

## **Paper I**

**Systematic literature review of templates for reporting pre-hospital major incident medical management**

# Systematic literature review of templates for reporting prehospital major incident medical management

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## ABSTRACT

**Objective:** To identify and describe the content of templates for reporting prehospital major incident medical management.

**Design:** Systematic literature review according to PRISMA guidelines.

**Data sources:** PubMed/MEDLINE, EMBASE, CINAHL, Scopus and Web of Knowledge. Grey literature was also searched.

**Eligibility criteria for selected studies:** Templates published after 1 January 1990 and up to 19 March 2012. Non-English language literature, except Scandinavian; literature without an available abstract; and literature reporting only psychological aspects were excluded.

**Results:** The main database search identified 8497 articles, among which 8389 were excluded based on title and abstract. An additional 96 were excluded based on the full-text. The remaining 12 articles were included in the analysis. A total of 107 articles were identified in the grey literature and excluded. The reference lists for the included articles identified five additional articles. A relevant article published after completing the search was also included. In the 18 articles included in the study, 10 different templates or sets of data are described: 2 methodologies for assessing major incident responses, 3 templates intended for reporting from exercises, 2 guidelines for reporting in medical journals, 2 analyses of previous disasters and 1 Utstein-style template.

**Conclusions:** More than one template exists for generating reports. The limitations of the existing templates involve internal and external validity, and none of them have been tested for feasibility in real-life incidents.

**Trial registration:** The review is registered in PROSPERO (registration number: CRD42012002051).

## INTRODUCTION

Major incidents, such as natural disasters, accidents and terrorist attacks, affect millions of lives each year. In 2011, natural disasters alone killed more than 30 000 people and injured 244 million people worldwide. The 332 natural disasters in 2011 caused the

## ARTICLE SUMMARY

### Article focus

- Identify templates that enable systematic and uniform reporting of prehospital major incident medical management.
- Appraise the data fields in the included templates regarding internal and external validity.

### Key messages

- Templates for reporting major incident medical management exist in different formats, but none have been tested for feasibility.
- A template for generating reports from the pre-hospital phase with clearly defined data variables enabling comparative analysis is needed.

### Strengths and limitations of the study

- A systematic review following the preferred reporting items for systematic reviews and meta-analyses guidelines.
- The protocol was published and deviations from protocol are revealed in the study report.
- Only English and Scandinavian language literature was included.

highest economic damage ever recorded; Asia was the continent most often hit, followed by the Americas, Africa, Europe and Oceania. This regional distribution of disaster resembles the profile observed from 2001 to 2010. Over the last decade, China, the USA, the Philippines, India and Indonesia were the five countries most frequently hit by natural disasters.<sup>1</sup>

Although disaster medicine can be traced back to the Middle Ages, it has become a distinct scientific discipline in only the last 60 years.<sup>2</sup> An evolving trend in disaster medicine calls for improved reporting of major incidents in order to increase the level of science within this field.<sup>3–8</sup> Previous expert group processes defined uniform data sets for reporting in both emergency medicine in general<sup>9 10</sup> and in disaster medicine specifically.<sup>11 12</sup> These templates were designated as Utstein-style templates after the Norwegian

monastery where they were developed. Qualitative research methods have also been used to identify areas within prehospital critical care and major incident management that require further research.<sup>13 14</sup> A recent review identified data from mass gatherings as non-uniform and called for consistent data to enable future research.<sup>15</sup> The importance of evaluating disaster exercises using predefined, high-quality data has also been discussed as a potential for improving disaster health management<sup>16</sup> and for comparing outcomes from different exercises.<sup>17</sup> The analysis of standardised data from previous incidents can allow decision-makers to make well-informed decisions.<sup>18</sup>

This systematic review was designed to identify and describe the content of templates for reporting prehospital major incident medical management. The questions being asked in this systematic review were: which data are reported in the existing templates (data extraction), and are the templates internally and externally valid with regard to the methodology with which they were developed and the data they are reporting (quality appraisal)? The need for a template for uniform reporting was assessed based on the findings. To the best of our knowledge, no similar studies have been performed or registered in the Cochrane or Prospero databases.

## METHODS

### Search strategy

A systematic literature search was performed to identify templates published after 1 January 1990 and up to 19 March 2012.<sup>19</sup> The controlled vocabulary of Medical Subject Headings (MeSH) from PubMed, including sub-headings, publication types and supplementary concepts, was used. The search was performed between 24 February 2012 and 19 March 2012. A systematic search of the grey literature was performed 25–29 June 2012.

In the main database search, three sets of entry terms were applied and combined (figure 1). The first set of

entry terms describes major incidents. The second set of entry terms describes templates. In addition to the MeSH terms in the first two sets, a third set of entry terms with free search phrases was included. For the grey literature search, only two sets of entry terms were combined.<sup>19</sup>

#### Inclusion criteria

- ▶ Templates reporting prehospital major incident medical management.
- ▶ Templates published after 1 January 1990 (inclusive) and until the date of the literature search.

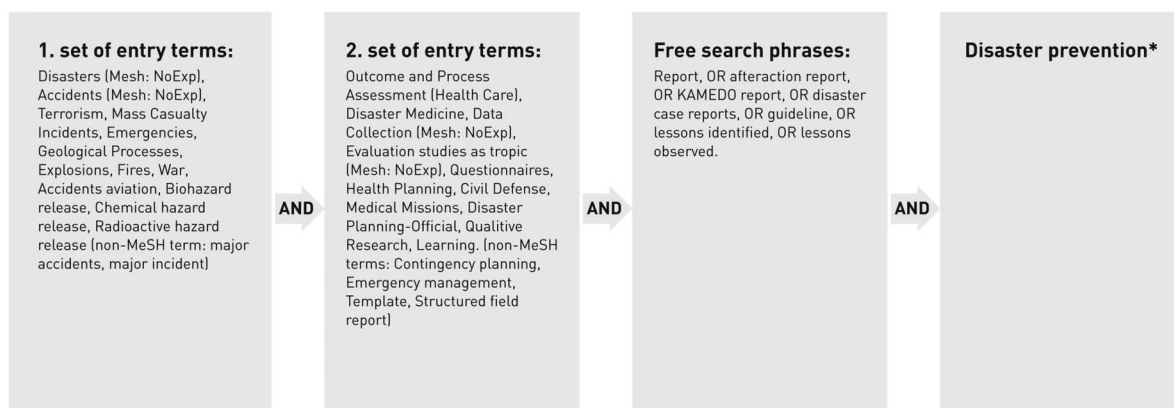
#### Exclusion criteria

- ▶ All non-English language literature, except Scandinavian.
- ▶ Literature without an available abstract.
- ▶ Literature reporting only psychological aspects.

### Deviations from protocol in search strategy

Combining the three sets of entry terms resulted in 225 individual searches in each database. If any of these individual searches returned more than 700 results, the search was performed again with a fourth entry term (*disaster prevention*) using the Boolean operator AND (figure 1).

In Scopus, two entry terms, “questionnaires” and “learning”, were excluded due to a large number of irrelevant results, and all searches were limited to the subject areas of life sciences, health sciences and physical sciences. Searches in Scopus were further limited to article title, abstract and keywords. In Web of Knowledge (ISI), all searches were limited to articles and reviews. The term “disaster prevention” was used to refine and decrease the number of search results in four of the individual searches performed in this database. ProQuest Research Library was excluded as it returned too many irrelevant results and the most relevant subjects were covered by the searches performed in PubMed/MEDLINE, Web of Knowledge and Scopus.



**Figure 1** Search strategy. The two first sets of entry terms consisted of 15 terms each, and the third set of eight free search phrases. Combining these three sets resulted in 225 individual searches in each database. \*If any of the individual searches returned more than 700 results, the search was performed again with a fourth entry term (*disaster prevention*) using the Boolean operator AND.

The grey literature databases revealed a broad range of quality and searchability. The System for Information on Grey Literature in Europe (OpenSIGLE) was excluded due to the need to order the documents from the original source or a library. Only the document title was available on the web page, making it difficult to determine which documents to order.

Deviations in the search strategy were necessary in order to make the systematic literature review feasible, as a larger number of findings might have made completion of the study impossible.

### Search findings

The search was performed according to the deviations described above. A total of 10 136 results from each individual database search were sent to Endnote X5 (Thomson Reuters, New York, USA). After removing duplicates, the number of results was 8497. The grey literature search returned 107 results (figure 2). A total of 18 articles were included for data extraction and quality appraisal.

### Analysis of identified literature

One author scanned the titles and abstracts of the identified literature. Literature not complying with the inclusion criteria was excluded. The full text was obtained for uncertain articles, and inclusion was subject to consensus

among three of the authors. Data analysis was performed according to the participants, interventions, comparisons, outcomes, study design (PICOS) methodology as described in PRISMA guidelines.<sup>20 21</sup> In this case, the participants were all the identified templates for reporting major incident medical management. Our intervention, comparisons and outcomes were carried out using the data extraction and quality appraisal variables described in methods and depicted in figures 3 and 4. From each template, 34 data items were extracted according to a pre-defined set of questions described in the study protocol<sup>19</sup> (figure 3). These data were classified into four categories: demographics, incident characteristics, system characteristics and descriptors of patient characteristics. After data extraction, quality appraisal was conducted using a checklist<sup>22</sup> designed by the authors prior to data collection<sup>19</sup> (figure 4). This checklist was based on authors' assumptions of the data relevant to report in a template. One author performed data extraction and quality appraisal; the results were checked by a second author. The contact authors of articles that provided an email address were asked whether the template had been used in real-life incidents. The reference lists of the included literature were scanned and relevant literature included. A quantitative synthesis (meta-analysis) was not performed. The preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines were followed.<sup>20 21</sup>

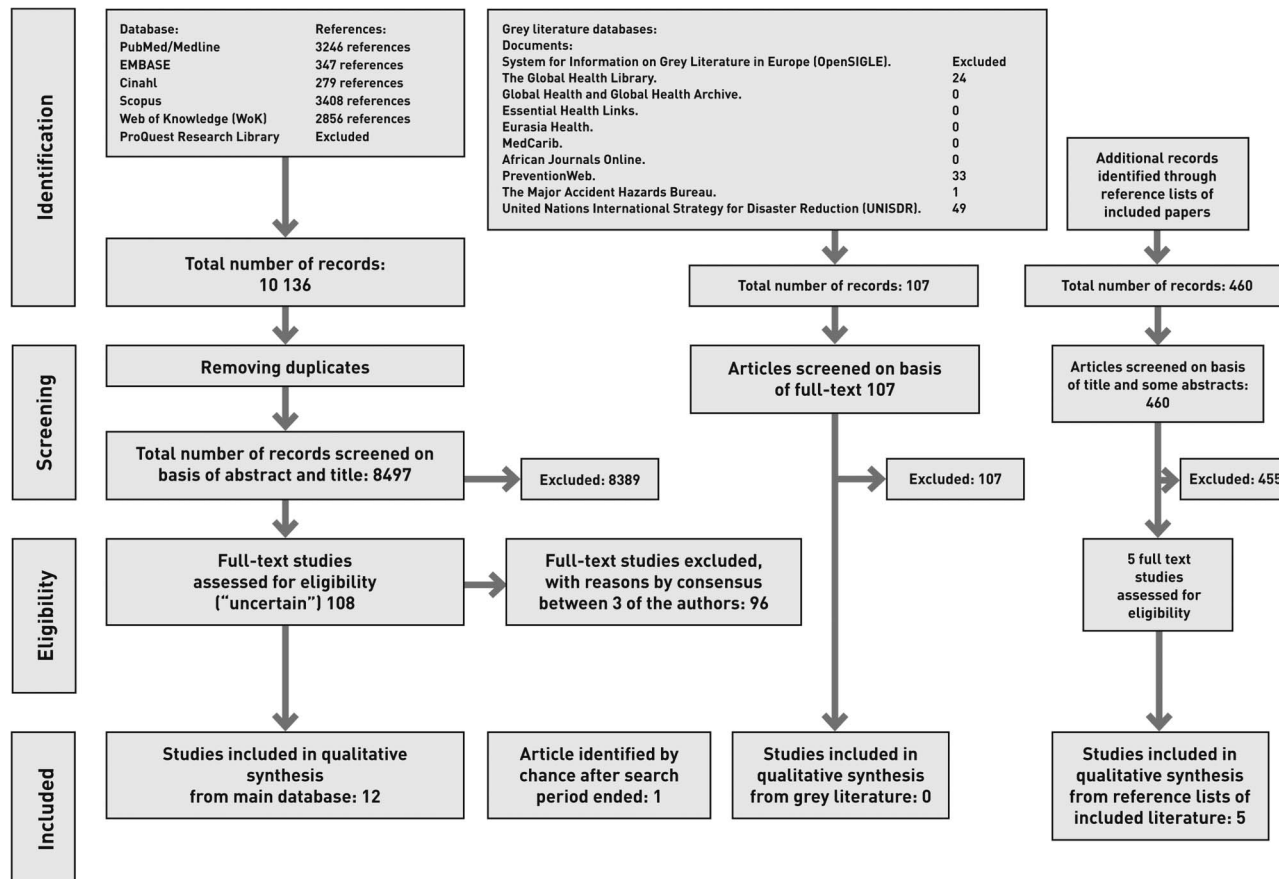


Figure 2 Flow diagram depicting the different stages of the systematic literature review.

	Basic info on affected area?	Characteristics and number of the affected population prior to MI?	Other pre-event information reported?	Time and date of MI	Description of damage caused by MI	Number deceased	Number severely injured	Number moderately injured?	Number slightly injured?	Number uninjured?	Other incident information reported?	Information received by ambulance dispatch centre (ADC)?	Information provided by ADC to responder?	Accessibility of the incident site?	Time from alarm to arrival at scene?	Safety situation at and around incident site?	Available pre-hospital resources?	Pre-hospital resources lacking?	Pre-hospital triage systems used?	Situation of pre-hospital telecommunications system?	Communication between rescue workers/aid organizations?	Coordination of rescue/relief work?	Time required for moving casualties from site to immediate next level of care?	Scaling up and scaling down of response?	Other system characteristics reported?	Children, adults, senior citizens or all age groups involved?	Triage classification patients received through ADC?	Triage at first evaluation on scene?	Triage before transport to next immediate level of care?	Injury models used?	Median/mean injury score reported?	The most frequent medical injuries/illnesses?	How medical illness was classified	Other patient characteristic descriptors			
Anderson [23]	X	X	✓	✓	✓		not all incidents	not all incidents	✓	not all incidents	✓	X	X	✓	X	X	✓	✓	X	✓	X	X	X	X	✓	X	X	X	X	X	X	X	X	✓	✓		
Debacker [13]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	✓	X	✓	✓	X	X	✓	X	✓	✓	✓	✓	✓	✓	X	✓	X	X	X	X	X	✓	✓		
DISAST-CIR [24–30, 35]	X	X	✓	✓	✓	✓	✓	✓	✓	X	✓	✓	X	X	✓	✓	✓	X	X	X	X	X	X	X	✓	X	X	X	X	✓	✓	✓	✓	X	X		
Green [36]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Ingrassia [31]	X	X	X	X	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	✓	✓	✓	✓	✓	X	X	✓	X	X	X	✓	X	X	X	X	X	X	✓	✓	
Juffermans [32]	✓	✓	✓	only date	✓	✓	X	X	X	X	✓	✓	✓	✓	X	✓	X	✓	✓	✓	✓	X	✓	✓	X	X	X	X	X	X	X	X	X	X	✓	✓	
Kulling [37]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	?	X	X	X	X	X	X	X	X	X	✓	✓	X	X	X	X	X	X	X	X	X	✓	X	
Lenquist [33]	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	✓	X	✓	✓	✓	✓	✓	✓	✓	X	✓	✓	X	X	X	X	X	X	X	X	✓	✓	
Performance indicators [34, 39]	X	X	X	X	X	X	X	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	only scale injury type	✓	X	X	X	X	X	X	X	X	X	X	X	X
Ricci [38]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	X	✓	✓	X	✓	✓	✓	✓	X	✓	✓	X	X	X	X	X	X	✓	✓	✓	✓	
Total number of ✓	3	3	6	5	7	7	5	5	6	4	7	2	2	2	4	2	5	5	3	5	5	5	6	3	10	3	0	3	0	2	2	3	7	7			

Figure 3 Data extraction from the included literature. ✓ Yes; × no; MI, major incident.

### Deviations from protocol regarding quality appraisal

The study protocol proposed to appraise whether the medical outcomes predicted by the templates were valid and to evaluate the outcome of using the templates. Both of these questions proved difficult to answer and were removed from the appraisal.

## RESULTS

A total of 12 articles were included from the main database search,<sup>23–34</sup> five articles were identified from the literature lists of included articles,<sup>35–39</sup> and one relevant article was published after the literature search was completed<sup>12</sup> (figure 2). The total of 18 articles included 10 different templates or guidelines for reporting (figure 5).

### Data extraction

The results of data extraction are shown in figure 3. In addition, under each of the four categories (pre-event information, incident information, system characteristics, patient characteristics), other information that was not extracted by the predefined questions was registered. Six of the 10 templates contained other pre-event information, such as climate, child mortality rate and descriptions of hazards. Seven of the 10 templates contained other incident information, such as a description of the incident. All templates included more system characteristics than what

we extracted, including on-site medical care, distribution of casualties, independent action by medical disaster response personnel, continuation of day-to-day care, decision flow and information management. Seven templates contained other descriptors of patient characteristics, such as different triage systems used, description of psychological reactions and morbidity using hospital data.

### Quality appraisal

The appraisal using a predefined checklist is shown in figure 4. The first five questions regarding internal validity indicated that two of the templates contained none of the data we were looking for, four templates contained one of the data items we found relevant and the remaining four templates included three or more data items included in our list of desirable information. The 11 items regarding external validity were also heterogeneous in regard to which and how many of the items each template contained.

### Use of templates

We succeeded in contacting the authors of seven templates. According to the authors, five of these templates<sup>24–30 31 33–35 37 39</sup> were used in other publications and one<sup>12</sup> is currently being used to retrospectively evaluate disaster management. One has not been used

	Anderson (23)	Debacker (13)	DISAST-CIR [24-30, 35]	Green (36)	Ingrassia (31)	Juffermans (32)	Kulling (37)	Lennquist (33)	Performance indicators (34,39)	Ricci (38)	
1. Was the methodology for developing the template clearly explained?	x	✓	x	✓	x	✓	✓	x	x	x	Internal validity
2. Are the data variables listed in the template clearly defined?	x	✓	✓	✓	x	x	✓	✓	✓	x	
3. Is the rationale for the data variables described?	x	✓	x	✓	✓	✓	✓	x	x	x	
4. Is handling of missing data described?	x	✓	x	✓	x	x	✓	x	x	x	
5. Has an ethics committee approved the template?	x	x	x	✓	x	✓	x	x	x	x	
6a. Does the literature state who developed the template?	x	✓	✓	✓	x	x	✓	x	✓	x	External validity
b. How the process was funded	x	✓	✓	✓	x	x	✓	x	x	x	
7a. Which continent/country/organization was the template developed in?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
b. Where [specific region] it is intended to be used?	x	✓	✓	✓	x	x	x	x	x	x	
8. Are the data variables transferable to other countries or major incident management systems?	x	✓	✓	✓	x	x	✓	✓	✓	x	
9. Is it possible to report the incident timeline?	x	✓	✓	✓	x	✓	✓	✓	x	x	
10. Is a valid discussion included about possible sources of bias?	x	✓	✓	✓	✓	✓	✓	x	✓	x	
11. Do the authors discuss using the template as a tool for evaluation?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
12. Has the clinical credibility of the tool been evaluated?	x	x	x	x	x	x	x	x	x	x	
13. Has the feasibility of the template been evaluated?	x	x	x	x	x	x	x	x	x	x	
14. Has the template been used in other publications?	?	*	✓	?	✓	x	✓	✓	✓	?	

**Figure 4** Quality appraisal of the included literature. ✓ Yes, x no, ? unclear, \* study is ongoing.

in other publications.<sup>32</sup> DISAST-CIR<sup>24-30, 35</sup> is routinely used to report each mass casualty incident in the registry of the Israeli Defence Force Home Front and Ministry of Health. Guidelines for reporting health crises and critical health events<sup>37</sup> have been used to report international disasters, but these publications were not available as official publications at the time of correspondence with the authors. The protocol for reports of major accidents and disasters<sup>33</sup> was published previously in the *International Journal of Disaster Medicine*<sup>40, 41</sup> and used for a report in this journal.<sup>42</sup> It has also been used in the *European Journal of Trauma and Emergency Surgery*<sup>43, 44</sup> and mentioned in an editorial in the same journal.<sup>45</sup> Two of the templates<sup>31, 34, 39</sup> are routinely used for reporting from exercises. Data on medical management during a mass casualty incident exercise<sup>31</sup> are normally used to assess the healthcare system in a mass casualty incident simulation and exercise. An online registry for the healthcare system is designed using this instrument. Performance indicators for major incident medical management<sup>34, 39</sup> have also been used in additional publications.<sup>17, 46-50</sup> For the three publications lacking author email,<sup>23, 36, 38</sup> we were unable to attain information on whether they have been used.

## DISCUSSION

We identified 10 templates for reporting prehospital major incident medical management that were

heterogeneous with regard to the data they reported. The quality appraisal revealed that, for most of the templates, the methodology for developing them was not clearly explained. In addition, the data variables were not clearly defined for all templates, and the rationale for choosing the data variables was only explained for half of the templates. Only three of the articles describe the handling of missing data and two depict whether an ethics committee approved the templates. All of these factors are important for internal validity, but the results were also heterogeneous for external validity. We chose to interpret that the templates were developed in the regions affiliated with the authors, though this was not specified. Only two templates stated in which region they were intended to be used. None of the articles discussed the clinical credibility of the template, and no feasibility studies have been performed. In all cases, the use of the template as a tool for evaluation was mentioned.

The data extraction and quality appraisal variables were based on the authors' assumptions on what is important in a template for reporting major incident medical management. Data variables for reporting should be uniformly defined in order to improve research and allow analysis of data; this is the ideological basis for several previous projects to standardise data for scientific use.<sup>9-12</sup> We also believe it is important that templates are preapproved by ethics committees to allow immediate reporting and rapid dissemination of data on

<p><b>Anderson, 1995 (23)</b></p> <p>A comparative analysis of the emergency medical services and rescue responses to eight airliner crashes in the United States, 1987-1991.</p> <p>Retrospective analysis of real events using a systematic method.</p>	<p><b>Debacker et al, 2012 (12)</b></p> <p>Utstein-style template for uniform data reporting of acute medical responses in disaster.</p> <p>Template for future reporting of real incidents.</p>	<p><b>DISAST-CIR, 2007-2008 (24-30, 35)</b></p> <p>Seven articles using a template (DISAST-CIR) for reporting from mass casualty incidents. Documented in the registry of the Israeli Defence Force Home Front and Ministry of Health.</p> <p>Systematic method for reporting real incidents.</p>	<p><b>Green et al, 2003 (36)</b></p> <p>Generic evaluation methods for disaster drills in developing countries.</p> <p>Systematic method for reporting from field exercises.</p>	<p><b>Ingrassia et al, 2010 (31)</b></p> <p>Evaluation of medical management during a mass casualty incident exercise.</p> <p>Systematic method for reporting from field exercises.</p>
<p><b>Juffermans et al, 2010 (32)</b></p> <p>Recurrent medical response problems during five recent disasters in the Netherlands.</p> <p>Retrospective analysis of real events using a systematic method.</p>	<p><b>Kulling et al, 2010 (37)</b></p> <p>Guidelines for report on health crisis and critical health events.</p> <p>Guidelines for systematic reporting from real incidents.</p>	<p><b>Lennquist, 2008 (33)</b></p> <p>Protocol for Reports from Major Accidents and Disasters in the International Journal of Disaster Medicine.</p> <p>Guideline for systematic reporting from real incidents.</p>	<p><b>Performance indicators, 2004, 2010 (34, 39)</b></p> <p>An evaluation tool for reporting major incident medical management from disaster exercises.</p> <p>Systematic method for reporting from field exercises.</p>	<p><b>Ricci et al, 1991 (38)</b></p> <p>Assessment of Pre-hospital and Hospital Response in Disasters.</p> <p>Guidelines for systematic reporting from real incidents.</p>

**Figure 5** An overview of the included literature.

the potential for improvement. For a template to be used, it needs to be both clinically credible and feasible. Ideally, if a template is to be used in a specific region, it ought to be developed together with experts from that region; if this is not possible, feasibility studies regarding regional differences could be performed. Reporting should be done by representatives with in-depth local knowledge and directly involved in responding to or managing the major incident. The ultimate goal of reporting is that an evaluation of the response be undertaken to identify areas for improvement, enabling those responsible in similar settings to improve their preparedness. For this kind of evaluation to occur, comparable, standardised reports that allow for research need to be published. Thus far, reporting on the scale needed for comparisons has not been achieved.

### Limitations

Not all of the included literature was intended for prospectively reporting real-life incidents. However, in order to not overlook potentially relevant aspects of major incident reporting, the literature aimed to report from exercises<sup>31 34 36 39</sup> and literature using a systematic method for reporting in general was included.<sup>23 32</sup> A clear weakness was that templates may exist in languages other than those included. We invite others to identify these

templates. Only literature in which an abstract was available was included. With more than 8000 articles identified in the search, reviewing full articles at the initial stage was not feasible. Another limitation was that only one author performed the initial review of the literature for inclusion. One author performed data extraction and the appraisal and a second author checked the results, but this can still allow room for subjective interpretations of the content of the templates. The aim of the appraisal was to systematically extract information that the authors thought would be important for reporting major incident medical management. However, neither the data extraction nor the quality appraisal represents a validated set of data or gold standard.

### CONCLUSIONS

Our findings show that more than one template exists for generating reports from the medical management of major incidents. Limitations are present in the existing templates regarding internal and external validity, and none of them have been tested for feasibility in real-life incidents. Uniform reporting can allow the analysis and comparison of medical management for different major incidents and identify areas that need improvement. Indirectly, this information can lead to better resource use and improved outcomes for patients and society. The

identified templates may be used as a basis for designing a template that is specifically aimed at prehospital medical care and at generating reports in such a quantity that comparative analysis can be performed. The work to create such a template seems warranted and is now underway.

**Contributors** SF, MR and TW conceived the idea and designed the study. ER designed and conducted the search strategy for the literature search. SF screened the identified literature. TW, MR and SF considered the eligibility of uncertain literature. SF performed data extraction and quality appraisal of the included literature. TW and MR checked these results and were mentors in the process. SF, MR, ER and TW approved the final version of the manuscript.

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**Data sharing statement** No additional data are available.

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