

Disaster management training in the euregio-meuse-rhine: What can we learn from each other to improve cross-border practices?

Peer-reviewed author version

Paquay, Méryl; Chevalier, Sabrina; Sommer, Anja; Ledoux, Céline; Gontariuk, Marie; Beckers, Stefan K.; VAN DER AUWERMEULEN, Loth; Krafft, Thomas & Ghuysen, Alexandre (2021) Disaster management training in the euregio-meuse-rhine: What can we learn from each other to improve cross-border practices?. In: International Journal of Disaster Risk Reduction, 56 (Art N° 102134).

DOI: 10.1016/j.ijdrr.2021.102134

Handle: <http://hdl.handle.net/1942/33677>

1 **Training for cross-border disaster management: A scoping review taking the Euregio-**  
2 **Meuse-Rhine as a case in point**

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## 21 **Abstract**

22 **Introduction:** Increasing numbers of extreme events, emerging and re-emerging infectious diseases  
23 and/or complex hazardous incidents require comprehensive preparedness and reliable and tested  
24 response strategies. Border regions are vulnerable as disasters might not halt at administrative borders  
25 and at the same time, due to the peripheral location of border regions (viewed from the center of the  
26 respective member state), resources to respond are often quite limited. Cross-border collaboration and  
27 coordination is therefore required based on mandatory strategy plans addressing the border region's  
28 specific needs and characteristics. As integral part of cross-border collaborations initiative in the Meuse–  
29 Rhine Euregio (EMR), under the Interreg project “International Information and Knowledge Centre in  
30 public safety” (IKIC) we reviewed published evidence informing on the current existing initiatives  
31 dedicated to disaster management training in the EMR.

32 **Material and Methods:** A search based on the PRISMA guidelines for scoping reviews was conducted  
33 to retrieve articles of interest in the following databases: Medline, PsychInfo and Scopus. The searches  
34 were limited to English, French, Dutch and German language articles and the period between January  
35 2010 and June 2019. No restrictions were set for the study design or the type of methodology used.

36 **Results:** A total of 18 articles met the inclusion criteria out of a total of 1771 publications. Training  
37 development was found in two studies while nine studies focused more on the state of knowledge in  
38 disaster management. Seven articles referred only to technical skills, three only to non-technical skills  
39 and eight combined both types of skills. For the technical nature, Knowledge was found seven times,  
40 Skills five times and Attitudes twice. On the non-technical side, Knowledge was found three and both  
41 Skills twice and Attitudes three times. Five studies trained and assessed all the Knowledge, skills and  
42 attitudes elements.

43 **Conclusions:** The current available literature provides little scientific evidence to guide disaster  
44 education initiatives for cross-border collaboration among the EMR countries. Most of the studies

45 constitute inventories with descriptive reporting and very few experimental studies of quality have been  
46 carried out to date. At the same time, non-technical skills for disaster preparedness and management  
47 have been well considered among the articles included in our analysis. International recommendations  
48 do not appear to be harmoniously implemented. Cross-border collaboration needs to be further  
49 investigated.

50 **Keywords:** Disaster medicine, Mass casualty incidents, Disaster education, Disaster planning,

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## 54 **Introduction**

55 Disaster management has become crucial in Public Health practice. Not only do disasters have  
56 undeniable human consequences, they also cause significant financial, environmental and social losses  
57 (Sever, Remuzzi, & Vanholder, 2018). Disaster has been defined as a *serious disruption of the*  
58 *functioning of a community or a society at any scale due to hazardous events interacting with conditions*  
59 *of exposure, vulnerability and capacity, leading to one or more of the following: human, material,*  
60 *economic and environmental losses and impacts*<sup>1</sup>. Disasters are often classified according to their natural  
61 or man-made nature, or be specified as Mass Casualty Incident (MCI) when *the event overwhelms the*  
62 *local healthcare system, where the number of casualties vastly exceeds the local resources and*  
63 *capabilities in a short period of time* (DeNolf & Kahwaji, 2020). The continuous increase in crises  
64 worldwide has persistently challenged the scientific community to contribute with sound evidence to  
65 concepts for disaster preparedness and management (Challen et al., 2012). The concept of disaster  
66 management in this context is indeed multifaceted, including the organization, anticipation and planning  
67 (preparedness) as well as the response to and recovering from a disaster. These considerations led to a  
68 shift in strategies, prioritising disaster preparedness over response (Rose, Murthy, Brooks, & Bryant,  
69 2017). Disaster preparedness includes multiple activities for anticipating any type of disaster by  
70 considering various aspects such as the early identification and assessment of risks, the identification of  
71 any available resources, skills assessment and education (Ryan, 2005). This preparation phase is one of  
72 the four phases defined in the disaster management cycle from the American National Governors'  
73 Association (NGA) work (National Governors' Association, 1979): mitigation, preparedness, response  
74 and recovery.

75 In 2010 and then in 2019, the European Union (EU) warmly recommended its member countries to  
76 strengthen their security policy considering the disaster management cycle and to particularly focus on

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<sup>1</sup> United Nations Office for Disaster Risk Reduction, 2017

77 mitigation and preparedness (Poljanšek et al., 2019). However, the focus was rather set on a national  
78 level than a regional level. The EU border regions need a particular focus as they are convoluted and  
79 more vulnerable due to legal and administrative barriers, language barriers or economic disparities.  
80 Regarding cross-border management in the EU, a study has reported a lack of interest from the  
81 respecting authorities in collaborating together (Kamel, 2016). Cross-border collaborations, like the  
82 Meuse–Rhine Euregio (EMR), were born out of the hopes to reducing those issues. One of the most  
83 effective actions would be the development of joint prevention initiatives, such as education, in these  
84 regions. Studies demonstrate that individuals who suffer from severe stress, who are at higher risk of  
85 developing post-traumatic stress disorder or burnout later on, are the least trained to react to disaster  
86 situations (Ron & Shamai, 2014). Disaster education is therefore becoming a necessity. However, very  
87 little is known about disaster education in the EMR: Who is targeted? What is the current level of  
88 training? What are the existing training programs? How are they delivered? What is their content?

89 In the context of the project “International Information and Knowledge Centre in public safety” (IKIC)  
90 funded by Interreg EMR, the aim of this scoping review is to investigate the current state of the art of  
91 disaster management training in the EMR through a scoping review. This study further aims to determine  
92 topics that have already been considered from specific topics that require in-depth examination in the  
93 EMR disaster management and education process. As an early achiever in cross-border collaboration,  
94 the experience and evidence from EMR would inform on the possible achievements, the pit-falls and  
95 the success factors to develop relevant disaster training modules and shape future researches.

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## 101 **Materials and methods**

### 102 *Literature search strategy and selection criteria*

103 This study uses a scoping review approach, which is intended to allow the breadth of knowledge and  
104 practice in an emerging domain to be explored and documented. Indeed, due to the multitude of  
105 disciplines, institutions and stakeholders engaging in this field an overview on sound and reliable  
106 scientific evidence can only be provided by an approach like a scoping review.

107 A search of studies, based on the PRISMA guidelines for scoping reviews (Moher et al., 2009), was  
108 conducted to retrieve relevant articles in the following medical and transversal databases: Medline,  
109 PsychInfo and Scopus. The searches were limited to EMR languages (English, French, Dutch and  
110 German) and the period between January 2010 and June 2019. No restrictions were set for the study  
111 design or the type of methodology used. Additional relevant studies were identified by reviewing  
112 references of included studies. The literature search was conducted between April 2019 and June 2019.

113 The search strategy was developed using the Patient, Intervention, Comparator, Outcome (PICO)  
114 (Eriksen & Frandsen, 2018) approach and included thesaurus terms and free terms relating (Appendix  
115 A,B and C) to or describing disaster management process. An inclusion and exclusion criteria table is  
116 provided in Appendix D.

### 117 *Study selection*

118 Study selection was carried out by two researchers for the different stages of the research (IB, MP). In  
119 the first stage, publication titles and abstracts were all screened by the two investigators. Publications  
120 were included if the studies met the inclusion criteria as well as studies for which exclusion or inclusion  
121 could not be determined based on title and abstract alone. Secondly, the full text of potentially eligible  
122 studies was retrieved and assessed for eligibility and the duplicates deleted. For Dutch and German  
123 articles, two other researchers, independent of the first ones, provided translation for data extraction.

124 Any disagreement between the reviewers about study eligibility was settled by consensus among the  
125 researchers.

126 Data were extracted from the final selection of studies and completed by four researchers. The following  
127 data were extracted for each relevant article: study ID (first author and date), title, research object,  
128 country(ies) involved, study design, disaster type, target group, initiative type (evaluation or training),  
129 Characteristics of the initiative (Bloom skills classification (Bloom, 1956); Teaching method; Training  
130 assessment; Evaluation type) and main conclusions. Concerning “Initiative type”, “Evaluation” is  
131 referring to studies performing an assessment of knowledge and skills while “Training” covers studies  
132 developing a particular training in disaster management. Bloom skills classification differentiates three  
133 levels of expertise: Knowledge, Skills and Attitudes (KSA). Knowledge refers to the cognitive abilities,  
134 facts and concepts we are conscious of. Skills represent the psychomotor sphere. These are the physical  
135 abilities used during a performance. Attitudes constitute the affective domain with emotions and  
136 feelings. It reflects life skills more accurately. Each KSA that was evaluated or taught within the articles  
137 was then graded according to its technical or non-technical nature. Technical skills in general are defined  
138 as subject-specific knowledge and hence competencies while on the other hand, non-technical skills are  
139 skills which are generic in nature and are relevant across various jobs or professions (Ghouse,  
140 Chaudhary, & Garg, 2018). Conditions for evaluating these KSA and their technical or non-technical  
141 nature were also collected. Finally, for the "Training" modality, teaching methods have been specified.

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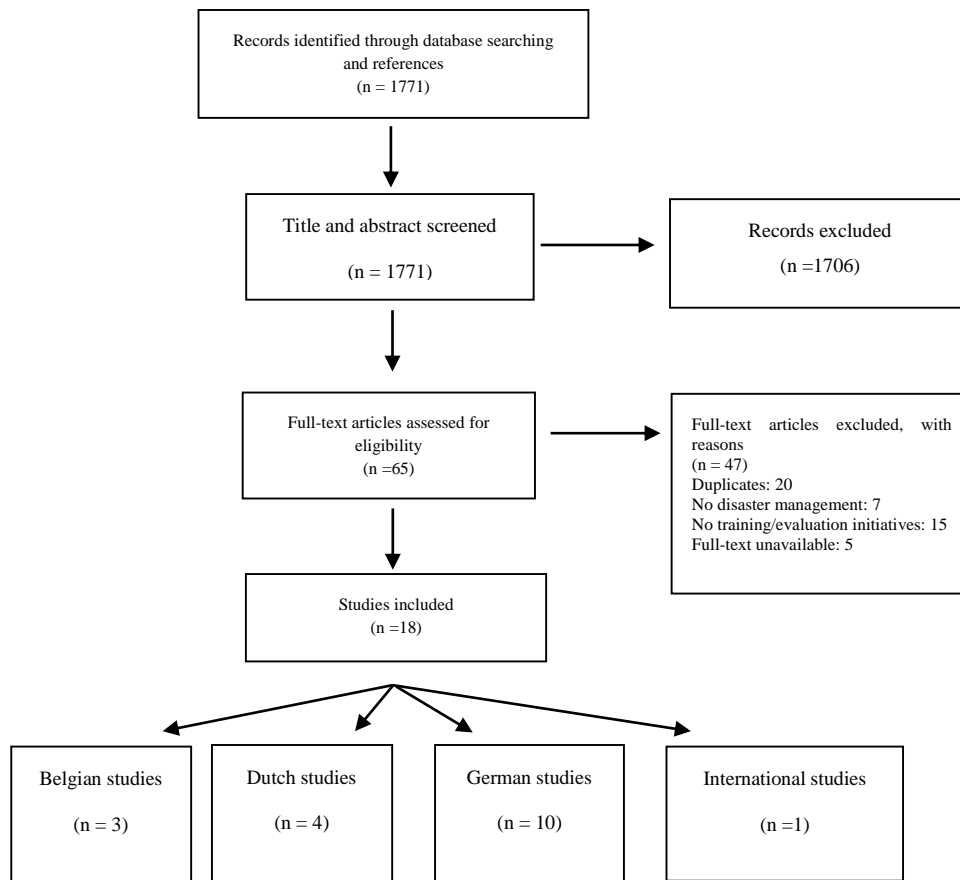
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154 **Figure 1.** Study selection process

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## 160 **Results**

161 A total of eighteen relevant articles were identified out of 1771. Three articles focused on Belgian  
162 territory, ten on German territory, four on Dutch territory and one on the three territories. Thirteen  
163 articles focused on descriptive studies, two articles were about experimental studies, two articles adopted  
164 a qualitative approach and one was a literature review. For the target groups, five studies targeted a  
165 student population while thirteen other studies targeted professionals. Regarding disaster type, nine  
166 articles discussed interventions applied to MCI, six articles on all types of disasters, two studies focused  
167 on CBRNs and one study focused only on natural disasters. Training development was found in two  
168 studies while nine studies focused more on the state of knowledge in disaster management. Of these  
169 eighteen articles, seven referred only to technical skills, three only to non-technical skills and eight  
170 combined both types of skills. For the technical nature, Knowledge was found seven times, Skills five  
171 and Attitudes twice. On the non-technical side, Knowledge was found in three articles, Skills in two  
172 articles and Attitudes in three articles. Five studies trained and assessed all the KSA. Table 1  
173 summarizes all the characteristics of the relevant studies.

**Table 1: Characteristics of the studies reporting training initiatives in the EMR**

References	Study design	Research object	Country(ies) involved	Target group	Disaster type	Type of initiative (Training or Evaluation)	Characteristics of the initiative	Main conclusions
1. (M. L. Verheul, Dückers, Visser, Beerens, & Bierens, 2018)	Retrospective descriptive study	Evaluation of the impact of MCI exercises in Netherlands among Strategic Crisis Team (SCT) members	Netherlands	SCT members and their hospital organizations	MCI	Training	<p><b>KSA</b> Non-technical skills and attitudes (decision making, workload, communication, situation awareness, leadership, planification)</p> <p><b>Teaching method</b> Large scale simulation</p> <p><b>Training's assessment</b> Assessment of self-administered reports by two independent investigators on validated categories.</p>	The authors could not establish that team members participating in MCI exercises in the Netherlands learn from their participation. More time and effort must be spent on the development of a validated evaluation system for these simulations, and more research into the role of the evaluator is needed.

<p>2. (Dittmar, Wolf, Bigalke, Graf, &amp; Birkholz, 2018)</p>	<p>Experimental study</p>	<p>Assessment of the decline in triage skills indicating a minimum time interval for re-training.</p>	<p>Germany</p>	<p>Members of professional Emergency Medical Service (EMS) staff</p>	<p>MCI</p>	<p>Training</p>	<p><b>KSA</b>          Technical skills, knowledge and attitude (triage time, triage algorithm adequacy, bleeding control)           Non-technical Knowledge, skills and attitudes (role clarity/leadership, communication)   <b>Teaching method</b>          Lecture and practical sessions   <b>Training's assessment</b>          Simulation observed by two independent investigators measuring the performance according to predefined validated criteria.</p>	<p>To improve disaster preparedness, triage skills should be refreshed yearly by a brief re-education of all EMS providers.</p>
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3. (Wunderlich et al., 2017)	Prospective, cross-sectional, observational study	Assessment of the self-perception of medical students' knowledge and interest in disaster medicine nine years after the implementation of a standardized disaster medicine curriculum in German medical schools.	Germany	Medical students	All hazards	Evaluation	<p><b>KSA</b> Technical knowledge (disaster theory, triage algorithm...)</p> <p>Non-technical knowledge (leadership, planification)</p> <p><b>Evaluation's type</b> Validated self-administered questionnaire</p>	German students are still largely not well-educated regarding disaster medicine, despite their high motivation. The curriculum of 2006 was not implemented as originally planned and the number of trained students still remains low as the self-perception of knowledge.
4. (Luc J M Mortelmans, Gaakeer, Dieltiens, Anseeuw, & Sabbe, 2017)	Descriptive, cross-sectional study	Preparedness evaluation of Dutch hospitals to deal with a large-scale CBRN incident.	Netherlands	Dutch hospitals	CBRN incidents	Evaluation	<p><b>KSA</b> Technical skills (decontamination practices, drugs supply...)</p> <p><b>Evaluation's type</b> Self-administered questionnaire</p>	Despite a high-risk perception of threats, there are serious gaps in the preparedness of Dutch hospitals for treating patients involved in CBRN incidents.

5. (Luc J M Mortelmans, Lievers, Dieltiens, & Sabbe, 2016)	Descriptive cross-sectional study	Evaluation of the impact of basic military training on disaster management education and knowledge, compared with civilian senior medical student colleagues.	Belgium	Senior military and civilian medical students	All hazards	Evaluation	<b>KSA</b> Technical knowledge (theoretical disaster knowledge)  <b>Evaluation's type</b> Self-administered questionnaire	Basic military training and its associated background make the military population better educated and prepared for disaster situations than their civilian counterparts.
6. (Luc J. M. Mortelmans et al., 2015)	Descriptive cross-sectional study	Preparedness evaluation of senior medical students for direct patient care or other tasks during mass casualty incidents in Netherlands.	Netherlands	Dutch senior medical students	All hazards	Evaluation	<b>KSA</b> Technical knowledge (theoretical disaster knowledge)  <b>Evaluations' type</b> Self-administered questionnaire	Despite a high willingness to respond, the students are not educated for disaster situations.
7. (Van Ruijven, Mayer and	Comparative study	Evaluation of on-scene command teams' coordination on	Netherlands	On-scene command teams comprising	All hazards	Evaluation	<b>KSA</b> Non-technical skills and attitudes (communication,	Emergency management performance and coordination patterns

de Bruijne, 2015)		multidisciplinary objectives and tasks, and impact of their performance.		various actors (police, etc)			coordination, role attribution) <b>Evaluation's type</b> Virtual reality simulation, observation of performance indicators	within and among on-scene command teams have considerable variation.
8. (L J M Mortelmans, Van Boxstael, De Cauwer, & Sabbe, 2014)	Descriptive cross-sectional study	Preparedness assessment of local hospitals to deal with CBRN incidents.	Belgium	Hospitals in Belgium with an emergency department (ED)	CBRN incidents	Evaluation	<b>KSA</b> Technical skills (decontamination practices, drugs supply...) <b>Evaluation's type</b> Self-administered questionnaire	There are serious gaps in hospital preparedness for CBRN incidents in Belgium. Lack of financial resources is a major obstacle in achieving sufficient preparedness.
9. (L J M Mortelmans, Dieltiens, Anseeuw, & Sabbe, 2014)	Descriptive cross-sectional study	Preparedness assessment of Belgian senior medical students for disaster medicine in their curriculum	Belgium	Belgian senior medical students	All hazards	Evaluation	<b>KSA</b> Technical knowledge (theoretical disaster knowledge) <b>Evaluation's type</b> Self-administered questionnaire	Belgian medical students do believe in the usefulness of teaching disaster medicine in the regular curriculum. Although knowledge and estimated capability are limited, there is a high willingness to

								assist. European guidelines could help to establish a basic training in preparing them for a real incident.
10. (Ingrassia et al., 2014)	Qualitative study	Assessment of the prevailing preferences and characteristics of disaster management educational and training initiatives (ETIs) at a postgraduate level that currently exist in the EU countries	Europe (Belgium, Germany and Netherlands)	Postgraduate level	All hazards	Evaluation	<p><b>KSA</b> Technical knowledge, skills and attitudes (training/education type developed)</p> <p>Non-technical knowledge, skills and attitudes</p> <p><b>Evaluation's type</b> Validated standardized online survey instrument</p>	Although ETIs currently exist, they are not broadly available in all 27 EU countries. Also, the curricula do not cover all key elements of disaster management in a standardized and competency-based structure.
11. (Haferkamp, Kraemer, Linehan, & Schembri, 2011)	Experimental study	Evaluation of the impact of the DREAD-ED game on two different target groups with different expertise	Germany	Students of a large German university as well as members of the	Natural hazards	Evaluation	<p><b>KSA</b> Non-technical skills and attitudes (communication, decision making, leadership, stress control)</p>	In conclusion, the DREAD-ED game provides an engaging environment for training group decision making processes. However, it must also



		on crisis management		Academy of Crisis Management and Civil Defense			<b>Evaluation's type</b> Serious game	be noted that further work is needed to validate the effectiveness of this training methodology
12. (Brauner, Stiehl, Lechleuthner, & Mudimu, 2014)	Literature review	Evaluation of training in mass casualty events: - Aspects of quality of emergency care for patients and - Comparison of mass casualty concepts	Germany	Emergency staff	MCI	Evaluation	<b>KSA</b> Technical knowledge, skills and attitudes (training/education performance)  Non-technical knowledge, skills and attitudes  <b>Evaluation's type</b>  Evaluation by training observer (qualitative evaluation) and by analyzing certain measurement values (time of triage and triage categorization) (quantitative evaluation)	An evaluation has to be universal and independent of staff behavior.  Patient care needs to be measured.

13. (Ellebrecht, 2013)	Descriptive, cross-sectional study	MCI experiences and education in triage	Germany	Paramedics and emergency physicians	MCI	Evaluation	<p><b>KSA</b>  Technical knowledge (training/education evaluated in these 3 aspects; MCI Triage experience/ Incidence and types of triage emergencies/Training and self-assessment)</p> <p><b>Evaluation's type</b>  Survey about MCI and triage for paramedics and emergency physicians</p>	<p>Only 56% of Professional EMS staff is experienced in triage.</p> <p>Triage needs to be more integrated into education and training for both target groups.</p>
14. (Mück et al., 2016)	Comparative study	Comparison of training simulations of MCI in two high	Germany	Ambulance services, emergency department	MCI	Training	<p><b>KSA</b>  Technical skills (triage)</p>	As the personnel did not know about the training beforehand, the simulation was

		level trauma centers		s involved in hospitals			<p>Non-technical skills and attitudes (decision making, workload, communication, situation awareness, leadership, planification)</p> <p><b>Teaching method</b> MCI simulation in a city tunnel (live including fire services, EMS, police and trauma centers)</p> <p><b>Training's assessment</b> Comparing of on-site triage, time intervals for reaching milestones (such as availability of x-ray images in the emergency department)</p>	adequate to train staff and to identify possibilities for improvement
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15. (Brodauf, Heßing, Hoffmann, & Friemert, 2015)	Descriptive, cross-sectional study	Evaluation of the preparedness for MCI in trauma centers	Germany	Head physicians and department managers	MCI	Evaluation	<p><b>KSA</b></p> <p>Technical knowledge (clinical setting, physician qualification and education, conditions in emergency department)</p> <p>Non-technical knowledge (opinion about changed education for specialized medical training / residency concerning polytraumatized patients; collaboration with other hospitals)</p> <p><b>Evaluation's type</b></p> <p>Online survey with head physicians and department managers</p>	<p>Almost all included hospitals do have preparations in place for MCI.</p> <p>Examples are emergency plans for incidents such as fire, evacuation, earth quakes, natural disasters, train or plain disasters</p> <p>Well organized cooperation between trauma centers of different categories.</p> <p>However, less than 60% have logistical resources or materials in stock for MCI.</p>
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16. (Schneider et al., 2015)	Qualitative study	Development of MCI training concept, their evaluation criteria and their test.	Germany	EMS personnel	MCI	Training	<p><b>KSA</b> Technical knowledge, skills and attitudes (triage of patients, number of EMS units, analysis of danger, evacuation measures)</p> <p><b>Teaching method</b> Not mentioned</p> <p><b>Training's assessment</b> Evaluation criteria such as</p> <ul style="list-style-type: none"> <li>- Time until last patient is transported to hospital</li> <li>- Time until all critical triaged patients left the scene</li> </ul>	<p>Good preparation of training scenarios is necessary for a successful training.</p> <p>Adequate registration of personnel and patient actors is important as well as the collection of predefined data.</p> <p>Further, electronic data analyses is essential for timely results.</p>
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							- Ratio EMS units / patient and observer during training	
17. (Fischer et al., 2013)	Descriptive, cross-sectional study	Assessment of the level of preparation of hospital physicians for MCI	Germany	Hospital physicians	MCI and terror attacks	Evaluation	<p><b>KSA</b></p> <p>Technical knowledge (location, hospital setting, medical expertise of physician concerning injury patterns and treatment of explosion victims and CBRN, base knowledge about MCI)</p> <p>Non-technical knowledge (personal opinion about the need of further education about MCI, terrorism for physicians and EMS staff)</p> <p><b>Evaluation's type</b></p>	<p>Hospital physicians are insufficiently prepared for a MCI.</p> <p>Standardized training programs about MCI management as well as triage and care of NBC contaminated patients are needed and should be integrated into the continuous education of physicians.</p>

							Survey (7700 hospital physicians), descriptive statistics	
18. (Kupfer, Michalzik, & Lenz, 2013)	Descriptive, cross-sectional study	Evaluation of nurses' response readiness in hospital emergency exercises	Germany	Nurses in emergency departments	MCI	Evaluation	<p><b>KSA</b></p> <p>Technical knowledge (hospital capacities, triage, patient care, materials management)</p> <p>Non-technical knowledge (own role, situational awareness, communication, ethics and law)</p> <p><b>Evaluation's type</b></p> <p>Creation of database and qualitative evaluation concept for literature review and field studies, later on: construction and qualitative evaluation of the process. The base of evaluation gives the potential to</p>	<p>The development of an adequate instrument to evaluate the response readiness is challenging.</p> <p>The resulting evaluation approach has the potential to substantiate education and training in the context of curriculum development.</p> <p>In the long run the focus of training and evaluation needs to be an interprofessional approach for all involved occupational groups.</p>

							further training education	concretize and	
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## 176 **Discussion**

177 With the aim of investigating the current state of the art of disaster management initiatives in the EMR,  
178 eighteen relevant articles out of 1771 were identified. This clearly shows the limited scientific studies  
179 on disaster management preparedness in the countries of the EMR region. Indeed, many studies about  
180 disaster and health emergencies have investigated the human, economic and psychological impact of  
181 disasters. However, only a few actually addressed preventive measures. Among the studies adopting a  
182 preventive approach, it appears that a very limited percentage of them are dedicated to disaster  
183 management education even though European and international directives promote this approach  
184 (Wannous & Velasquez, 2017). This shows that despite being acknowledged as an important subject,  
185 disaster management has not been considered as a priority among curricula over other themes to date  
186 (Ingrassia et al., 2014). Exploring grey literature and fieldwork would also provide support for this  
187 hypothesis. Indeed, initiatives may have been taken without being reported or published.

188 In view of the study designs adopted, a majority of descriptive studies was found and only two studies  
189 have adopted an experimental design. Those results are in line with previous study showing a vast  
190 majority of descriptive studies in the field of disaster management (Smith, Burkle, Aitken, & Leggatt,  
191 2018). This may be explained by the lack of standardized assessment tools or suitable training context  
192 in this very specific research area. Yet, experimental studies are required to ascertain if any learning  
193 impact is to be observed as the result of any training implemented.

194 The authors noticed that the scientific concern for disaster management appears to be quite  
195 heterogeneous among the countries of interest. Indeed, there were more studies conducted on the  
196 German region than on Belgian and Dutch regions. It is hypothesized that this heterogeneity could be  
197 lessened by exploring grey literature. Besides, no article addressing the cross-border aspect was found,  
198 while European directives strongly stimulate cross-borders initiatives, such as hence the emergence of  
199 collaboration such as EMR. In this context, it would be valuable to investigate the reasons for this lack  
200 of interest for research on cross-borders and the barriers.

201 Regarding the target audience, undergraduate students and relief professionals tend to be the most  
202 frequent target group. No study, however, took into consideration citizens' education about disaster  
203 management, either in terms of disaster management competencies evaluation or training. Citizens are  
204 the first to be affected and directly on the spot when a disaster strikes and it has been demonstrated that  
205 its consequences tended to be reduced when communities were acknowledged, motivated to create a  
206 culture of prevention and resilience to disaster (Torani, Majd, Maroufi, Dowlati, & Sheikhi, 2019). In  
207 this context, raising awareness on risk reduction, individuals capacities and empowering the  
208 communities should be prioritized (Rundmo & Nordfjærn, 2017). Furthermore, there is evidence that  
209 primary and secondary schools are the most conducive environment for learning disaster management  
210 (A. Johnson, R. Ronan, M. Johnston, & Peace, 2014). It would therefore be interesting to investigate  
211 whether schools actually train their students, and how this training is designed for the development of  
212 initiatives that promote compliance with international guidelines.

213 Besides, it is worth noting that although some study focused on precise themes such as CBRNs, most  
214 initiatives appear to have a "global hazards" or "MCI" approach. Further a lack of common acceptance  
215 for rather ubiquitous themes or vocabulary shared between the different authors was noticed, which may  
216 lead to some confusion. While some studies indifferently employ MCI to refer to an "all hazards"  
217 approach, other studies distinguished both terms. The same applies to the words "disaster" and "crisis",  
218 for which there does not seem to be a consensus. This could be explained by the lack of international  
219 consensus on the definitions and the legal specificities applicable within each country. However,  
220 defining clear concept could help their operationalization and guide future interventions (M. L. M. I.  
221 Verheul & Dücker, 2020).

222 Most of these initiatives aimed to assess knowledge and skills rather than developing and evaluating  
223 training that will enable expertise improvement. Moreover, knowledge about disaster management is  
224 first assessed and taught among the developed initiatives, rather than skills and attitudes. However, more  
225 focus on competence-based than knowledge-based training would be needed to meet both professional  
226 and field-level requirements. This study found very interesting results with regard to the two

227 experimental studies which incorporated simulation education within their programs. At this point,  
228 numerous studies have suggested that simulation as a teaching tool may play a key role in technical and  
229 non-technical skills training (Morgan, Kurrek, Bertram, LeBlanc, & Przybyszewski, 2011). Indeed,  
230 simulation is important in critical care and disaster medicine training as simulation offers the potential  
231 to replicate high-risk, but infrequent disaster environments, without harming any patients or learners  
232 (Pucher et al., 2014). Using simulation as an evaluation method, might be of more limited interest.  
233 Although this is one of the rare processes by which all KSA modalities can be measured, limitations  
234 come from the potential difficulty encountered in validating a simulation-based evaluation process. Less  
235 than half of the studies actually used validated tools to assess state-of-the-art knowledge or training  
236 program developed. Besides technical skills, non-technical skills have proved to be highly valuable  
237 when a disaster strikes but the authors found data about non-technical skills in only six of the studies  
238 reported. Of interest and great hope is that the skills most commonly taught in these studies, namely  
239 leadership, communication and coordination, seem to reflect the gaps identified among relief  
240 professionals in post-disaster reports (Goralnick, Van Trimont, & Carli, 2017).

241 In the light of these results, different perspectives may be considered, from both scientific as well as  
242 pedagogical aspect.

243 Scientifically, by adding articles from the grey literature, the authors could observe whether they follow  
244 the same tendencies as the chosen scientific articles. Similarly, by applying the same research question  
245 to multiple relief agencies, its training facilities, and professionals involved in training and education, a  
246 more meaningful understanding of the field initiatives could be generated. As previously mentioned,  
247 more experimental protocols are needed to really witness the impact of disaster management training  
248 within the EMR. Research and training efforts must also be focused on citizens, particularly primary  
249 and secondary school students.

250 From the pedagogical point of view, there would be merit in developing and validating educational  
251 curricula incorporating simulation. This should help to lead to more a competency-based approach rather  
252 than a knowledge-based approach.

## 253 **Conclusions**

254 The current available literature provides little scientific evidence to guide disaster education initiatives  
255 within EMR countries. Most of the elements reported have descriptive purposes and very few  
256 experimental studies of quality have been carried out to date. However, non-technical skills seem well  
257 considered among the analyzed articles.

258 As a conclusion, international recommendations do not appear to be harmoniously implemented and,  
259 finally, the cross-border collaboration needs to be further investigated.

## 260 **Declaration of Interest**

261 The authors declare no conflict of interest

## 262 **Declaration of Financial Support**

263 This work was supported by the International Information and Knowledge Centre in Public Safety  
264 (IKIC) (EMR77/2018-2021) project and Interreg-EMR program.

## 265 **Acknowledgments**

266 The authors warmly acknowledge all the IKIC Public Safety partners and Interreg-EMR organization:  
267 Maastricht University, RWTH Aachen University, Order of Malta, School of the Landassociation North-  
268 Rhine e.V. (German Red Cross), Fire department of the City of Aachen, South Limburg Security Region,  
269 Research Centre Jülich, Technical and Pedagogical Cooperation Centre and Hasselt University.

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414 **Appendix A : Research Strategy for Medline**

- 415 1 Disaster Planning/ (13461)
- 416 2 Strategic Stockpile/ (58)
- 417 3 Disaster Medicine/ (786)
- 418 4 1 or 2 or 3 (13999)
- 419 5 Disasters/ (18489)
- 420 6 Natural Disasters/ (70)
- 421 7 Terrorism/ (5049)
- 422 8 Chemical Terrorism/ (162)
- 423 9 Bioterrorism/ (4561)
- 424 10 5 or 6 or 7 or 8 or 9 (27663)
- 425 11 disaster\*.ti,ab,kf. (23574)
- 426 12 (strategic adj2 stockpile\*).ti,ab,kf. (86)
- 427 13 emergenc\* preparedness.ti,ab,kf. (1654)
- 428 14 emergenc\* management.ti,ab,kf. (2712)
- 429 15 11 or 12 or 13 or 14 (26866)
- 430 16 (mass adj2 casualt\*).ti,ab,kf. (2257)
- 431 17 (mass adj2 murder\*).ti,ab,kf. (157)
- 432 18 terrorism.ti,ab,kf. (3107)
- 433 19 (terror\* adj2 attack\*).ti,ab,kf. (2270)
- 434 20 16 or 17 or 18 or 19 (7035)
- 435 21 4 or 10 or 15 or 20 (52111)
- 436 22 belgium/ or germany/ or netherlands/ (188566)
- 437 23 (belgium or belgian or german\* or netherlands or dutch or euregio\* or meuse-rhine).ti,ab,kf. (218978)
- 438 24 22 or 23 (314183)
- 439 25 21 and 24 (964)
- 440 26 limit 25 to yr="2010 -Current" (410)
- 441 27 limit 26 to (dutch or english or flemish or french or german) (404)
- 442
- 443

444 **Appendix B : Research Strategy for PyschInfo**

- 445 1. Emergency Preparedness/ (1079)  
446 2. Emergency Management/ (641)  
447 3. 1 or 2 (1629)  
448 4. disasters/ (3182)  
449 5. Natural Disasters/ (3935)  
450 6. Mass Murder/ (146)  
451 7. Terrorism/ (6998)  
452 8. Bioterrorism/ (111)  
453 9. 4 or 5 or 6 or 7 or 8 (13631)  
454 10. emergenc\* preparedness.ti,ab,id. (335)  
455 11. emergenc\* management.ti,ab,id. (600)  
456 12. disaster\*.ti,ab,id. (9150)  
457 13. (strategic adj2 stockpile\*).ti,ab,id. (4)  
458 14. 10 or 11 or 12 or 13 (9599)  
459 15. (mass adj2 murder\*).ti,ab,id. (293)  
460 16. (mass adj2 casual\*).ti,ab,id. (142)  
461 17. terrorism.ti,ab,id. (5606)  
462 18. (terror\* adj2 attack\*).ti,ab,id. (2828)  
463 19. 15 or 16 or 17 or 18 (7736)  
464 20. 3 or 9 or 14 or 19 (19387)  
465 21. (belgium or belgian or german\* or netherlands or dutch or euregio\* or meuse-rhine).ti,ab,id. (48945)  
466 22. 20 and 21 (362)  
467 23. limit 22 to yr="2010 - 2019" (205)  
468 24. limit 23 to (dutch or english or french or german) (193)  
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473 **Appendix C : Research Strategy for Scopus**

474 ( TITLE-ABS-KEY ( ( "emergenc\*  
475 preparedness" ) OR ( "emergenc\*management" ) OR disaster\* OR ( strategic W/2 stockpile\* ) ) OR TITLE-  
476 ABS-  
477 KEY ( ( mass W/2 murder\* ) OR ( mass W/2 casualt\* ) OR ( terrorism ) OR ( terror\* W/2 attack ) ) AN  
478 D TITLE-ABS-  
479 KEY ( ( belgium OR belgian OR german\* OR netherlands OR dutch OR euregio\* OR meuse-  
480 rhine ) ) ) AND ( LIMIT-TO ( PUBYEAR , 2019 ) OR LIMIT-TO ( PUBYEAR , 2018 ) OR LIMIT-  
481 TO ( PUBYEAR , 2017 ) OR LIMIT-TO ( PUBYEAR , 2016 ) OR LIMIT-  
482 TO ( PUBYEAR , 2015 ) OR LIMIT-TO ( PUBYEAR , 2014 ) OR LIMIT-  
483 TO ( PUBYEAR , 2013 ) OR LIMIT-TO ( PUBYEAR , 2012 ) OR LIMIT-  
484 TO ( PUBYEAR , 2011 ) OR LIMIT-TO ( PUBYEAR , 2010 ) ) ) AND ( LIMIT-  
485 TO ( AFFILCOUNTRY , "Germany" ) OR LIMIT-TO ( AFFILCOUNTRY , "Netherlands" ) OR LIMIT-  
486 TO ( AFFILCOUNTRY , "Belgium" ) ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) OR LIMIT-  
487 TO ( LANGUAGE , "German" ) OR LIMIT-TO ( LANGUAGE , "Dutch" ) OR LIMIT-  
488 TO ( LANGUAGE , "French" ) )  
489

490 **Appendix D: Inclusion and Exclusion criteria**

Inclusion	Exclusion
Disaster, terrorism, mass casualty incident	Financial crisis, demographic crisis (refugee), humanitarian crisis, non-acute disaster (heat wave, etc.), individual emergency 491 492 493 494
EMR countries	Non-EMR countries, crisis/disaster managed by an EMR country but outside the EMR country 495 496
Training interventions, assessment of knowledge and skills	Interventions during the crisis, post-crisis interventions, preventive interventions not part of training/education
Interventions from 2010	Articles relating to events prior to 2010