiple graduate programs in all aspects of disaster management.⁵²

Saudi Arabia ranked second after the US, which may be explained by the fact that the Kingdom was one of the most affected countries by Middle East Respiratory Syndrome Coronavirus (MERS-CoV) infection.⁵³ Also, the annual complex and unique challenges of the Hajj enhanced the academic and governmental interest in improving the preparedness against the different health threats related to such mass gathering events.^{54–57} Moreover, it is clear that most studies were performed in high-income⁵⁸ countries while only few studies were conducted in developing countries. Unfortunately, this finding is not new. In one study, it was found that less than 1% of disaster-related research was conducted in developing countries even though these countries are the scene of about 85% of world disasters.⁵⁹

Fifty eight percent of studies are related to Theme 1, with most of them focusing on disaster triage training. This is not surprising considering the vital role of triage accuracy in such situations and the necessity of improving triage skills of first responders.^{60,61} In fact, poor prehospital disaster triage efficiency is associated with unfavorable clinical outcomes^{62,61} and inefficient resource utilization.⁶³ Educational and training activities reported by different studies resulted in positive impact either on the knowledge or the performance of the trainees. However, the study design of many studies listed under this theme was quasi-experimental design using pretest-posttest or within-subjects analysis and fewer studies followed randomized design. While randomized design is considered the optimal design for interventional studies, implementation may be hindered by logistic or ethical obstacles.⁶⁴ The main shortcoming of quasi-experimental designs is the presence of unequivocal comparative groups.⁶⁵ Following within-subject analysis is arguably related to false or biased conclusions particularly when used in studies based on educational or training interventions.^{66–68} Pretest-posttest design also has multiple inherent flaws.⁶⁹ Unfortunately, these study design issues are frequently encountered in the prehospital care and paramedical research and can affect the quality of evidence that can be derived from these studies. Martin-Gill et al.⁷⁰ recognized multiple gaps in the quality of recommendations suggested by many prehospital care guidelines. They highlighted the value of using high-quality research in development of these guidelines. Also, McDonald et al.⁷¹ identified the lack of standardization in paramedicine research in terms of variables, methods, quality thresholds, and used terminology.

Many studies included in this review showed the effectiveness of integrating technological innovations in paramedics education and training for disaster management.^{72–74} The continuous improvement of VR and augmented reality (AR) technologies is particularly attractive in disaster education and training considering the cost and the demanding logistic requirements of conventional real life training methods.

Notably, 37% of the studies exclusively included paramedics or paramedic students, and in other studies, they were part of multi-professional samples. Considering the important direct role paramedics play in disaster management, further research specifically designed with paramedics' needs for disaster risk management knowledge and skills may be required. One of the hurdles against development of dedicated paramedicine research is the inflexible adoption of hospital care principles into the prehospital setting without considering its distinctive features.⁷⁵ A multidisciplinary approach that involves academic institutions, paramedicine researchers, and industry

Table 3. Summary of included studies (*n* = 43)

Country	Design	Scenario/Context	Sample	Main findings	
Theme 1 Conventional Disaster Education/Training Techniques (n = 25)					
Subtheme 1A Disaster triage education/training techniques (n = 15)					
Aghababaeian 2013 ¹²	Iran	Quasi-experimental	Comparison between role playing and educational video for triage training.	Paramedics n = 10 Others n = 134	Both interventions were effective. Role playing was more desirable with more lasting effect on performance.
Cicero 2014 ¹³	United States	Mixed methods	Development of pediatric disaster triage simulations.	Physicians and Paramedics n = 8	Refined simulations gained high consensus among experts.
Cicero 2017 ¹⁴	United States	Randomized	Disaster triage video game.	First responder or student n = 12 EMT n = 17 Paramedics n = 13 Other n = 7	While the game improved trial accuracy, no significant difference from controls was found.
Cicero 2018 ¹⁵	United States	Quasi-experimental	Screen-based simulation for disaster triage.	EMT n = 196 Paramedics n = 251 RN n = 97 Student n = 97 Others n = 98	Use of intervention improved in-game triage accuracy.
Cicero 2019 ¹⁶	United States	Randomized	Screen-based versus immersive simulations for disaster triage.	EMT/Paramedics n = 17 Other n = 7	Screen-based simulation resulted in better triage accuracy.
Cuttance 2017 ¹⁷	Australia	Randomized	Sieve triage training through educational review session and/or an aide-memoir.	Paramedics n = 292	Use of aide-memoir increased triage accuracy.
Deluhery 2011 ¹⁸	United States	Quasi-experimental	SALT triage accuracy after brief lecture.	Paramedics n = 292	Brief repeated lecture increased accuracy of triage performance.
Demir 2023 ¹⁹	Turkey	Quasi-experimental	Visually enhanced mental simulation for triage and management skills.	Paramedic students n = 20	Intervention resulted in improved triage accuracy and management skills.
Dittmar 2018 ¹⁷	Germany	Quasi-experimental	MCI triage performance after 1 year of training and retraining.	Paramedics: variable EMT: variable Others: variable	Yearly refresh training enhanced triage accuracy.
Ghazanfar 2022 ²¹	United Arab Emirates	Quasi-experimental	Knowledge retention after sieve triage training.	Soldiers 80% Officers 9% Paramedics 1% Nurses 1% Others 1%	Knowledge retention for sieve triage training declined after 60 days of training.
Knight 2010 ²⁰	United Kingdom	Randomized	Comparison between serious gaming and card-sort exercise in sieve triage training.	Physicians Nurses Paramedics	Triage accuracy was better with serious gaming.
Leggio 2014 ⁷⁹	Saudi Arabia	Mixed methods	Simulated MCI training.	Paramedic students n = 9	The exercise improved participants skills and highlighted training gaps.

(Continued)

Table 3. (Continued)

	Country	Design	Scenario/Context	Sample	Main findings
Risavi 2013 ⁸⁰	United States	Quasi-experimental	Written versus moulage scenarios for MCI triage training.	EMTs n = 28 EMT-Paramedics n = 17	No significant difference was found between both techniques.
West 2014 ⁸¹	United States	Randomized	FAST scan in MCI triage.	Paramedics n = 10	FAST was difficult to perform. However, its use limited the likelihood of false-negative triage.
Whitfill 2020 ⁸²	United States	Randomized	Cost-effectiveness of video game versus live simulation in pediatric disaster training.	First responder or student n = 48 EMT n = 26 Paramedics n = 67 Others n = 3	Video game-based simulation disaster triage training was more cost-effective.
Subtheme 2 Other types of disaster education/training (n = 10)					
Aljahany 2021 ²³	Saudi Arabia	Quasi-experimental	In situ simulation for Covid–19 pandemic preparedness.	Emergency nurses 64.8 % Emergency physicians 20.4 % Paramedics/EMTs 9.3 % RTs 5.6 %	In situ simulation was effective method for increasing pandemic readiness.
Andreatta 2015 ²⁴	United States	Quasi-experimental	Cholinergic crisis management training by multimedia with either live animal or patient actor examples.	Nurses n = 21 Paramedics n = 137 Medical students n = 47	No significant differences were found between the live animal and patient actor groups.
Cicero 2019 ²⁵	United States	Mixed methods	State-wide drills for pediatric disaster preparedness.	Paramedics Nurses Physicians Mental health professionals, Experts in disaster response	Such drills enhanced cooperation and uncovered real-world gaps.
Gangaram 2023 ²⁶	Qatar	Mixed methods	Stadium patient evacuation simulation using helicopter or ground ambulance.	Paramedics n = 44	Helicopter didn't significantly shorten time of patient transport.
Huabbangyang 2023 ²⁷	Thailand	Quasi-experimental	Hazardous area response team training.	EMT n = 51 Nurses n = 11 Physicians n = 4 Paramedics n = 4	Training improved participants knowledge and confidence.
Innis 2021 ²⁸	Canada	Mixed methods	Interprofessional disaster training.	Nursing student n = 78 Pharmacy technician n = 37 Pre-service fire n = 29 Police foundations n = 22 Paramedic n = 24	Training improved knowledge about collaborating with different professions and interprofessional roles.
Jones 2014 ²⁹	United States	Quasi-experimental	Active shooter incidents training.	EMT-basic 68% Paramedics 19% Others 13%	Training improved participants attitudes and perceptions.

(Continued)

Table 3. (Continued)

	Country	Design	Scenario/Context	Sample	Main findings
Motola 2015 ³⁰	United States	Randomized	Just-in-time training for mass destruction weapons events.	Paramedics n = 90	Training improved participants performance in explosives and chemical nerve agent scenarios but not in radiologic scenario.
Paddock 2015 ³¹	United States	Randomized	Traditional versus ultrasound simulator for FAST skills training in disaster response team.	Nurse n = 9 Physician n = 14 Paramedics/EMT n = 13	Both interventions were equal.
Shulman 2024 ³²	Israel	Mixed methods	Comparison between Sukkah and field drills incident command training.	Paramedic students	Both interventions were comparable.
Theme 2 Smart Technology-Based Disaster Education/Training Techniques (n = 11)					
Bauchwitz 2024 ⁴²	United States	Quasi-experimental	Smartphone-Based training for MCI.	Medical students n = 1 Nurses n = 4 Physicians n = 8 Paramedics n = 8	The intervention was effective and can be easily deployed.
Berndt 2018 ³⁴	Germany	Mixed methods	Newly developed immersion and presence VR training for MCI in comparison to traditional training.	Paramedic students n = 18	VR training can fill the gap between paper-based simulations and large-scale exercises. Further development is required.
Berndt 2018 ³³	Germany	Mixed methods	Human-centered VR training for MCI.	Paramedics n = 10	The simulation appeared to be useful in triage training but needs further improvement particularly in presence and immersion.
Bilek 2021 ³⁵	Austria	Mixed methods	VR training for MCI.	Paramedics Practitioners	The application had a positive learning effect but can't replace real-life training.
Cone 2011 ³⁶	United States	Quasi-experimental	SALT versus Smart triage systems using VR.	Paramedic students n = 22	Greater accuracy was noted with Smart triage.
Harada 2024 ³⁷	Japan	Randomized	VR versus lecture training for START triage.	Paramedics n = 70	VR improved academic ability of participants than lecture training.
Kman 2023 ³⁸	United States	Mixed methods	VR for MCI training.	Physicians Paramedics EMT	The system is the first fully automated, fully immersive VR system for training first responders. However, it's designed for the SALT triage protocol.
Lochmannová 2022 ³⁹	Czech Republic	Action research	VR for MCI training.	Paramedic students Paramedics	The application provided a flexible and adaptable environment but can't replace real-world training.
McCoy 2019 ⁴³	United States	Feasibility	Google Glass telesimulation for MCI triage education and training.	Physicians n = 12 Nurses n = 4 EMT/ paramedics n = 5	Inter-continental MCI triage course using telesimulation and wearable/mobile technology was successfully achieved.
Mills 2020 ⁴⁰	Australia	Quasi-experimental	VR triage training versus live simulation-based scenarios.	Paramedic students n = 5 Paramedics n = 5	Both interventions were comparable.
Vogt 2023 ⁴¹	Netherlands	Mixed methods	VR for triage in complex scenarios.	Paramedics n = 32	The application was effective but further improvements are needed.

(Continued)

Table 3. (Continued)

	Country	Design	Scenario/Context	Sample	Main findings
Theme 3 Development of and/or Assessment of Disaster Education/Training Courses, Programs or Curricula (n = 7)					
Alnoaimi 2022 ⁴⁴	Bahrain	Qualitative	Prehospital provider training curricula.	Paramedics Nurses	The study identified the major core competencies of the expatriate providers' curricula working in the country.
Bajow 2018 ⁴⁵	Saudi Arabia	Mixed methods	Major incident management course.	Paramedics n = 9 Physicians n = 7 Nurses n = 2	The study described the development of prehospital MCI management course in Saudi Arabia with domains and core competencies. Course implementation was able to improve disaster preparedness.
Bajow 2019 ⁴⁶	Saudi Arabia	Quasi-experimental	Humanitarian health emergency and relief course.	Nurse n = 4 Paramedics n = 13 Physician n = 3 Radiology technician n = 1	The study described the development of a 4-level educational basic course on humanitarian health emergency and relief. The course improved participants knowledge with marked information retention even after 10 months after participation.
Bhattacharya 2020 ⁴⁸	India	Quasi-experimental	Training program for disaster preparedness.	Paramedic students n = 119	The study described a 3-month program that used multiple educational and training tools with positive impact on knowledge and attitudes towards disaster preparedness.
Caviglia 2022 ⁴⁹	Sierra Leone	Mixed methods	National disaster training package.	Paramedics n = 441 Ambulance drivers n = 441 Operators: n = 36	The study described the development and curriculum of a prehospital disaster training package. Implementation of the package resulted in significant improvement in students' engagement and knowledge retention.
Cicero 2017 ⁸³	United States	Mixed methods	Multiple simulations curriculum for pediatric disaster triage.	EMT n = 34 Student n = 101 Paramedic n = 107	The study described the development of multiple simulation curriculum and assessment tools. Curriculum implementation improved accuracy of triage.
Sultan 2023 ⁴⁷	Saudi Arabia	Survey	Disaster and emergency medicine curriculum.	Physicians n = 37 Nurses n = 66 Paramedics n = 25	The study assessed the current curriculum of disaster and emergency medicine in Saudi Arabia. Multiple gaps were identified. Integration of the collaborative tools and simulation exercises was recommended.

Abbreviations: ALS: Advanced life support, BLS: Basic life support, EMT: Emergency medicine technician, FAST: Focused Assessment with Sonography in Trauma, MCI: Mass casualty incident, RN: Registered nurse, RTs: Respiratory therapists, SALT: Sort-assess-lifesaving interventions-treatment/transport, START: simple triage and rapid treatment, VR: Virtual reality.

*Conference paper

leaders may provide a platform to build reality-based paramedicine research agendas at the national and international levels.^{76–78}

Limitations

The findings of the present review may be limited by search strategy restriction to studies published in English. This may lead to missing important data published in other languages. Also, the review focused on paramedical education and training in the field of disaster management, which essentially requires multidisciplinary approach.

Conclusions

The present scoping review highlights the main features of published studies in the evolving field of disaster education and training for paramedics and paramedic students. While traditional disaster triage education and training is the main subject of many studies, there is increasing interest in development of new training tools integrating AR and VR into the educational and training programs. There is a trending international interest in development of national disaster management education and training programs and curricula.

Recommendations

Development of a comprehensive agenda that integrates paramedicine research in multidisciplinary disaster management is highly recommended. Assessment of the efficacy of educational/training interventions through randomized controlled studies is also encouraged. International initiatives are needed to promote paramedicine research in disaster management, particularly in developing countries. More integration of technological advancements, especially VR, is advisable to overcome multiple shortcomings related to conventional training protocols.

Author contribution. All authors contributed to conceptualization, formal analysis, drafting, and final revision of this review.

Competing interests. The author(s) declare none.

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