D3.1

Overview of Current Training and Best Practices of Training Curricula in European MFR and Impacts on the EPME Model and Training

Version
V1.2

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Versions

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Report Review

Version	Date	Reviewer(s)	Statement
V1.1	13/01/2022	Consortium	Specific comments on contents, elements to be included, and structure.
V1.2	28/01/2022	Helmut Schrom-Feiertag	Final review

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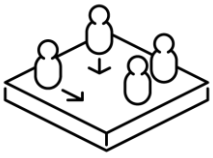
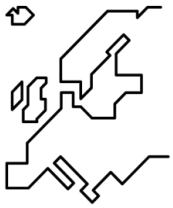
List of Acronyms and Abbreviations

Acronym/ Abbreviation	
EPME	Effective Performance in Medical Emergencies
EU	European Union
MFR	Medical First Responder
MR	Mixed Reality
VR	Virtual Reality

Relation to Objectives

Objective	Description
	**Obj. 1: Pioneering MR training approach for enhanced realism** In order for VR training to feel realistic to the trainees, we need to discover how they are currently training and how these training methods are experienced. Based on the insights gained from the trainees, we can design training scenarios that not only connect to the usual training, but may even provide elements to enhance realism that are lacking in the current training.
	**Obj. 2: Effective training scenarios and a training curriculum** The training curriculum that is developed within the scope of this project needs to build on the validated training methods. This ensures that our training approaches will be accepted by the end-user organizations and yield the desired effectiveness.
	**Obj. 3: Physiological signal and trainee behavior feedback loop and smart scenario control** Relevant behavioral responses and physiological measurements can only be identified for clear goals end key performance indicators for specific training scenarios.
	**Obj. 4: Position the pioneering MR training approach across Europe** By explicitly using the current training methods as a foundation, we lower the threshold for end-user organizations to actually implement the technology given its close alignment with already familiar approaches.

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Executive Summary

In order to develop effective Mixed Reality (MR) disaster training methods, we need to establish an overview of the current best practices for Medical First Responder (MFR) training. Once the current standards are determined, we can then proceed by adding crucial elements that are currently missing from the training curricula, while at the same time relying on the methods' effectiveness. Therefore, in this deliverable we will first present the current best practices of MFR training. These insights are based on 1) an extensive review of training curricula in higher education institutions from a previous EU project called "Disaster Training Curriculum" (Ingrassia et al., 2014), 2) systematic training observations conducted by members of the consortium (see Deliverable 2.2), and 3) a systematic literature review focusing on the empirically validated training methods. We will then discuss how these insights help to build our Effective Performance in Medical Emergencies (EPME) model for future research.

In general, the most used disaster training methods are built around practical simulation exercises. This approach is reflected in both the actual trainings conducted by the end-user organizations as well as the empirically validated methods. It is important to note that the trainees repeatedly state that the more realistic these simulations are, the more they feel immersed in the actual situation. However, the validation of these methods is typically limited to knowledge acquisition with a particular focus on the triage process, (i.e., when medical resources are limited). Behavioral performance indicators or team-based performance indicators (e.g., communication) are rarely assessed. Additionally, modern technologies, such as MR, are rarely integrated in the trainings and only few studies have examined their effectiveness.

Relation to other deliverables and tasks in MED1stMR

Table 1: Previous deliverables integrated into this deliverable.

No.	Title	Information on which to build
D2.2	End users Point of View: Requirements Report, Stakeholder Map and Expectation Summary for Smart Wearables, MR Training Framework and Curriculum	The requirements and wishes for curriculum content indicate what the end-user organizations perceive as good practice and what they would like to add to their current program.

Table 2: The results of this work will be incorporated into following work and developments.

No.	Title	Basis for
D3.2	Multi-Dimensional Conceptual EPME Model and Research Agenda for Validation	The current best practices and empirically validated methods will help to identify relevant elements of the EPME model.

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1 Disaster Training Curricula

In the first step of this deliverable, we identified previous work that has been conducted within the EU with the aim to identify current best practices of disaster training for MFRs. Ingrassia and colleagues (2014) conducted a web-based review of such training curricula specifically to synergize the different disaster training approaches of higher education institutions within the EU. Important premises for their search were that the training was conducted within the EU and provided certification. Ingrassia and colleagues (2014) reflects the latest EU-specific insights for structured training curricula. Surprisingly, there is, to the best of our knowledge, no more recent account of EU-specific disaster training programs on the university-level.

1.1 Main Results

The search of Ingrassia and colleagues (2014) yielded a total of 140 different training curricula and the complete list can be found in this publication. A majority (78%) were conducted in the United Kingdom, France, and Germany. This means that in the other 24 EU countries, disaster training at the higher education institution may either be scarce or the curricula are not publicly available. This further implies that the insights derived from this search are heavily dominated by these three countries. Therefore, a representative depiction of European training methods may be limited.

Of the 140 curricula, most (67%) emphasize on-site education, while some use either an e-learning (11%) or mixed-modality including both on-site and e-learning (14%) approaches. Regardless of the organizational structure of the curricula, the majority (84%) relied on oral lectures in combination with self-studies of peer-reviewed publications and book chapters for theoretical foundations. On top of that, discussion- and operation-based elements were also implemented. However, only 17% (fewer than 1 out of 5) actually used a combination of discussions and operation-based exercises for practical education.

The specific foci of the different curricula also showed large variations. Only 20% of the programs focused exclusively on health-related topics (e.g., public health and nutrition, healthcare in disasters, or risk and safety), while the rest implemented multidisciplinary approaches including elements, such as management, logistics, or even law and ethics. However, this also means that across the different programs, there was a rather small overlap of common themes. Most importantly, only 61% of all curricula are based on skill-training.

Only 18% of admission procedures required their applicants to have field experience to enter these training programs. This is rather surprising given the target audiences. The curricula were developed either specifically for the strategic management remotely coordinating the procedures (29%), responders who are coordinating the on-site staff (39%), on-site responders attending to the victims (22%), or a combination of the latter two groups (3%). Thus, there seems to be a discrepancy between the perquisites of on-site experience and the target audiences' competencies. Specifically, while

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relatively few individuals have to have practical experience, the trainings are tailored to staff that should manage the MFRs at the site or coordinate the global process.

1.2 Implications

Ingrassia and colleagues (2014) argue that there seems to exist insufficient capacities for disaster trainings. The lack of training capacities is further hindered by the lack of a coherent framework for the acquisition of specific knowledge and skills across institutions and countries. That is, the alignment between theory and practice needs to be enhanced by implementing programs that combine theory-based with operation-based methods. Therefore, a standard training approach that can be implemented in as many training institutions as possible is crucial for further developments. Ideally, this training module would enable face-to-face teaching incorporating practical exercises and discussion-rounds.

The core competencies emphasized by most curricula focus on “management” and “hazard and vulnerability analysis”. However, there is currently no validation or universal acceptance of these competencies. Meanwhile, psychological elements for stress management or overall performance enhancement are currently lacking from all of the analyzed curricula. Therefore, although theoretical knowledge and the relevant skills may be sufficiently trained, the performance of the MFRs and managerial staff may be disrupted due to insufficient self-regulation and coping skills against the immense demands posed by largescale disasters. Future training should not only focus exclusively on skill-acquisition, but also make sure that the MFRs are mentally prepared for their tasks. Mental skills training that may help MFRs to prepare for a disaster deal with on-site distractions and challenges, post-recovery techniques should be integrated into the regular training curricula.

2 Systematic Training Observation

The previous findings may not be representative of the training methods that are implemented by end-user organizations (cf. Deliverable 2.2) given that they are based on training curricula of higher education institutions. Therefore, we conducted systematic observations of the end-user organizations´ training which actively do frontline fieldwork to create an overview of their practical training methodology. The observed trainings were conducted by two end-user organizations from our consortium (i.e., SERMAS and HRT) as well as the Sanitätspolizei[1]. Each training was classified by multiple raters according to an observation protocol (see Deliverable 2.1). Additionally, a selection of training participants was interviewed to provide insight into the trainee perspective on the training.

[1] Note that additional training observations were delayed due to the COVID-19 restrictions.

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2.1 SERMAS Training

The observed training was a real-life simulation of a mass casualty incident training that focused on communication and organizational skills, the coordination of staff and victims on site, and triage. The training was split into three separate elements. First, the trainees followed presentations by their instructors for a theoretical foundation. Afterwards, the group of trainees was divided into smaller subgroups to provide further depth into the theoretical underpinnings. Finally, the trainees were dispatched to the simulated accident site, which resembled a largescale explosion on the outskirts of the city.

While scenario-based trainings are commonly preferred by the organization, they are not implemented frequently given that they are time-consuming, challenging to design, and require many resources (e.g., manpower and material). Furthermore, to increase the realism, a large number of individuals would need to be included. For example, in this particular training, no actors playing the victims were included. Instead, the triage process was trained based on information sheets that indicated the injuries and vital signs of a given individual. The trainees also indicated that while going to a potential site enhanced their impression of training under realistic circumstances (resulting in changes in stress levels), the absence of real people and manikins prohibited them from actually practicing hands-on skills that would normally be required. There was no feedback by an actor or manikin if the treatment would have been correct and if the reaction would change the further treatment. Thus, there seems to be a limited capacity to train for large-scale incidents on a regular basis given the restricted amount of time and resources available to the end-user organizations. This hints at the need to develop disaster training modules for MFRs that can be trained regularly without heavily relying on many resources.

Figure 1: Photograph of the SERMAS training. The MFRs are evaluating the patient information for triage.

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2.2 HRT Training

The HRT training focused mainly on trauma care. Compared to the SERMAS training, HRT improved on the realism of the training scenarios by including realistic crash sites and actors. Specifically, they showed the trainees video clips of an actual car accident and then staged the outcome of the incident. The primary goal of this training exercise in combination with three previous sessions was to improve on-site trauma care. Particularly, one of the main foci was placed on communication and coordination of the rescue team. However, the training was not specifically tailored to disaster trainings with several injured individuals at once. An additional training aim was the extraction of an injured individual from a car wreckage. A separate extraction exercise was conducted with an actual individual (who acted as an injured victim) and a real vehicle (although the car that was used was not actually damaged).

The structure of the training employed by HRT was highly appreciated by the trainees. The enhanced realism caused by the additional video material was universally commended as it triggers some sort of emotional connection to the accident. Furthermore, the use of an actual car and person was also emphasized by the trainees. Thereby, the relevant practical skills that need to be applied during a similar rescue mission can be trained adequately. Additionally, the trainers expressed a strong preference for training under circumstances that resemble the real world as closely as possible. Thus, similar to the training conducted by SERMAS, training with real equipment at real accident sites is regarded as highly effective.

2.3 SANO Training

The training consisted of three different training scenarios (i.e., cardiac arrest, birth with postnatal bleeding, and hypothermia). Before conducting the scenarios, the MFRs were shown videos with a brief introduction to the aims of the training (i.e., strengthen known procedures, teamwork, and communication skills). Each scenario was completed in teams (2-6 persons). The individuals who were not involved in the scenario observed their colleagues to be able to engage in a review-discussion with the trainers afterwards. This review included the observers, active trainees, and trainers. For reviewing specific actions, the training was video recorded in order to replay key moments and procedures. However, the trainees did not receive any formal evaluation of their performance. Instead, the trainees were informed what skills that were focused on during the training were carried out well and what could be improved further.

Again, creating scenarios that are as realistic as possible was a key focus of the organization. Specifically, the training was designed to mirror realistic sites as closely as possible (e.g., using a real car or artificial grass for an outdoor scenario), where the incidents may occur. Furthermore, some trainees acted as role-players to simulate realistic victims. In addition to real individuals, fully dressed manikins and even a baby-sized manikin attached to a placenta were used. Moreover, to fully practice the relevant actions in the field, the MFRs had access to a real ambulance vehicle and their standard equipment. The high degree of realism and relevance was also emphasized as highly effective by both the trainees and trainers.

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3 Systematic Review

While the first two approaches to identifying the current best practices of disaster training for MFRs are useful for capturing what programs and training methods are being implemented, they cannot indicate whether these methods are indeed effective. That is, there is no empirical validation associated with identifying how MFRs are training. To fill this void, we conducted systematic literature review to identify the effectiveness of current training methods. Specifically, the review aimed to answer the following research questions:

1. What **current disaster training methods** for MFRs have already been scientifically **evaluated**?
2. **How** are MFR disaster training methods evaluated? What **effectiveness indicators** are used?
3. Based on the findings of the reviewed studies, what methods for MFR disaster training seem to be **effective**?
4. How and to what extent is **virtual or mixed reality** used to prepare MFRs for disasters?

3.1 Method

The systematic review was conducted according to the PRISMA guidelines (Moher et al., 2015). Relevant articles were identified in the search engines “Web of Science” and “PubMed”. To optimize the search, a professional medical librarian was consulted, who suggested to use “MeSH” terms in the search string alongside a range of fitting terminology.

Search string for PubMed

> (("Health Personnel"[MeSH Terms] OR "Emergency Medical Technicians"[MeSH Terms] OR "Emergency Medical Services"[MeSH Terms] OR "Emergency Medicine"[MeSH Terms] OR "first responder*"[Title/Abstract] OR "emergency medical technician*"[Title/Abstract] OR "ambulance"[Title/Abstract] OR "paramedic*"[Title/Abstract] OR "prehospital"[Title/Abstract] OR "nurse*"[Title/Abstract] OR "nursing student*"[Title/Abstract] OR "medical student*"[Title/Abstract] OR "physician*"[Title/Abstract] OR "health care"[Title/Abstract] OR "healthcare"[Title/Abstract] OR "emergency service*"[Title/Abstract])
>
> AND ("Teaching"[MeSH Terms] OR "Education"[MeSH Terms] OR "Simulation Training"[MeSH Terms] OR "training*"[Title/Abstract] OR "practice*"[Title/Abstract] OR "exercise*"[Title/Abstract] OR "education*"[Title/Abstract] OR "teaching*"[Title/Abstract] OR "simulation*"[Title/Abstract])
>
> AND ("Disasters"[MeSH Terms] OR "disaster medicine/education"[MeSH Terms] OR "Mass Casualty Incidents"[MeSH Terms] OR "mass casualt*"[Title/Abstract] OR "disaster*"[Title/Abstract] OR "major incident*"[Title/Abstract] OR "major accident*"[Title/Abstract] OR "catastrophe*"[Title/Abstract])
>
> AND ("Comparative Study" [Publication Type] OR "Evaluation Study"[Publication Type] OR "Outcome Assessment, Health Care"[MeSH Terms] OR "intervention*"[Title/Abstract] OR "effective*"[Title/Abstract] OR "compar*"[Title/Abstract] OR "evaluat*"[Title/Abstract] OR "measure*"[Title/Abstract] OR "assess*"[Title/Abstract])

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AND (2010/1:2021/9[pdat]) AND (english[Filter]))

Search string for Web of Science

TS=((health personnel OR emergency medical service* OR emergency service* OR emergency medicine OR first responder* OR emergency medical technician* OR ambulance OR paramedic* OR prehospital OR nurse* OR nursing student* OR medical student* OR physician* OR health care OR healthcare)

AND (training* OR practice* OR exercise* OR education* OR teaching* OR simulation*)

AND (mass casualt* OR disaster* OR major incident* OR major accident* OR catastrophe*)

AND (compar* OR evaluat* OR intervention* OR effective* OR measure* OR assess*))

Language: English; Time Span: 2010-01-01 – 2021-09-30

To ensure that the review represents the training methods that are *currently* in use, we only included studies published between January 2010 and September 2021 (i.e., date of search). To be included, articles had to include peer-reviewed studies which

1. explicitly conduct research on testing a training method,
2. focus specifically on MFRs, and
3. implement designs allowing for testing the effectiveness of the training methods (e.g., quasi-experiments, pre-post testing).

Reviews or studies that included several populations without separated analyses for MFRs were not considered.

The literature search revealed a total of 3,628 articles after removing duplicates (PubMed, *n* = 2,497; Web of Science, *n* = 2,036). The titles and abstracts of all articles were screened by two independent raters. The raters only disagreed on 121 articles (3.34%) regarding their inclusion or exclusion. These conflicts were resolved either by discussion or through a third, independent rater. Overall, 175 articles were deemed eligible for the full-text screening. At this stage, another 112 articles were excluded before the data extraction (full text not available, *n* = 6; wrong publication type, *n* = 12; wrong population, *n* = 40; wrong content, *n* = 46; wrong study design, *n* = 8). Thus, the data extraction was based on 63 articles (see Table 3).

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Table 3: List of all identified articles.

Lead Author	Year	Title	Journal
Aghababaeian	2013	A comparative study of the effect of triage training by role-playing and educational video on the knowledge and performance of emergency medical service staffs in Iran	Prehospital and Disaster Medicine
Alenyo	2018	A Comparison Between Differently Skilled Prehospital Emergency Care Providers in Major-Incident Triage in South Africa	Prehospital and Disaster Medicine
Alim	2015	Evaluation of disaster preparedness training and disaster drill for nursing students	Nurse Education Today
Aluisio	2016	Focused Training for Humanitarian Responders in Regional Anesthesia Techniques for a Planned Randomized Controlled Trial in a Disaster Setting	Prehospital and Disaster Medicine
Andreatta	2010	Virtual Reality Triage Training Provides a Viable Solution for Disaster-preparedness	Academic Emergency Medicine
Andreatta	2015	Outcomes From Two Forms of Training for First-Responder Competency in Cholinergic Crisis Management	Military Medicine
Bajow	2016	Evaluation of a new community-based curriculum in disaster medicine for undergraduates	Bmc Medical Education
Betka	2021	Improving rural disaster response preparedness	Public Health Nursing
Chan	2010	Development and Evaluation of an Undergraduate Training Course for Developing International Council of Nurses Disaster Nursing Competencies in China	Journal of Nursing Scholarship
Chandra	2014	Implementing Psychological First-Aid Training for Medical Reserve Corps Volunteers	Disaster Medicine and Public Health Preparedness
Chou	2021	The Effectiveness of Functional Exercises for Teaching Method Disaster Medicine to Medical Students	Cureus
Cicero	2018	60 Seconds to Survival: A Multisite Study of a Screen-based Simulation to Improve Prehospital Providers Disaster Triage Skills	AEM Education and Training

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Cicero	2017	60 seconds to survival: A pilot study of a disaster triage video game for prehospital providers	American Journal of Disaster Medicine
Cicero	2012	Simulation training with structured debriefing improves residents' pediatric disaster triage performance	Prehospital and Disaster Medicine
Cicero	2017	Pediatric Disaster Triage: Multiple Simulation Curriculum Improves Prehospital Care Providers' Assessment Skills	Prehospital Emergency Care
Cicero	2019	Correlation Between Paramedic Disaster Triage Accuracy in Screen-Based Simulations and Immersive Simulations	Prehospital Emergency Care
Claudius	2015	Comparison of Computerized Patients versus Live Moulaged Actors for a Mass-casualty Drill	Prehospital and Disaster Medicine
Cooper	2012	Evaluating the efficacy of the AAP pediatrics in disaster" course: the Chinese experience	American Journal of Disaster Medicine
Cowling	2021	Knowledge retention and usefulness of simulation exercises for disaster medicine-what do specialty trainees know and think?	African Journal of Emergency Medicine
Cuttance	2017	Paramedic Application of a Triage Sieve: A Paper-Based Exercise	Prehospital and Disaster Medicine
Dittmar	2018	Primary mass casualty incident triage: evidence for the benefit of yearly brief re-training from a simulation study	Scandinavian Journal of Trauma Resuscitation & Emergency Medicine
Edinger	2019	Evaluation of an Online Educational Intervention to Increase Knowledge and Self-efficacy in Disaster Responders and Critical Care Transporters Caring for Individuals with Developmental Disabilities	Disaster Medicine and Public Health Preparedness
Farra	2013	Improved Training for Disasters Using 3-D Virtual Reality Simulation	Western Journal of Nursing Research
Fernandez-Pacheco	2017	Drones at the service for training on mass casualty incident: A simulation study	Medicine
Foronda	2016	Impact of Virtual Simulation to Teach Concepts of Disaster Triage	Clinical Simulation in Nursing
Furseth	2016	Impact of Interprofessional Education Among Nursing and Paramedic Students	Nurse Educator

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Gable	2021	Disaster Day: A Simulation-Based Disaster Medicine Curriculum for Novice Learners	J Med Educ Curric Dev
Greco	2019	Ethical Reasoning Debriefing in Disaster Simulations	J Prof Nurs
Huh	2019	Effects of an educational program on disaster nursing competency	Public Health Nursing
Hutchinson	2011	Implementing a multidisciplinary disaster simulation for undergraduate nursing students	Nursing Education Perspectives
Ingrassia	2015	Virtual reality and live simulation: a comparison between two simulation tools for assessing mass casualty triage skills	European Journal of Emergency Medicine
Ingrassia	2014	Nationwide Program of Education for Undergraduates in the Field of Disaster Medicine: Development of a Core Curriculum Centered on Blended Learning and Simulation Tools	Prehospital and Disaster Medicine
James	2021	Nursing student's attitudes toward teams in an undergraduate interprofessional mass casualty simulation	Nurs Forum
Jones	2014	Emergency medical services response to active shooter incidents: provider comfort level and attitudes before and after participation in a focused response training program	Prehospital and Disaster Medicine
Kim	2020	Effects of a simulation-based education program for nursing students responding to mass casualty incidents: A pre-post intervention study	Nurse Education Today
Knight	2010	Serious gaming technology in major incident triage training: a pragmatic controlled trial	Resuscitation
Koca	2020	The effect of the disaster management training program among nursing students	Public Health Nursing
Koutitas	2021	Performance evaluation of AR/VR training technologies for EMS first responders	Virtual Reality
Kuhls	2017	Basic Disaster Life Support (BDLS) Training Improves First Responder Confidence to Face Mass-Casualty Incidents in Thailand	Prehospital and Disaster Medicine
Lampi	2017	Pre-hospital triage performance after standardized trauma courses	Scandinavian Journal of Trauma Resuscitation & Emergency Medicine

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Lampi	2013	Triage performance of Swedish physicians using the ATLS algorithm in a simulated mass casualty incident: a prospective cross-sectional survey	Scandinavian Journal of Trauma Resuscitation & Emergency Medicine
Ma	2021	Does theme game-based teaching promote better learning about disaster nursing than scenario simulation: A randomized controlled trial	Nurse Education Today
Merlin	2010	Improving medical students' understanding of prehospital care through a fourth year emergency medicine clerkship	Emergency Medicine Journal
Mills	2020	Virtual Reality Triage Training Can Provide Comparable Simulation Efficacy for Paramedicine Students Compared to Live Simulation-Based Scenarios	Prehospital Emergency Care
Montán	2015	Assessment of the accuracy of the Medical Response to Major Incidents (MRMI) course for interactive training of the response to major incidents and disasters	American Journal of Disaster Medicine
Motola	2015	Just-in-time learning is effective in helping first responders manage weapons of mass destruction events	Journal of Trauma and Acute Care Surgery
Paddock	2015	Disaster response team FAST skills training with a portable ultrasound simulator compared to traditional training: pilot study	Western Journal of Emergency Medicine
Phattharapornjaroen	2020	Alternative Leadership in Flexible Surge Capacity-The Perceived Impact of Tabletop Simulation Exercises on Thai Emergency Physicians Capability to Manage a Major Incident	Sustainability
Pollard	2015	Development of a disaster preparedness curriculum for medical students: a pilot study of incorporating local events into training opportunities	American Journal of Disaster Medicine
Pouraghaei	2017	The Effect of Start Triage Education on Knowledge and Practice of Emergency Medical Technicians in Disasters	Journal of Caring Science
Ripoll-Gallardo	2020	Residents working with Medecins Sans Frontieres: training and pilot evaluation	Scandinavian Journal of Trauma Resuscitation & Emergency Medicine
Rivkind	2015	Combating terror: A new paradigm in student trauma education	Journal of Trauma and Acute Care Surgery
Robaina	2018	Mass casualty incidents and B-Con training	Journal of Emergency Management

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Saiboon	2021	E-Learning in Teaching Emergency Disaster Response Among Undergraduate Medical Students in Malaysia	Front Public Health
Scott	2010	Disaster 101: a novel approach to disaster medicine training for health professionals	Journal of Emergency Medicine
Sena	2021	Disaster Preparedness Training for Emergency Medicine Residents Using a Tabletop Exercise	MedEdPORTAL
Smith	2015	Preparing Nursing Students for Leadership Using a Disaster-Related Simulation	Nurse Educator
Unver	2018	Analysis of the effects of high-fidelity simulation on nursing students' perceptions of their preparedness for disasters	International Emergency Nursing
Wiese	2021	Responding to a simulated disaster in the virtual or live classroom: Is there a difference in BSN student learning?	Nurse Education Today
Xia	2020	Evaluating the effectiveness of a disaster preparedness nursing education program in Chengdu, China	Public Health Nursing
Yanagawa	2018	Difference in First Aid Activity During Mass Casualty Training Based on Having Taken an Educational Course	Disaster Medicine and Public Health Preparedness
Zhang	2021	Effect of virtual reality simulation training on the response capability of public health emergency reserve nurses in China: a quasiexperimental study	BMJ Open
Zheng	2020	Flipped Classroom Approach Used in the Training of Mass Casualty Triage for Medical Undergraduate Students	Disaster Medicine and Public Health Preparedness

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3.2 Preliminary Results

At the moment, approximately 10% of the articles have been fully analyzed by the two independent raters, including the risk of bias assessment. The data extraction focused on the study designs, the kind of training method that was employed, the learning goals of the trainings, the applied effectiveness indicators, and the training context.

The dominant study designs that have been identified so far are either pre-post designs of a single group or quasi-experimental pre-post assessments. A randomized controlled trial (RCT) has not been implemented by any of the studies analyzed thus far. Instead, participants were allocated to the different experimental groups using stratified methods. Given the relatively small sample size of some studies, this approach may even be preferred because the random allocation dissolves systematic differences only for large groups.

The major training foci of the examined studies were placed on either a broad disaster curriculum including personnel and resource management or on the triage process specifically (i.e., 50%). The training methods typically included some scenario-based exercises with role-players. Few studies relied exclusively on theoretical approaches (i.e., lectures) and video materials. One study even implemented a VR-based simulation (using the CAVE). The included training scenarios were rather diverse covering explosion scenarios or a building collapse. The overall aim of all these studies was to increase the trainees' knowledge of either the triage process or proper crisis management procedures. Thus, the effectiveness of the trainings was mainly assessed through pre-post comparisons of knowledge tests. Some studies also examined behavioral performance indicators, such as accuracy of triage categorizations, duration of the triage process, or the trainees' perceived effectiveness through proxies like self-efficacy. This means that the current literature primarily contains validated methods for knowledge acquisition, rather than skill acquisition. Interestingly, not a single study analyzed the effectiveness of the training based on team performance indicators even though the MFRs responders typically work in teams. That is, basic communication skills were not targeted by the current training methods despite the importance of well-coordinated work of many individuals during a disaster.

Finally, the number of identified studies should also be noted. That is, in the past 10 years, only 63 studies assessing the effectiveness of disaster training for MFRs were published. This is rather surprising given the latest developments in technology and training design that increase the efficiency. For example, serious gaming as a training method has been introduced in various contexts. However, these novel approaches are hardly ever implemented for MFRs.

4 Discussion & Conclusion

The aim of this deliverable was to identify the current best practices of disaster training for MFRs. To do so, we examined what systematic training programs have summarized in the existing literature, how end-user organizations train, and what current empirically validated training methods exist. Overall, the different insights revealed that MFR training should explicitly integrate practical simulations. This has been pointed out not only by the trainers and trainees, but also by the empirically validated methods which typically include some sort of simulation. However, an important perquisite is that the simulation is realistic. The trainees who were interviewed after the observations clearly

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stated that enhanced realism is essential to become fully immersed in the training for optimal results (see Deliverable 2.2). A potential avenue for enhanced realism may be implementing modern technology like VR or MR solutions. Specifically, one of the shortcomings in one of the observed trainings was that no realistic patients were used. Simulating people in virtual training may therefore yield more realistic training scenarios. Additionally, if simulated patients could exhibit configurable biological signals such as heart rate or injuries (one shortcoming of using role-players) the experienced realism may be enhanced even further.

Our preliminary results of the systematic review show that relatively few novel technologies have been implemented in systematically validated training programs. Instead, the trainings rely more heavily on mixed methods including simulations similar to what is already implemented by the end-user organizations. However, these approaches have mainly shown that they are effective for knowledge acquisition, but have neglected other important elements such as coordination and communication of the individuals involved. That is, while accurate knowledge of the triage process is essential, the entire procedure for attending many injured individuals consists of far more steps.

Taken these insights together, there seems to be a need for modern technology in order to enhance the realism of the training scenarios. However, the effectiveness of such training methods is yet to be validated empirically. The current best practice seems to rely on simulation-based training that requires many resources in terms of manpower and equipment. These simulations seem to be effective in knowledge acquisition and are received well by trainer and trainees alike. Nevertheless, clear performance indicators for the actual behaviors that the MFRs need to demonstrate during a scenario are rarely assessed systematically.

5 References

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