Comparative Review on the Cost-Effectiveness Analysis of Relief Teams' Deployment to Sudden-Onset Disasters

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**PREHOSPITAL and
DISASTER MEDICINE**

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**COMPARATIVE REVIEW ON THE COST-EFFECTIVENESS
ANALYSIS OF RELIEF TEAMS DEPLOYMENT TO SUDDEN
ONSET DISASTERS**

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ABSTRACT

When a disaster exceeds the capacity of the affected country to cope with its own resources, the provision of external rescue and health services is required, and the deployment of relief units requested. Recently, the cost of international relief and the belief that such deployment is cost-effective has been questioned by the international community; unfortunately, there is still little informed debate and few detailed data are available. This paper presents the results of a comparative review on the cost-effectiveness analysis of Search and Rescue (SAR) and Emergency Medical Team (EMT) deployment. The aim of this work is to provide an overview of the topic, highlights the criteria used to assess the effectiveness and identify gaps in existing literature. The results show that both deployments are highly expensive, and their success is strongly related to the time they need to be operational; SAR deployments are characterized by limited outcomes in terms of lives saved, and EMTs by insufficient data and lack of detailed assessment. This research highlights that the criteria used to assess the effectiveness need to be explored further, considering different purposes, lengths of stay, and different activities performed especially for any comparison. This study concludes that data reporting should be mandatory for humanitarian response agencies.

KEYWORDS

Comparative Review, Cost-Effectiveness Analysis, Search and Rescue, Emergency Medical Team, International Deployment

21 LIST OF ABBREVIATIONS

22	SAR	Search And Rescue
23	USAR	Urban Search And Rescue
24	EMT	Emergency Medical Team
25	NGO	Non-Governmental Organization
26	CEA	Cost-Effective Analysis
27	INSARAG	International SAR Advisory Group
28	FFH	Foreign Field Hospital
29	AMP	Advance Medical Post
30	FMT	Foreign Medical Team
31	WHO	World Health Organization
32	SOD	Sudden Onset Disaster
33	IEMT	International Emergency Medical Team
34		

35 INTRODUCTION

36 Natural disasters cause sudden health and social impacts upon populations with deaths and
 37 injuries, damage to critical infrastructure, damage to health facilities, disruption of transportation
 38 networks and of communication systems ^{1,2}. Earthquakes, in particular, are disasters that result in
 39 the structural collapse of buildings which can entrap the occupants of the building ^{3,4} under
 40 complex, heavy structural debris, and rescue requires complex technical intervention.
 41 Earthquakes often result in a massive need for medical care and health assistance; often
 42 hospitals and health facilities are damaged or destroyed by the earthquake and are therefore not
 43 able to adequately address health care needs due to the loss of functionality ⁵.
 44 When disasters exceed the capacity of the affected country to cope within its own resources,
 45 assistance from external sources is required and typically requested ⁶. The provision of
 46 international disaster relief, including Search and Rescue (SAR) teams and Emergency Medical
 47 Teams (EMTs) can be an essential support to the affected country. SAR activities involve the

48 location, extrication, and initial medical treatment of victims trapped in structural collapse ³. The
49 goal of SAR operations is to rescue the greatest number of trapped people in the shortest amount
50 of time, while minimizing the risk to rescuers ⁷. EMTs are groups of health professionals
51 (doctors, nurses, paramedics etc.) coming from governments, militaries, charities (NGOs), and
52 international organizations whose goal is to provide treatment to patients affected by an
53 emergency or disaster.

54 Recently, the cost of international relief and the assumption that these deployments are cost-
55 effective have been questioned by many authors and agencies. De Ville de Goyet and colleagues
56 ⁸ commented that deploying a relief team to a disaster is an easy decision for donor countries and
57 it is usually a quick answer that meets an urgent need recognized by the donor public and media.
58 He continues by affirming that the international community is eager to demonstrate its solidarity,
59 exercise its “right of humanitarian intervention” and undertake its own relief effort on the basis
60 that local health services are unable or unwilling to respond adequately. This usually results in
61 large flows of teams and supplies that do not necessarily match the needs of the affected country
62 and potentially create problems with the coordination of the relief activities. Providing
63 humanitarian assistance is a highly emotional, and therefore political, undertaking but many
64 international agencies are starting to re-think the deployment strategy ⁹.

65 Cost benefit analyses of SAR deployments exist but are rarely part of the decision process when
66 there is a need to save life. The acceptable costs for disaster response have rarely been
67 scientifically explored sufficiently even though this is crucial to real-world pre-disaster
68 preparedness and post-disaster response planning ¹⁰. Despite the economic importance of this
69 subject, there is still little debate and published data. Most of the available information comes

from general research and scientific analysis in different fields, each of them with a different focus ⁴.

This paper presents the results of comparative review on the cost-effectiveness of SAR and EMT deployment. A comparative scoping literature review was performed, selecting and summarizing current knowledge from existing research papers and reports. Results of the search have been used to map concepts and identify gaps in existing literature with the objective of suggesting how to improve the evaluation of outcomes and inform the decision to deploy a relief team for the future.

METHODOLOGY

A scoping literature review was carried out to provide an overview of the topic, highlights the criteria used to assess the effectiveness and identify gaps in research related to relief teams' deployment, searching, selecting and synthesizing existing knowledge. As described by Arksey & O'Malley ¹¹, this methodology aims to: i) examine the extent, range, and nature of research activity especially when is difficult to visualize the range of material that might be available; ii) summarize and disseminate research findings to policy makers, practitioners, and consumers and iii) identify gaps in the existing evidence base, followed by conclusions around the current overall state of the research activity in the area.

The identification of researches from the scientific literature was performed through PubMed, Scopus and Google Scholar search engines; Google Scholar, in particular, provides full texts of scientific literature and research across different publishing formats ^{12,13}. For this paper, peer-reviewed online academic journals and books, conference papers, theses and dissertations, working documents, and technical reports from both national and international organizations

were analysed. The review firstly involved a primary search using keywords followed by a grey literature search; finally, a hand search was undertaken of the bibliographies of analyzed papers (see Tab.1).

INSERT TABLE 1 HERE

To enrich the search, a discussion was undertaken with authors and stakeholders to acquire further sources, references and insights; practitioners involved in the response to the Nepal Earthquake in 2015 most recently involved and international responders were contacted. The review was focused on English language literature, with references not written in English excluded, using each of the following keywords: 1) Search and Rescue (SAR); 2) Cost-Effectiveness Analysis (CEA); 3) cost; 4) International SAR Advisory Group (INSARAG); 5) disaster and 6) Emergency Medical Team (EMT). Titles and documents containing those words, or combinations of them, were reviewed to collect information about cost effectiveness of SAR and EMT. With respect to the review of EMTs, the research was extended to consider the former definitions of medical teams such as: 1) Foreign Field Hospital (FFH); 2) Advanced Medical Post (AMP) and 3) Foreign Medical Team (FMT). Citations from the hand search have to be complete while inaccurate references were not included. All publication dates were considered, with special attention paid to papers published after the two WHO official classifications in 1998 for SAR and in 2013 for EMTs. Papers before those dates have been used to assess changes in response and to evaluate improvement (for criteria of inclusion see Table 2).

INSERT TABLE 2 HERE

116

117 Selected studies have been analyzed to gather information about costs and/or effectiveness of
118 SAR and/or EMT deployment, with special attention paid to works that provide a comparative
119 discussion on the cost-effectiveness in disaster, particularly Sudden Onset Disasters (SODs);
120 other deployments, such as conflicts, were not included.

121

122 **RESULTS**

123 A total of 7823 studies were found; 7769 records were excluded after reviewing the title and
124 duplicate removal. 54 records meeting the criteria were identified. 28 works met all the criteria
125 of the research on cost-effectiveness. Table 3 provides a list of the papers selected after the
126 review.

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INSERT TABLE 3 HERE

COST AND EFFECTIVENESS
SAR

Despite commonly beliefs, survivors in the immediate aftermath of a disaster react with solidarity and tend help each other ^{14–16}. The first rescue efforts are usually performed by survivors and by the local response assets ^{1,14,17–19}; the majority of survivors are found and extricated quickly because they are usually “lightly trapped” ^{19,20} while a significant number of earthquake victims remain “heavily” trapped under rubble requiring a heavy rescue response ²⁰. According to Statheropoulos et al. ²¹, SAR response is technically demanding and time consuming; SAR success in operations, in fact, involves the advance purchase, operational integration and deployment of best available technologies ²² that makes the task-force highly expensive.

Detailed information about USAR funding is not always available. According to the Congressional Research Service ⁹, the USA USAR task force, as part of the federal emergency network response, was funded with US\$28 million in FY 2011 and US\$32.5 million in FY 2010. This was due mostly to the perceived successful efforts in Haiti in early 2010 and the growing support for a SAR team for domestic and international crisis. In the USA, a USAR team costs between US\$1.8 - US\$2.2 million per year to maintain ²³. According to the Humanitarian Emergency Response Review (HERR) ²⁴, the UK ISAR teams cost spent £250,000 per life saved in Haiti, the UK surgical teams about one hundredth of this (a little over £2,500) per life saved. The HERR suggests that there should be an intelligent deployment decision process. The UK’s main costs lie in maintaining equipment and personnel training at an effective readiness level

with a 24/7 deployable capacity. The reported budget does not cover actual deployment costs, which are met from separate government program funds for each specific response²⁵. Neither does the cost include the salary related costs of the UK Fire and Rescue Service personnel which are met by their individual services.

Time is crucial in SAR operations; sophisticated and costly technology is required to minimize the time to intervention and the sooner a victim is found, the higher the possibility for him/her to survive^{4,20,22}. SAR activities are effective when done in the first hours after an event and the survival rate of trapped victims plunges dramatically over time²⁶ and after several days of searching, SAR teams typically find no additional survivors¹⁷.

As reported by Macintyre et al.²⁰, the majority of rescues (90%) occur within the first 24 hours, with the last survivor rescue usually four days post-impact. A dramatic drop-off occurs in during the first 24-48 hour post-earthquake²⁷. Rescue activities can last for days; according to Macintyre et al.²⁰, the average maximum time reported in their studies was 6.8 days with the longest time to rescue of 19 days. Comparison between and the analysis of past events, the Armenia earthquake in 1988¹⁹ and the Nepal Earthquake in 2015²⁸ confirms that, despite progressive improvement in coordination and better technologies, the effectiveness of SAR teams has not increased.

Despite the significant cost associated with the deployment of an ISAR team, there is still a lack of detailed information about the issues; for example, most of the existing data refer to a non-itemized total budget, and most of the papers provide the total number of people extracted from the rubble using the criteria “lives saved” rather than a distinction between people saved by ISAR and those saved by locals.

The debate around the effectiveness of SAR introduces a delicate ethical issue; despite the high cost of their deployment, in most societies every possible effort is taken to save life²⁰ and teams are requested to operate until the last person has been saved. The risk of abandoning a potential survivor deeply entrapped under rubble usually extends the activities of SAR many days after the last “save”²⁰. More, one of the most valuable service provided by highly-qualified urban search-and-rescue teams is not necessarily finding survivors, but rather using the sophisticated structural assessment, advanced search capabilities and specialized medical judgment to assist the local leaders in limiting the period that focuses primarily on the possibility of trapped survivors. The extension of this search phase has an impact on response priorities; as long as the possibility of finding survivors exists, the response efforts and the attention of the affected community remain focused on SAR even though this diverts efforts and resources away from the management of the disaster and other post disaster issues²⁰. This must be considered as part of the judgement required from some who suggest that international urban search and rescue teams are never needed since local personnel, using simple equipment, make the majority of earthquake rescues within 24 hours²⁹.

EMT

In the immediate aftermath of a disaster, authorities need to meet extraordinary treatment and rehabilitation demands with resources that have been drained by the wider emergency response⁸. Von Schreeb et al.³⁰ reported the estimated cost per bed per day in US dollars during different disasters, such as the Bam Earthquake (1750 US\$/bed/day) and the Kashmir earthquake (2250 US\$/bed/day).

As noticed by de Ville de Goyet⁸, the cost of mobilizing a field hospital for few weeks often exceeds US\$1 million and suggests that the funds could be more productively used in the

construction and equipping of simple but sturdy temporary facilities. In the case of the Bam earthquake, the cost of rebuilding the entire primary and secondary health facilities and teaching institution was estimated at around US\$10.5 million, the same spent on the dispatch of 12 field hospitals from the international community. According to Peleg and Kellerman ³¹ the cost of deploying a medium-size urban search and rescue mission is roughly equivalent to those of an EMT type 1. The authors added that a heavy ISAR costs approximately US\$900,000 to deploy, whilst the Israeli Defence Force spent US\$1.7 million on its EMT type 3 in Haiti.

As with SAR, EMT effectiveness is strongly dependent on the time of arrival. Aoki et al. ¹⁰ analyzed 4,786 cases after the Kobe earthquake and found that 76.6% of those who lost their lives died within an hour. Furthermore, they found that 36% of injured victims who died between three and 12 hours after the earthquake might have been saved if the appropriate initial emergency response had been available. Foreign mobile hospital and medical teams rarely arrive promptly in the immediate aftermath of a disaster, usually not in time for immediate trauma care ^{1,2,32,33}. De Ville de Goyet et al. ⁸ also noticed that in Banda Aceh, Indonesia, after the 2004 tsunami, victims were eager to return to normality while external medical relief workers were still arriving in large numbers.

The published literature suggests three days to be the average time for an EMT to arrive and become operational into the affected country ³⁴. The challenge is not just to save the lives of the trauma victims, but to re-establish a level of routine health care for a population living under temporary shelters ¹. In the aftermath of a SOD historically, medical response has been focused on providing emergency trauma care for the first 48 hours following the event, whilst they tend to be operational much later and treat a different range of problems. The deployment of EMTs

218 should perhaps be oriented toward supporting or substituting for a pre-existing but damaged
219 hospital or health facility rather than on providing immediate trauma care ³⁰.

220 As for SAR deployments, there is a lack of detailed published information about cost-
221 effectiveness of EMTs. In particular, the paucity of collection, management and reporting data
222 results in incomplete and largely qualitative research ³⁵. Most reports are narratives of the
223 activities performed by EMTs during recent disasters ^{18,32}, and few detail the cost and outcomes
224 ^{1,30}. Many papers report the impossibility to describe the outcome of the EMT activities and the
225 tendency of facilities and agencies not to respond to request for detail on their activities ^{33,36}.

226 In addition, the literature usually reports only the total number of interventions ³⁶ making it
227 possible to create a timeline and define the phases of the medical response interventions. With
228 such lack of data, it is challenging to estimate and assess the outcome, the quality and potential
229 patient benefit for improvements from medical interventions. Gerdin et al. ³³ suggest that the
230 huge medical response to a disaster is inadequately documented and, despite the challenging
231 circumstances of their deployment, international agencies should be held accountable for the
232 services they provide.

233 Disasters are characterized by a highly emotional and sensationalized climate that has prevented
234 the adoption of a cost-effectiveness pragmatic approach to decision making ⁸. When survival of
235 both people and political institutions are threatened, perceptions and visibility tend to prevail
236 over facts and analysis, resulting in a lack of evidence-based decision based upon cost/benefit
237 considerations.

238 The political benefit of sending an EMT should not be underestimated ³³ and usually there are
239 additional indirect drivers that trigger the deployment. After the Haiti earthquake, at least five

(11%) FFH stayed for a very short time, three for just a single week, and the cost effectiveness and medical value of such a short intervention is debatable.

DISCUSSION

The analysis shows that both SAR and EMT deployment are very expensive and that the effectiveness of both teams is strongly dependent upon the time of arrival. The value of SAR is dependent upon the time of arrival before the maximum time of surviving; unfortunately, most foreign rescue teams arrive late, when they travel over long distances, and their output in terms of people saved remains low.

A similar argument is advanced for the EMTs that rarely arrives within 48h and by which time many patients will have already died from their injuries or been evacuated to other facilities. The team focusing on immediate trauma care will arrive too late and find that they are caring for relatively minor injuries and for health problems not directly related to the disaster. EMT effectiveness is directly related to the ability to answer the needs of the population.

The literature on cost-effectiveness is based on an analysis of the ratio of lives saved divided by cost of deployment. The concepts described in this paper show that there are consistent differences, such as the different purpose, length of stay, and different activities performed, that make the use of the same criterion to make a comparison between the two deployments too simplistic. SAR, in fact, includes people extracted from the rubble, bodies recovered and structural assessment, but it is difficult to quantify the effect simply on lives saved since this outcome also requires local health system activity or the support of an EMT. On the other hand, the assessment of the effectiveness of an EMT is more complicated; the role of the medical team is not limited in time in the same way. They can stay longer but one of their primary functions is

263 to support the local health system in providing wider medical care, particularly when the native
264 health system is heavily damaged. The criteria used to define effectiveness, particularly
265 considering their limitations, have been considered and found wanting. The researchers have
266 argued that there is a need to create a different way of considering cost-effectiveness. The
267 concept of comparison by “lives saved” is inappropriate; cost-effectiveness, the balancing of
268 spending on disaster resilience and the capacity building against post-incident response have
269 rarely been studied and compared, even though this plays a pivotal role in the ultimate outcome
270 from a disaster.

271 Specific data on outcomes from medical activities are rare, often incomplete and hard to analyze.
272 There is a need to agree a framework and core dataset for the assessment of medical
273 effectiveness, perhaps focusing on the number of people treated and the types of conditions
274 instead of the “lives saved”.

275 Despite the importance of this topic, international discussion is still limited, and few data are
276 available to objectively describe the outcome of the presence of EMTs. Almost all the authors
277 from the search ^{1,17,19,23,30,33,36} agree that this lack of appropriate information results in an
278 ineffective and wasteful relief response and, in the recent decades, not enough has been done to
279 improve preparedness and response programs based on lessons identified from reviewing
280 responses to previous earthquakes.

281 As De Ville De Goyet et al. ⁸ report, the tendency of the international community to show
282 solidarity and exercise the “right of humanitarian intervention“ often leads to mistakes and errors
283 in management. In many cases this is due to an underestimation of the local capacity to respond.
284 This error, with the accompanying disregard for the cost-effectiveness of the approach,
285 contributes to making disaster relief one of the least cost-effective health activities. As Glassey ³⁷

suggests, the cost of the deployment could save more lives if allocated pre-event to disaster risk reduction and mitigation programs.

International humanitarian response of every type should be subject to post-assessment critical analysis, including comparison between outcomes and costs, and using standardized and agreed criteria. The evaluation should also consider different deployment approaches, including the decision not to send a team for the immediate response or perhaps the deployment of a late and differently skilled team with a focus on general medical care and rehabilitation rather than on immediate trauma care.

Some of the literature presents proposals on how to improve the general effectiveness of deployment and so, indirectly, cost. One common theme is to enhance the education and resilience of local resources, with a focus on the first responders. Local and neighboring facilities are the best placed to provide immediate health care ¹ and each improvement in coordination and organizational capacity can be essential.

Local authorities and available resources, particularly neighboring hospital facilities, are typically not sufficiently considered by international responding agencies, while building the local coping capacity is one of the most cost-effective measures to improve the quality of the national response and the external interventions ¹.

This study has some limitations; the authors selected the most relevant literature found but limitations potentially exist due to the scarcity of directly relevant publications. Among the works considered, only a few studies presented detailed costs, budget, organized dataset, and evidence-based analysis.

Some concepts were only briefly explained within the papers and there is a potential inconsistency in language complicating comparison. Some documents were narrative, qualitative

research or were based upon interviews sector experts and after mission reports. Several authors stressed the problem of data gathering with agencies rarely responding to requests to share data^{33,35,36}.

CONCLUSION

The literature and evidence-based research analyses, showed that international SAR and EMT deployments are very expensive. ISAR is characterized by few lives saved, largely due to the response time, the long-distance travel and relatively late arrival in the disaster area. EMT evaluation is hampered by a lack of detailed clinical information being gathered and made available. Studies have demonstrated the difficulties in evaluating a response due to the lack of reliable data and the tendency of responding agencies to not share internal reports and records. Important lessons have been identified from previous disaster responses. The assumption that receiving a great number of relief items always results in a more effective response is false; humanitarian assistance should not be sent *a priori*, rather it should be the last option only where the affected country does not have the capacity to absorb and recover itself. Before requesting the deployment of an international team, the host nation and international community should undertake a rapid assessment and assess the specific need. Local resources should be used, and local response plans implemented, supported by the regional and international systems. Increasing local adaptive and absorptive capacity is perhaps the most cost-effective way for the affected Government to meet their responsibility. This review has helped to identify specific research questions that need to be answered. Firstly, the criteria for SAR and EMT cost-effectiveness assessment need to be improved to consider all the outcomes of the two deployments. Secondly, this paper underlines the need to have a

mandatory data recording strategy for all the agencies that take part in relief efforts and support the concepts of cost-effectiveness and accountability.

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341 **REFERENCES**

- 342 1. de Ville de Goyet C. Health lessons learned from the recent earthquakes and Tsunami in
343 Asia. *Prehosp Disaster Med.* 2007;22(1):15-21. doi:10.1017/S1049023X00004283.
- 344 2. Henderson AK, Lillibridge SR, Salinas C, Graves RW, Roth PB, Noji EK. Disaster
345 medical assistance teams: providing health care to a community struck by Hurricane Iniki.
346 *Ann Emerg Med.* 1994;23(4):726-730. doi:10.1016/S0196-0644(94)70306-X.
- 347 3. Cone DC. Rescue from the rubble: Urban search & rescue. *Prehospital Emerg Care.*
348 2000;4(4):352-357. doi:http://doi.org/.
- 349 4. Morris B. Preparedness required for ensuring best coordinated use of international urban
350 search and rescue assistance by earthquake affected countries. 2007.
- 351 5. Government of Nepal. Nepal Earthquake 2015: Post Disaster Needs Assessment. 2015:1-
352 134.
- 353 6. UNISDR. 2009 UNISDR Terminology on Disaster Risk Reduction. *Int Strat Disaster*
354 *Reduct.* 2009:1-30. doi:978-600-6937-11-3.
- 355 7. OCHA. INSARAG Guidelines. 2016;I:26.
- 356 8. De Ville De Goyet C, Marti RZ, Osorio C. Natural Disaster Mitigation and Relief. *Dis*
357 *Control Priorities Dev Ctries.* 2003;000(Ifr):1147-1162.
- 358 9. Bea K. Urban Search and Rescue Task Forces : Facts and Issues. *Growth (Lakeland).*
359 2010.
- 360 10. Aoki N, Nishimura A, Pretto EA, Sugimoto K, Beck JR, Fukui T. SURVIVAL AND
361 COST ANALYSIS OF FATALITIES OF THE KOBE EARTHQUAKE IN JAPAN.
362 *Prehospital Emerg Care.* 2004;8(2):217-222. doi:10.1080/312703004386.
- 363 11. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc*

- 364 *Res Methodol.* 2005;8(1):19-32. doi:10.1080/1364557032000119616.
- 365 12. Tober M. PubMed, ScienceDirect, Scopus or Google Scholar - Which is the best search
366 engine for an effective literature research in laser medicine? *Med Laser Appl.*
367 2011;26(3):139-144. doi:10.1016/j.mla.2011.05.006.
- 368 13. Mikki S. Google Scholar compared to Web of Science. A Literature Review. *Nord J Inf*
369 *Lit High Educ.* 2009;1(1):41-51. doi:10.15845/noril.v1i1.10.
- 370 14. Auf der Heide E. The importance of evidence-based disaster planning. *Ann Emerg Med.*
371 2006;47(1):34-49. doi:10.1016/j.annemergmed.2005.05.009.
- 372 15. Quarantelli EL. Conventional Beliefs and Counterintuitive Realities. *Soc Res (New York).*
373 2008;75(3):873-905.
- 374 16. Bartolucci A, Magni M. Survivors' Solidarity and Attachment in the Immediate Aftermath
375 of the Typhoon Haiyan (Philippines). *PLOS Curr Disasters.* 2017.
376 doi:10.1371/CURRENTS.DIS.2FBD11BD4C97D74FD07882A6D50EABF2.
- 377 17. Peleg K, Kellermann AL. Medical relief after earthquakes: It's time for a new paradigm.
378 *Ann Emerg Med.* 2012;59(3):188-190. doi:10.1016/j.annemergmed.2011.07.028.
- 379 18. Abolghasemi H, Radfar MH, Khatami M, Nia MS, Amid A, Briggs SM. International
380 medical response to a natural disaster: lessons learned from the Bam earthquake
381 experience. *Prehosp Disaster Med.* 2006;21(3):141-147.
- 382 19. Noji EK, Armenian HK, Oganessian A. Issues of rescue and medical care following the
383 1988 armenian earthquake. *Int J Epidemiol.* 1993;22(6):1070-1076.
384 doi:10.1093/ije/22.6.1070.
- 385 20. Macintyre AG, Barbera J a, Smith ER. Surviving collapsed structure entrapment after
386 earthquakes: a "time-to-rescue" analysis. *Prehosp Disaster Med.* 2006;21(1):4-17;

- discussion 18-9.
21. Statheropoulos M, Agapiou A, Pallis GC, et al. Factors that affect rescue time in urban search and rescue (USAR) operations. *Nat Hazards*. 2015;75(1):57-69. doi:10.1007/s11069-014-1304-3.
22. Statheropoulos M, Agapiou A, Pallis GC, et al. Factors that affect rescue time in urban search and rescue (USAR) operations. *Nat Hazards*. 2015;75(1):57-69. doi:10.1007/s11069-014-1304-3.
23. Alexander D. The Costs of Relief in International Disasters. 2011:1-19.
24. Ashdown L (Paddy). Humanitarian Emergency Response Review. *Humanit Emergencies*. 2011;(March):58.
25. DFID. United Kingdom International Search and Rescue (UK ISAR) Deployment Support Programme for Emergency Response Operations Overseas (2012 - 2015). 2015.
26. Bartels SA, Vanrooyen MJ. Medical complications associated with earthquakes. *Lancet*. 2012;379(9817):748-757. doi:10.1016/S0140-6736(11)60887-8.
27. Barbera JA, Cadoux CG. Search, rescue, and evacuation. *Crit Care Clin*. 1991;7(2):321-337.
28. Okita Y, Katsube T. Coordination of International Urban Search and Rescue (USAR) Teams in the 2015 Nepal Earthquake : “ Disaster Literacy ” for International USAR. 2016;16(7):24-36.
29. de Ville de Goyet C. Stop propagating disaster myths. *Aust J Emerg Manag*. 1999;14(4):26-28. doi:10.1016/S0140-6736(00)02642-8.
30. von Schreeb J, Riddez L, Samnegård H RH. Foreign field hospitals in the recent sudden-onset disasters in Iran, Haiti, Indonesia, and Pakistan. *Prehosp Disaster Med*.

2008;23(2):144-151; discussion 152-153. doi:10.1017/S1049023X00005768.

31. Peleg K, Kellermann AL. Medical Relief After Earthquakes : It ' s Time for a New Paradigm. *YMEM*. 2012;59(3):188-190. doi:10.1016/j.annemergmed.2011.07.028.
32. Care H, May JP, Joseph P, Pape JW, Binswanger IA. Early Disaster Response in Haiti: The Israeli Field Hospital Experience. *Ann Intern Med*. 2010:391-393.
33. Gerdin M, Wladis A, von Schreeb J. Foreign field hospitals after the 2010 Haiti earthquake: how good were we? *Emerg Med J*. 2012:1-6. doi:10.1136/emered-2011-200717.
34. Arziman I. Field Organization and Disaster Medical Assistance Teams. *Turkish J Emerg Med*. 2015;15(Supp 1):11-19. doi:10.5505/1304.7361.2015.79923.
35. Redmond AD, Mardel S, Taithe B, et al. A qualitative and quantitative study of the surgical and rehabilitation response to the earthquake in Haiti, January 2010. *Prehosp Disaster Med*. 2011;26(6):449-456. doi:10.1017/S1049023X12000088.
36. Brolin K, Hawajri O, von Schreeb J. Foreign medical teams in the philippines after typhoon haiyan 2013 - Who were they, when did they arrive and what did they do? *PLoS Curr*. 2015;7(DISASTERS):1-8. doi:10.1371/currents.dis.0cadd59590724486bffe9a0340b3e718.
37. Glassey S. Analysis of urban search and rescue markings applied following the 22 February 2011 Christchurch earthquake. *J Search Rescue*. 2013;1(1):29-49.

TABLES

Search Type	Source	Publication Dates	Search Terms
Primary	Google Scholar, Scopus, PubMed	All	SAR; CEA; cost; INSARAG; WHO; disaster; EMT; FFH; FMT
Grey	DFID, HERR, WHO, INSARAG, OCHA	All	SAR; CEA; cost; INSARAG; WHO; disaster; EMT; FFH; FMT
Hand Searching	Bibliographies from all selected papers	All	n/a

Table 1: Search type used to identify researches to be included in the study

Inclusion Criterion	Details
Language	References not written in English were not included
Reference	The citation from hand searching needed to be complete. Incomplete or inaccurate references were not included
Reference type	Scientific literature, peer-reviewed online academic journals and books, conference papers, theses and dissertations, working documents, technical reports from national and international organizations
Topic	Studies must discuss costs and/or effectiveness of SAR and/or EMT deployment after disaster, especially SODs.

Table 2: Details of the Inclusion Criteria Applied to Search Results

Citation	Type*	SAR	EMT	Costs	Effectiveness	Case study	Disaster
Abolghasemi et al., 2006	R	.	FFHs	.	X	Iran 2003	EQ
Alexander, 2011	B	USAR	FFHs	X	X	Haiti 2010	EQ
Aoki et al., 2004	P	.	EMS	X	X	Japan 1995	EQ
Arziman, 2015	Rv	.	DMAT	X	X	.	.
Bartels & VanRooyen, 2011	Rv	SAR	.	.	X	Various	EQ
Bea, 2010	R	USAR	.	.	X	USA	.
Brolin et al., 2015	P	.	FMT	.	X	Philippines 2012	Typhoon
de Ville de Goyet et al., 2000	A	.	FMT	X	X	.	.
de Ville de Goyet et al., 2006	C	SAR	FH	X	X	Indonesia 2004	Tsunami
de Ville de Goyet, 2006	R	.	FFHs	X	X	Iran 2003; Asia 2004; Pakistan 2005	EQ, Tsunami
DFID, 2013	Rv	ISAR	.	X	.	.	.
DFID, 2015	bc	ISAR	.	X	.	.	.
Gerdin et al., 2012	P	.	FFHs	X	X	Haiti 2010	EQ
Glassey, 2013	P	USAR	.	.	X	NZ 2011	EQ
Henderson et al., 1994	P	.	DMAT	X	X	Hawaii 1992	Hurricane
HERR, 2011	R	USAR	.	.	.	UK	.
Kondo et al., 2010	P	.	DMAT	.	X	Japan	EQ
Kreiss et al., 2010	P	.	FFHs	.	X	Haiti 2010	EQ
Macintyre et al., 2006	P	SAR	.	.	X	1985-2004	EQ
Morris, 2007	D	SAR	.	X	X	.	.
Noji et al., 1993	P	SAR	MC	.	X	Armenia 1998	EQ
Okita & Katsube, 2016	R	USAR	MT	.	X	Nepal 2015	EQ
Peleg & Kellerman, 2012	P	USAR	MT	X	X	Iran 2003; Indonesia 2009; Haiti 2010; NZ 2004; Pakistan 2005	EQ
Salman & Gul, 2014	P	.	FH	.	X	.	.
Schnitzer & Briggs	P	.	FH	.	.	Iran 2003	EQ
Statheropoulos et al., 2014	P	USAR	.	X	X	Various	.
von Schreeb et al., 2008	P	.	FFHs	X	X	Iran 2003; Haiti 2004; Indonesia 2004; Pakistan 2005	EQ
WHO, 2017	A	.	EMT	X	.	.	.

Table 3: List of studies selected for the review

* Pp = Peer-review Paper R = report D = dissertation Rv = Review B = Blog W = webpage C = Chapter Bc = Business Ca