Utilisation of helicopter emergency medical services in the early medical response to major incidents: a systematic literature review

Anne Siri Johnsen,1,2,3 Sabina Fattah,1,4 Stephen J M Sollid,1,2 Marius Rehn1,2,5

ABSTRACT

Objective: This systematic review identifies, describes and appraises the literature describing the utilisation of helicopter emergency medical services (HEMS) in the early medical response to major incidents.

Setting: Early prehospital phase of a major incident.

Design: Systematic literature review performed according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

MEDLINE, EMBASE, the Cochrane Central Register of Controlled Trials, the Web of Science, PsycINFO, Scopus, Cinahl, Bibsys Ask, Norart, Svemed and UpToDate were searched using phrases that combined HEMS and ‘major incidents’ to identify when and how HEMS was utilised. The identified studies were subjected to data extraction and appraisal.

Results: The database search identified 4948 articles. Based on the title and abstract, the full text of 96 articles was obtained; of these, 37 articles were included in the review, and an additional five were identified by searching the reference lists of the 37 articles. HEMS was used to transport medical and rescue personnel to the incident and to transport patients to the hospital, especially when the infrastructure was damaged. Insufficient air traffic control, weather conditions, inadequate landing sites and failing communication were described as challenging in some incidents.

Conclusions: HEMS was used mainly for patient treatment and to transport patients, personnel and equipment in the early medical management of major incidents, but the optimal utilisation of this specialised resource remains unclear. This review identified operational areas with improvement potential. A lack of systematic indexing, heterogeneous data reporting and weak methodological design, complicated the identification and comparison of incidents, and more systematic reporting is needed.

Trial registration number: CRD42013004473.

INTRODUCTION

Major incidents remain a major global health challenge. In 2013, natural-triggered disasters killed more than 20 000 people, created almost 100 million victims and caused enormous economic damage worldwide.1 These numbers are only for natural disasters and do not take into account other types of major incidents. Major incidents are characterised by the need for an extraordinary medical response. They are heterogeneous by nature and their unexpectedness remains a challenge for emergency medical services (EMS). Fundamental for an effective major incident response is a robust and resilient EMS system.2 These systems can provide rapid access to advanced major incident management to improve patient outcome3 and optimise resource allocation as demand often exceeds capacity.4

Helicopters are obvious resources in major incident management through their capacity to bring specialised teams and equipment to incident scenes. They can also transport patients, provide search and rescue services, and perform overhead surveillance. When a site is remote or difficult to access, helicopters may be the only way to transport personnel, equipment and patients in and out of it.5–9 Following the first organised use of helicopters for military medevac during the Korean War,10 the use of helicopters for civilian patient transportation was introduced in the USA in the early 1970s.11 It was later integrated as helicopter EMS (HEMS) in most high-income countries.12–14 Although HEMS is embedded in most emergency response plans, the optimal
use of this limited resource in the early medical management of major incidents remains unclear.

We aimed to systematically identify, describe and appraise the literature that describes the utilisation of HEMS in the early medical response to major incidents, to better address common challenges and to facilitate future research.

METHODS
Study identification
The protocol was published prior to conducting the literature search and registered in PROSPERO (CRD42013004473). A comprehensive literature search was performed to identify all relevant articles available as of 19 March 2015. The following databases were searched: MEDLINE, EMBASE, the Cochrane Central Register of Controlled Trials, the Web of Science, PsycINFO, Scopus, Cinahl, Bibsys Ask, Norart, Svemed and UpToDate. An additional search was performed in PubMed in order to retrieve articles that had not yet been entered into MEDLINE. The search was designed using Medical Subject Headings and related terms as keywords. This search was then adapted for use in the other databases (see online supplementary additional file I). In the absence of universally accepted nomenclature, literature that defined their incident as a major incident or disaster was included.

Study eligibility and selection
Inclusion criteria:
- Articles that describe the use of HEMS in the early medical management of a major incident.

Exclusion criteria:
- Articles in languages other than English and Scandinavian
- Articles without abstracts
- Book chapters, conference abstracts, letters to the editor and editorials

Deviations from the protocol on inclusion and exclusion criteria.
- Inclusion of commentaries
- Exclusion of literature where:
  - Only fixed-wing aircraft were used
  - Helicopters without dedicated medical capacity were used
  - Incidents were considered to be part of military conflicts
  - HEMS was used in the later recovery phase of the response.

The reason for the inclusion of commentaries was that these did not provide less relevant information than case reports. Exclusion criteria were adjusted to better target civilian medical helicopter response to major incidents in the acute phase.

Search findings
All studies were collected in an Endnote bibliographic database (2011; Thomson Reuters, USA). One author (ASJ) scanned the titles and abstracts, and excluded articles that clearly did not meet the inclusion criteria. Full-text versions of the remaining articles were obtained and divided among pairs of authors (ie, ASJ and MR, SF and SJMS) for further screening, using the criteria listed above. Excluded articles were listed with the reason(s) for exclusion. If there was any uncertainty about whether a study should be included, there was a discussion until a consensus was reached among all of the authors. The reference lists of the studies that were included initially were examined individually to identify the additional relevant literature.

Data extraction and appraisal
ASJ appraised the quality of the included studies and extracted predefined data from the included articles into an Excel spreadsheet (2010; Microsoft, USA). Data extraction included the demography of incident area and characteristics regarding HEMS, major incident, incident response and patient characteristics. The data extraction variables were pilot-tested on four randomly selected articles before the protocol was published. The appraisal items were selected by the authors, and aimed to describe the internal and external validity of the included studies. All data extraction and appraisal results were agreed on by another co-author.

RESULTS
Literature search
The search identified 4948 records (2763 after duplicates were removed), and the full-text versions of 96 articles were obtained. Of these, 37 articles were included in the study, and an additional 5 were identified by searching through the reference lists of the 37 articles. Thus, the review included a total of 42 articles (table 1), with 59 articles excluded for various reasons (see online supplementary additional file II). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram (figure 1) shows the inclusion and exclusion of articles in the different phases of this review.

Data extraction
None of the included articles contained all of the items on the data extraction list (figure 2). Basic information about the affected area was described in 12 articles (29%), information about the affected population in 24 (57%) and scene access in 29 articles (69%). Most papers described the characteristics of the incident. A timeline for the incident response was present in 25 articles (59%) and a description of personnel in 35 (85%) articles. In 12 (29%) of the articles, there was a lack of resources, prehospital surge capacity was reported in 2 (5%), and the response time was documented in 19 articles (45%). Communications and coordination were described in 34 articles (81%), and were in most cases failing. Scene safety was reported to...
<table>
<thead>
<tr>
<th>Method</th>
<th>Described use of HEMS</th>
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</thead>
<tbody>
<tr>
<td>Afzali et al (^{16})</td>
<td>Prospective observational study</td>
</tr>
<tr>
<td>Almersjø et al (^{49})</td>
<td>Case report</td>
</tr>
<tr>
<td>Ammons et al (^{17})</td>
<td>Case report</td>
</tr>
<tr>
<td>Assa et al (^{7})</td>
<td>Case report</td>
</tr>
<tr>
<td>Bland (^{18})</td>
<td>Case report</td>
</tr>
<tr>
<td>Bovender and Carey (^{19})</td>
<td>Case report</td>
</tr>
<tr>
<td>Brandsjø et al (^{60})</td>
<td>Case report</td>
</tr>
<tr>
<td>Brandstrom et al (^{20})</td>
<td>Case report</td>
</tr>
<tr>
<td>Buerk et al (^{21})</td>
<td>Case report, design not clearly described</td>
</tr>
<tr>
<td>Buhrer and Tilney (^{22})</td>
<td>Case report</td>
</tr>
<tr>
<td>Carlascio et al (^{23})</td>
<td>Case report, design not clearly described</td>
</tr>
<tr>
<td>Cassuto and Tarnow (^{24})</td>
<td>Case report, design not clearly described</td>
</tr>
<tr>
<td>Cocanour et al (^{25})</td>
<td>Case report, describing same type of incident as Bovender and Nates</td>
</tr>
<tr>
<td>Eckstein and Cowen (^{26})</td>
<td>Case report</td>
</tr>
<tr>
<td>Felix Jr (^{27})</td>
<td>Summarizes HEMS in USA in the early 1970s with a major incident case report</td>
</tr>
<tr>
<td>Franklin et al (^{28})</td>
<td>Case report</td>
</tr>
<tr>
<td>Furukawa (^{28})</td>
<td>Case report</td>
</tr>
<tr>
<td>Iselius (^{29})</td>
<td>Case report describing the same incident as Oestern</td>
</tr>
<tr>
<td>Jacobs et al (^{30})</td>
<td>Review of seven major incidents in one HEMS service describing the same incidents as Stohler</td>
</tr>
<tr>
<td>Lavery and Horan (^{31})</td>
<td>Case report</td>
</tr>
<tr>
<td>Lavon et al (^{32})</td>
<td>Two case reports</td>
</tr>
<tr>
<td>Leiba et al (^{33})</td>
<td>Case report describing the same incident as Lavon</td>
</tr>
</tbody>
</table>

Continued
be an issue in 18 reports (43%), and this was related to issues such as inadequate air traffic control, active shooters, inadequate landing sites and bad weather. HEMS tasks included patient evacuation and transport from scene as well as transport of supplies, personnel and equipment to the scene. The literature also described HEMS being used for secondary transport, treatment, leadership and on-scene triage. In addition, HEMS was

<table>
<thead>
<tr>
<th>Table 1 Continued</th>
<th>Method</th>
<th>Described use of HEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leiba et al&lt;sup&gt;64&lt;/sup&gt;</td>
<td>Case report describing the same incident as Assa. The DISAST-CIR methodology of reporting also used by Schwartz</td>
<td>Primary transport of injured to different hospitals ensuring that the closest hospital did not reach surge capacity</td>
</tr>
<tr>
<td>Lockey et al&lt;sup&gt;65&lt;/sup&gt;</td>
<td>Case report describing the same incident as Bland</td>
<td>Deployed staff and equipment to the scenes and staff from home to the hospitals. Allowed rapid deployment in difficult traffic conditions</td>
</tr>
<tr>
<td>Lyon and Sanders&lt;sup&gt;50&lt;/sup&gt;</td>
<td>Commentary of a case report</td>
<td>Brought pre-hospital doctors to the scene for medical incident command and advanced interventions. Transported the patients directly to specialist paediatric trauma centres</td>
</tr>
<tr>
<td>Malik et al&lt;sup&gt;47&lt;/sup&gt;</td>
<td>Observational study of scoring systems in a major incident in remote area</td>
<td>Transported personnel to the incident. Secondary transport of priority I patients to trauma centre</td>
</tr>
<tr>
<td>Martchenke et al&lt;sup&gt;48&lt;/sup&gt;</td>
<td>Case report, interviewing all participating HEMS members involved</td>
<td>Triage, treatment and transport of patients from earthquake</td>
</tr>
<tr>
<td>Martin&lt;sup&gt;51&lt;/sup&gt;</td>
<td>Case report</td>
<td>Helicopter and personnel present at event. Tasks not specified</td>
</tr>
<tr>
<td>Matsumoto et al&lt;sup&gt;49&lt;/sup&gt;</td>
<td>Case report</td>
<td>Mainly used for patient transportation and evacuation. Also transported food, water and generators to destroyed hospitals</td>
</tr>
<tr>
<td>Nates&lt;sup&gt;40&lt;/sup&gt;</td>
<td>Case report and review of literature. Describing same type of incident as Bovender and Cocanour</td>
<td>Transport of patients from damaged hospital, vital in evacuation because of damaged roads</td>
</tr>
<tr>
<td>Nia et al&lt;sup&gt;53&lt;/sup&gt;</td>
<td>Case report and survey of survivor’s opinions about health response</td>
<td>Evacuated injured from the earthquake zone and brought resources and equipment to affected area</td>
</tr>
<tr>
<td>Nicholas and Oberheide&lt;sup&gt;52&lt;/sup&gt;</td>
<td>Case report describing the same incident as Ammons</td>
<td>Transport from primary to secondary health care facility. Brought supplies to scene</td>
</tr>
<tr>
<td>Nocera and Dalton&lt;sup&gt;41&lt;/sup&gt;</td>
<td>Two case reports</td>
<td>Transport of experienced crew to the scene. Performed advanced life-saving procedures in one of the incidents</td>
</tr>
<tr>
<td>Oestern et al&lt;sup&gt;42&lt;/sup&gt;</td>
<td>Case report describing the same incident as Iselius</td>
<td>Transported patients to more remote hospitals</td>
</tr>
<tr>
<td>Pokorny&lt;sup&gt;43&lt;/sup&gt;</td>
<td>Case report</td>
<td>Evacuation of victims in flooded area, otherwise not specified.</td>
</tr>
<tr>
<td>Romundstad et al&lt;sup&gt;44&lt;/sup&gt;</td>
<td>Case report</td>
<td>Arriving HEMS doctor was appointed Medical Incident Commander and organized medical resources in teams. Transported some of the patients to more remote hospitals</td>
</tr>
<tr>
<td>Schwartz and Bar-Dayan&lt;sup&gt;45&lt;/sup&gt;</td>
<td>Case report presented in DISAST-CIR methodology for uniform presentation. Leiba 2009 used same methodology</td>
<td>Patient transport of the most seriously injured patients</td>
</tr>
<tr>
<td>Sollid et al&lt;sup&gt;46&lt;/sup&gt;</td>
<td>Case report</td>
<td>Flew out extra personnel and stretchers. Triaged and treated patients acted as medical incident commander and transported the most severely injured from one of the incident sites</td>
</tr>
<tr>
<td>Spano et al&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Case report</td>
<td>Brought personnel and equipment to site and evacuated the patients when weather allowed</td>
</tr>
<tr>
<td>Stohler et al&lt;sup&gt;6&lt;/sup&gt;</td>
<td>Retrospective review of four major incidents. Same incidents as Jacobs</td>
<td>The responses included bringing extra personnel and equipment to scene, triage, medical treatment, air surveillance and transport</td>
</tr>
<tr>
<td>Urquieta and Varon&lt;sup&gt;47&lt;/sup&gt;</td>
<td>Case report</td>
<td>Triage and transport of severely injured victims</td>
</tr>
<tr>
<td>Yi-Szu et al&lt;sup&gt;48&lt;/sup&gt;</td>
<td>Case report, analysing patterns and outcomes of patients with chest injuries</td>
<td>Secondary transport of patients from field hospitals in earthquake zone</td>
</tr>
</tbody>
</table>

in some incidents utilised for search and rescue, and for air surveillance (table 1).

Appraisal
We sought to identify data items related to internal and external validity. Of the included articles, 19 (45%) contained references to where the data were obtained. We found 5 articles (12%) that reported no conflicts of interests and 1 (2%) that reported a conflict of interests. No articles reported they had ethical approval, although 1 (2%) stated that such approval was not needed. The description of both the HEMS and EMS structure before the incident was described in 12 (29%), whereas 7 articles (17%) described HEMS alone. The incident itself was clearly described in 40 articles (95%). Study limitations were discussed in 5 (12%), and the study design was described in 32 articles (76%). The quality appraisal findings are shown in figure 3. The study methodology was as follows: Of the 42 included studies, 37 (88%) were case reports, 2 (5%) observational studies, 2 (5%) reviews and 1 (2%) was a summary of the use of HEMS combined with a case report (table 1).

DISCUSSION
This systematic literature review found little or no systematic reporting of the utilisation of HEMS in the early medical management of major incidents. HEMS were most often reported to be used in patient evacuation and transport from the scene, and in transport of supplies and personnel to the incident scene (table 1). Data relevant to depict internal and external validity, such as reference to data source and handling of missing data, were lacking (figure 3). Further, the heterogeneity of the literature and the overall weak methodological design made it difficult to evaluate the contribution of HEMS to the management of major incidents.

The included incidents had various logistical and geographical challenges. In the 7/7 London terrorist bombings in 2005, a helicopter was used to deploy staff and equipment to urban scenes when road access was difficult. Use of a helicopter also allowed the deployment of staff from home at a time when public transportation was inaccessible in the city. In the 22/7 Utøya terrorist shootings in 2011, additional medical personnel were brought to the scene, which this time was a rural area with overloaded provincial roads. Other studies described how HEMS facilitated the transport of victims to the hospital, especially when the scene of the incident was difficult to access. HEMS also helped in secondary transfers of patients with particular needs, such as transporting patients to dedicated burns units. Although scene safety remains a foremost priority in major incident management, this was discussed in less than half of the studies. The inability to fly due to bad weather and the lack of designated landing sites were described as operational hazards. Further, HEMS involvement in major incident management often

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Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).


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involved multiple aircraft operating in uncontrolled airspace, indicating insufficient air traffic control. Future improvements in aviation traffic awareness systems, navigation, and traffic control may mitigate the aviation risks. However, the emphasis should be on implementing procedures for multiple aircraft operations in uncontrolled airspace. Crew training may also reduce the risk.
The heterogeneous nature of major incidents is reflected by the lack of a common nomenclature. Several definitions of a major incident have been proposed that differ slightly from each other. To avoid excluding relevant articles, literature that defined their incident as a major incident or disaster was included.

<table>
<thead>
<tr>
<th>Table 2 continued</th>
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<tbody>
<tr>
<td>How was the major incident declared?</td>
</tr>
<tr>
<td>The timeline for the medical response</td>
</tr>
<tr>
<td>Who participated – personnel (health, fire, police, military, voluntary organizations)</td>
</tr>
<tr>
<td>Who participated – transport</td>
</tr>
<tr>
<td>What tasks did they perform?</td>
</tr>
<tr>
<td>Which prehospital resources were lacking?</td>
</tr>
<tr>
<td>Prehospital surge capacity</td>
</tr>
<tr>
<td>HEMS: number of crews</td>
</tr>
<tr>
<td>Estimated arrival time from alarm</td>
</tr>
<tr>
<td>Information received</td>
</tr>
<tr>
<td>Bring extra crew</td>
</tr>
<tr>
<td>Extra equipment</td>
</tr>
<tr>
<td>Number of patients transported by HEMS</td>
</tr>
<tr>
<td>Which hospitals received patients?</td>
</tr>
<tr>
<td>Did HEMS have other responsibilities?</td>
</tr>
<tr>
<td>Did HEMS have other tasks?</td>
</tr>
<tr>
<td>Communication and coordination described</td>
</tr>
<tr>
<td>Scene safety described</td>
</tr>
<tr>
<td>Other incident response data described</td>
</tr>
</tbody>
</table>
Our findings emphasise that a universally accepted definition of major incident is needed to facilitate comparative studies and to improve the accuracy of database indexing.

Our appraisal found that the majority of the included articles provided detailed descriptions of the incidents but that there was a tendency towards inadequate descriptions of the everyday HEMS system. The lack of
baseline data made it difficult to evaluate the deployment and utilisation of extraordinary resources during major incidents. The methodological designs were generally weak and dominated by retrospective observational case reports. This is not surprising considering the difficulties in planning and executing prospective studies on major incidents. With an established template of standardised variables, a prospective study design can, however, be established to collect data from major incidents. If similar data are collected from major incident exercises in similar systems, a case–control design can even be applied to future studies. Such studies can be further strengthened by including other data sources such as focus group interviews from involved personnel in the sense of method triangulation.\textsuperscript{59} \textsuperscript{60} We also found that some incidents were described by several reports, indicating possible skewness in the literature regarding high-profile incidents. As with all unstructured reporting, establishing a denominator for HEMS involvement proved difficult, again highlighting that future research should build on systematically collected data with uniform variable definitions to allow better comparisons.\textsuperscript{61}

Limitations
The authors selected items for use in data extraction and appraisal that they assumed were relevant. However, these items do not represent a reference standard, since such a standard does not exist, to our knowledge.

Many major incidents occur in non-English-speaking countries; accordingly, it is a weakness that only articles in English and the Nordic languages were included. However, the included articles described incidents on different continents, which improve the generalisability of the findings. Further, we may have failed to identify some relevant studies, since articles without abstracts were not included, and a single author performed the initial screening.

Conclusion
This systematic literature review identified, described and appraised the literature on the utilisation of HEMS in the early medical management of major incidents. Heterogeneous data reporting complicated our efforts to identify and evaluate the overall utilisation of HEMS in such incidents. To address such shortcomings, systematic uniform reporting of HEMS in major incidents is called for.

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Contributors ASJ and MR conceived the study. ASJ, MR, SJMS and SF took part in study design, data analysis and writing of the manuscript, and approved the final version of the manuscript.

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Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

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REFERENCES
51. Nocera A. Australian major incident nomenclature: it may be a ‘disaster’ but in an ‘emergency’ it is just a mess. *ANZ J Surg* 2001;71:162–6.
Additional file I; Search strategy.

Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1950 to Present

1 Air Ambulances/
2 helicopter*.ti,ab.
3 hems*.ti,ab.
4 (air* adj ambulance*).ti,ab.
5 (medical adj1 air*).ti,ab.
6 aeromedical.ti,ab.
7 (aeromedical*.ti,ab.
8 rotorcraft*.ti,ab.
9 rotor wing*.ti,ab.
10 helipad*.ti,ab.
11 or/1-10
12 Mass Casualty Incidents/
13 mci.ti,ab.
14 (casualt* or accident* or calamit* or fatalit* or catastroph* or traum* or polytrauma or injur* or disaster* or triage* or terror*).ti.
15 ((mass* or major or multiple or complex) adj1 (incident* or emergen*))ti.
16 ((mass* or major or multiple or complex) adj1 (casualt* or calamit* or fatalit* or catastroph* or disaster* or incident*)).ab.
17 Triage/
18 exp Disasters/
19 Disaster Planning/
20 Disaster Medicine/
21 exp Terrorism/
22 Rescue Work/
23 Crime/
24 exp Homicide/
25 exp War/
26 Violence/
27 exp "Wounds and Injuries"/
28 exp Accidents/
29 exp Environmental Pollutants/po
30 Traumatology/
31 Trauma Centers/
32 Advanced Trauma Life Support Care/
33 exp Trauma Severity Indices/
34 or/12-33
35 11 and 34
36 limit 35 to (danish or english or norwegian or swedish)

Embase Classic+Embase 1950 to present

1 Helicopter/
2 Helicopter Pilot/
3 Air Medical Transport/
4 helicopter*.ti,ab.
5 hems*.ti,ab.
6 (air* adj ambulance*).ti,ab.
7 (medical adj1 air*).ti,ab.
8 aeromedical.ti,ab.
9 aero-medical*.ti,ab.
10 rotorcraft*.ti,ab.
11 rotor wing*.ti,ab.
12 helipad*.ti,ab.
13 or/1-12
14 Mass disaster/
15 mci.ti,ab.
16 (casualt* or accident* or calamit* or fatalit* or catastroph* or traum* or polytraum* or injur* or disaster* or triage* or terror*).ti.
17 ((mass* or major or multiple or complex) adj1 (incident* or emergen*)).ti.
18 ((mass* or major or multiple or complex) adj1 (casualt* or calamit* or fatalit* or catastroph* or disaster* or incident*)).ab.
19 exp *Disaster/
20 *Disaster Planning/
21 *Disaster Medicine/
22 *Terrorism/
23 exp *Crime/
24 exp *Violence/
25 *War/
26 *Injury/
27 *Accident/
28 or/14-27
29 13 and 28
30 limit 29 to (danish or english or norwegian or swedish)

Cochrane Library (including The Cochrane Central Register of Controlled Trials (CENTRAL))
#1 helicopter* or hems* or (air* next ambulance*) or (medical near air*) or
aeromedical or aero-medical* or rotorcraft* or (rotor next wing*) or helipad*:ti,ab,kw
#2 casualt* or accident* or calamit* or fatalit* or catastroph* or traum* or polytrauma
or injur* or disaster* or triage* or terror*:ti
#3 ((mass* or major or multiple or complex) near (incident* or emergen*)):ti
#4 ((mass* or major or multiple or complex) near (casualt* or calamit* or fatalit* or
catastroph* or disaster* or incident*)):ti,ab,kw
#5 #2 or #3 or #4
#6 #1 and #5
Additional file II: Excluded articles with reason.

Describes helicopter used for evacuation, not use of HEMS.

Describes fixed wing, not HEMS.

Review of aircraft accidents.

Mathematical model of use of HEMS in MI, does not describe use of HEMS in MI.

System description, not real MI.


No HEMS described, only fixed wing evacuation.


System description, not real MI.


Describes airport system, not real MI.


System description, not real MI.


Describes the role of HEMS in simulated MI.


Military aeromedical teams.


Medevac described, not directly involved in the MI.


Describes patterns and HEMS operations, no real MI described.


Describes use of HEMS 4 months after MI.


Conference proceedings / review.


Describes theoretical model, no real MI described.


Describes fixed wing, not HEMS.

Describes military Medevac.


Describes military scenario not role of HEMS.


Describes fixed wing transport shortly after MI.


Does not describe HEMS, only helicopter use in MI.


System description, not real MI.


Questionnaire: should medical teams be sent to major incidents. No description of HEMS in MI.

Describes media, not HEMS in MI.


Planning, not HEMS in real MI.


Describes fixed wing, not HEMS.


System description, not real MI.


Secondary transport.

System description and simulation, no real MI.


System description, not real MI.


System description and simulation, no real MI, conference abstract.


Describes helicopters, but not HEMS in MI.


Describe transfer of neonates in a disaster, but no use of HEMS.


Model design / review, no real MI.

Describes fixed wing, not HEMS.


Aeromedical evacuation, no HEMS.


Aeromedical evacuation with ad hoc medical teams, no HEMS.


Describes fixed wing, not HEMS.


Describes helicopter, but not HEMS in MI.

Theoretical response, no real MI.


Theoretical response, no real MI.


Planning, not HEMS in real MI.


Secondary transport, not directly involved in MI.

Planning, not HEMS in real MI.


Describes fixed wing, not HEMS.


Does not describe HEMS dedicated operation.


Military


Describes helicopters, but not HEMS in MI.


Conference abstract, HEMS mentioned, but not described.

Military


No description of HEMS, only secondary helicopter transport.


Review, no HEMS in real MI.


MI in war


MI in war

MI in war


System description, not real MI.