

# Survey of Bam Earthquake Survivors' Opinions on Medical and Health Systems Services

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**Keywords:** air evacuation; Bam earthquake; international response; medical disaster response; primary health facility

## Abbreviations:

IRCS = Iranian Red Crescent Society  
FFH = foreign field hospital

Received: 28 September 2007

Accepted: 08 October 2007

Revised: 14 November 2007

Web publication: 20 June 2008

## Abstract

**Introduction:** On 26 December 2003, a catastrophic earthquake measuring 6.6 on the Richter scale devastated large areas of the city of Bam in south-eastern Iran. More than 40,000 people died, tens of thousands were injured, and almost 20,000 homes were destroyed.

Many national and international search-and-rescue teams were dispatched to the area to provide medical and health services and assist in the evacuation of survivors to undamaged areas.

**Problem:** The purpose of the study was to evaluate the opinions of survivors about medical responses provided, and the process of reconstruction of health infrastructures.

**Methods:** This was a descriptive study performed two years after the earthquake. Stratified, two-stage area sampling was used to enroll 211 survivors into the survey. A designed questionnaire was applied to evaluate the respondents' opinions about medical and health responses. The respondents were asked to score their satisfaction on a variety of services on a five-point scale, with 1 being "very poor" and 5 being "very good".

**Results:** Family members and relatives comprised the majority of first responders for those injured or trapped (127, 60.2%). Field hospitals deployed by the Red Crescent, international relief teams, and military forces were the first medical facilities for 98 (46.4%) of the casualties. As denoted by the mean values for the satisfaction scores, transportation by aircraft to the backup hospitals received the highest score (4.2), followed by international assistance (4.1), first medical care (3.5), search and rescue (3.3), primary transportation (3.1), and reconstruction and the quality of access to the infrastructures of the city (2.6). Two years after the earthquake, 151 (71.5%) respondents still were living in connexes (temporary accommodations or shelters for victims to live in; resemble a small hotel), only 33 (15.6%) had access to safe drinking water, and 44 (20.9%) did not have sufficient supplies of sanitary food.

**Conclusions:** In addition to reinforcing the medical and health infrastructures of a society in accordance with geographical and architectural characteristics, effective air evacuation and relief missions carried out by experienced international relief teams can play an important role in the appropriate management of approximately 30,000 casualties after a catastrophic event, such as experience with the Bam Earthquake.

Saghafi Nia M, Nafissi N, Moharamzad Y: Survey of Bam earthquake survivors' opinions on medical and health systems services. *Prehospital Disaster Medicine* 2008;23(3):263–268.

## Introduction

Events due to natural hazards are ecological phenomena that endanger the lives of people worldwide. The normal order of life is disturbed, thousands of people are injured, and the infrastructures of societies are damaged.<sup>1,2</sup> Earthquakes can be the most unpredictable and severe events, striking unexpectedly and without warning.<sup>3,4</sup> They result in an unexpected number of casualties or deaths that may be beyond the response capacity of local health-care facilities. Such situations necessitate the mobilization of search and res-

cue teams from other areas in the country and/or abroad. The transportation of the casualties to undamaged backup hospitals also is a problem.<sup>5</sup> Therefore, appropriately managing and providing immediate primary medical care under such circumstances significantly differs from that provided during ordinary conditions.<sup>6</sup> Providing proper, immediate first aid by trained personnel has been a challenge during disaster conditions, especially in developing countries.<sup>7-9</sup>

On 26 December 2003, at 05:26 hours local time, an earthquake measuring 6.6 on the Richter scale struck the city of Bam and neighboring villages in southeastern Iran, causing widespread destruction. More than 40,000 people died, and thousands were injured.<sup>10</sup> It devastated approximately 20,000 homes (87% of all buildings), and 45,000 displaced people were transferred to temporary shelters provided by government organizations. The Iranian Red Crescent Society (IRCS) was one of the most active organizations involved in relief missions.<sup>11</sup> In addition, numerous search and rescue teams consisting of physicians, paramedics, and volunteers from Universities of Medical Sciences from all over the country were dispatched to the area. Helicopters and aircraft from national military forces began to transport the casualties to the backup hospitals a few hours after the event.<sup>12</sup> Authorities asked for international help on the day of the earthquake. Up through 29 December, 1,600 international rescue workers from 44 countries were registered by the Virtual On-Site Operations Coordination Centre.<sup>13</sup> With these facts, the important question to consider is "What did the earthquake survivors think about the medical responses provided by the authorities?". This study, conducted nearly two years after the earthquake, aimed at answering the above question and evaluating the process of the reconstruction of the health infrastructures and the rate of access to primary facilities among the survivors.

## Methods

This descriptive study was performed in September 2005, approximately two years after the earthquake. Two hundred eleven survivors who had been injured and received medical services were asked to participate in this study. To select a representative sample of survivors, stratified, two-stage area sampling was applied. For this reason, a map provided by IRCS teams following the earthquake for distributing relief goods was used. Based on this map, the city of Bam had been divided geographically into 12 operational areas. Each area was covered by sub-operational IRCS teams. Then, within each area, random sampling was taken to select the households. Random sampling was based on a list of all households registered by IRCS. Ultimately, the respondents were selected randomly from all individuals living in the same household. Therefore, all households in the city had a similar chance of being sampled.

A group of trained research assistants interviewed the respondents in their settlements. The variables surveyed were demographic data, estimated time of being trapped in collapsed buildings, estimated time of rescue team arrival, the means of transportation to the nearest medical station, and the parts of the body and the type of injuries sustained. To evaluate the survivors' views about received medical

responses, a questionnaire was designed consisting of six major categories of medical responses after an event due to natural hazards: (1) help and rescue; (2) primary transportation; (3) first medical care; (4) transportation by aircraft; (5) international relief assistance; and (6) reconstruction of the health infrastructures of the city. The respondents were asked to rate each variable using a five-point Likert scale (1 for "very poor", 2 for "poor", 3 for "moderate", 4 for "good", and 5 for "very good") in order to reflect their views about received medical responses, the process of the city's reconstruction, and access to infrastructure health facilities at the time of the study.

Descriptive indices such as frequency, percentage, mean, and standard deviation (SD) were used to express the data collected. A comparison of the rankings of six different categories of medical responses was done using a Kruskal Wallis test. All processing used SPSS software version 13.0 (SPSS Inc, Chicago, IL).

## Results

The study involved 211 respondents (126 women and 85 men). Their mean value  $\pm$  SD of the age at the time of the study was  $29.9 \pm 12$  years. One hundred twenty-five (59.2%) had a high school diploma or lower degree, 76 (36%) had degrees above a high school diploma, whereas 10 respondents (4.8%) were not able to read and/or write, and completed the questionnaire with the help of research assistants.

At the onset of the earthquake, 129 (61.1%) respondents were asleep. One hundred thirty (61.6%) reported being trapped indoors for a mean standard deviation (SD) time of  $3.1 \pm 4.3$  hours. Family members and relatives were the first rescuers for 127 (60.2%) of the respondents. Local people rescued 10.9%, Red Crescent personnel rescued 0.5%, and military forces rescued 0.5%. Fifty-nine respondents (28%) had been unconscious and did not remember or did not know who rescued them. Ninety-eight (46.4%) were transferred to the first medical stations by private car. These medical stations were mainly field hospitals deployed by the Red Crescent, international relief teams, or national military forces. A total of 27 (12.8%) patients arrived on foot, eight (3.8%) with different means of transportation, and 66 (31.3%) did not respond. Only 12 (5.7%) reported being transported by ambulance. Whereas 50 (23.7%) respondents did not report the type of their injuries, long bone fractures were the most common injury occurring in 69 (32.7%) casualties, followed by open wounds in 62 (29.4%), deep open wounds in 15 (7.1%), limb amputation in seven (3.3%), and soft tissue injuries in eight (3.8%).

The respondents reported that they did not return to Bam for an average of 40 days. During this period, they mainly stayed in hospitals and after finishing their treatments; they were transferred to temporary accommodations that were established by governmental organizations for the temporary settlement of survivors. The hospitals paid for the expenses of 139 (66%) patients, 29 (13.7%) paid their own expenses, charitable donations paid for 22 (10.4%), and insurance companies paid for 21 (9.9%) of the respondents.

The results of the surveillance for five different categories of medical responses (search and rescue, primary

	Very Poor n (%)	Poor n (%)	Moderate n (%)	Good n (%)	Very Good n (%)	Total/Mean $\pm$ SD
Search-and-Rescue						
Starting time	46 (21.8)	40 (19.0)	79 (37.4)	36 (17.1)	10 (4.7)	2.9 $\pm$ 0.7
Covered areas	28 (13.3)	41 (19.4)	99 (46.9)	35 (16.6)	8 (3.8)	
Modern instruments	29 (13.7)	48 (22.7)	74 (35.1)	51 (24.2)	9 (4.3)	
Coordination	25 (11.8)	37 (17.5)	90 (42.7)	51 (24.2)	8 (3.8)	
Experienced Personnel	15 (7.1)	27 (12.8)	95 (45.0)	63 (29.9)	11 (5.2)	
Voluntary Individuals	15 (7.1)	36 (17.1)	85 (40.3)	45 (21.3)	30 (14.2)	
Primary Transportation						
Modern Devices	33 (15.6)	43 (20.4)	69 (32.7)	56 (26.5)	10 (4.7)	2.8 $\pm$ 0.9
Safety Points	26 (13.3)	48 (22.7)	99 (46.9)	26 (12.3)	16 (17.6)	
Rapidness	24 (11.4)	24 (19.9)	76 (36.0)	53 (25.1)	16 (17.6)	
First Medical Care						
Quality	22 (10.4)	41 (19.4)	96 (45.5)	44 (20.9)	8 (3.8)	2.9 $\pm$ 0.7
Accessibility	16 (7.6)	48 (22.7)	108 (51.2)	35 (16.6)	4 (1.9)	
Trained personnel	18 (8.5)	35 (16.6)	95 (45.0)	56 (26.5)	7 (3.3)	
Responsibility	12 (5.7)	35 (16.6)	91 (43.1)	58 (27.5)	15 (7.1)	
Aircraft Transportation						
Modern Devices	22 (10.4)	42 (19.9)	87 (41.2)	49 (23.2)	11 (5.2)	3.2 $\pm$ 0.7
Quality	12 (5.7)	28 (13.3)	70 (33.2)	56 (26.5)	45 (21.3)	
Responsibility	5 (2.4)	24 (11.4)	90 (42.7)	79 (37.4)	13 (6.2)	
International Relief Help						
Coordination	24 (11.4)	25 (11.8)	75 (35.5)	72 (34.1)	15 (7.1)	3.2 $\pm$ 0.9
Collecting	18 (8.5)	38 (18.0)	63 (29.9)	67 (31.8)	25 (11.8)	

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**Table 1**—Surveillance results about different categories of medical responses after the Bam earthquake\*

\*Data are expressed as the frequency (percentage) except as noted; Scores were designed as very poor = 1 to very good = 5 (SD = standard deviation)

	Very Poor n (%)	Poor n (%)	Moderate n (%)	Good n (%)	Very Good n (%)	Total/Mean $\pm$ SD
Appropriate Settlement	32 (15.2)	25 (24.6)	81 (38.4)	34 (16.1)	12 (5.7)	2.6 $\pm$ 0.6
Drinking Water	65 (30.3)	63 (29.9)	57 (27.0)	21 (10.0)	5 (2.4)	
Environmental Health Services	48 (22.7)	62 (29.4)	71 (33.6)	25 (11.8)	5 (2.4)	
Infrastructure Facilities	48 (22.7)	52 (24.6)	75 (35.5)	31 (14.7)	5 (2.4)	
Financial Support	36 (17.1)	37 (17.5)	96 (45.5)	37 (17.5)	5 (2.4)	
Educational Facilities	22 (10.4)	44 (20.9)	94 (44.5)	42 (19.9)	9 (4.3)	
Health Facilities	16 (7.6)	37 (17.5)	90 (42.7)	49 (23.2)	19 (9.0)	

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**Table 2**—Surveillance results about reconstruction of the city of Bam and quality of accessing to primary health facilities two years after the earthquake\* (n = frequency, SD = standard deviation)

\*Data are expressed as the frequency (percentage)

	Frequency n (%)
Settlement	
Private home	26 (12.3)
Red Crescent tents	6 (3.0)
Connex	151 (71.5)
Pre-fabricated houses	28 (13.2)
Access to safe drinking water	
Tanker	121 (57.3)
Bottled water	33 (15.6)
Piped water	9 (4.3)
No access	48 (22.8)
Access to sanitary food	
Canned foods	88 (41.7)
Warm food	79 (37.4)
Insufficient	44 (20.9)
Access to shower	
Private	93 (44.0)
Public	74 (35.0)
No access	44 (21.0)
Access to sanitary toilets	180 (85.3)
Access to electricity	147 (70.0)
Access to telephone	80 (38.0)
Access to sufficient clothing	132 (62.5)

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**Table 3**—Situation of settlement and access to primary facilities among survivors two years after the Bam earthquake

transportation of the victims, initial medical care, aircraft transportation, and international relief help) are in Table 1. Aircraft transportation and international help received the highest mean scores, reflecting higher satisfaction rate for these two categories among respondents in comparison to other aspects of the medical responses provided. Survivors' views about the accessibility of health infrastructures (Category 6) are in Table 2. Transportation of the casualties by aircraft to the backup hospitals listed received the highest score (4.2). Following transportation by aircraft, international assistance (4.1), initial medical care (3.5), search-and-rescue (3.3), primary transportation (3.1), and reconstruction and the quality of access to infrastructures of the city (2.6) had the highest scores, respectively.

The situation of respondents regarding access to primary facilities two years after the earthquake is listed in Table 3. The majority of the survivors (151, 71.5%) still were living in connexes, and only 15.6% had access to bottled water that was considered to be safer than the water carried by tankers and pipes used by others (61.6%). The remainder of the respondents reported that they did not have access to safe and healthy water.

According to official reports, 11,792 (approximately 40%) injured people were airlifted to other hospitals across the country during >682 hours of flying.<sup>12</sup> According to unpublished data from the Iranian military air forces, following transportation of casualties to other cities, in their return to Bam, nearly 882,640 kg of resources and equipment were carried by fixed-wing aircraft and helicopters, including: (1) canned foods, bread, and bottled water; (2) medications (antibiotics, analgesics, and intravenous solutions); (3) detergents; (4) self-hygiene products; (5) blankets, kerosene heaters, and tents; and (6) electrical generators and equipment required for setting up a temporary airport. Although no reports have been released regarding the quality and standards of the airborne transportation of the injured, or on any medical complications encountered during the transportation of the casualties, the respondents being questioned in this study remarked that aircraft personnel did their best to transport victims who needed immediate assistance. They also emphasized the quality of relief provided and said that the experienced personnel were familiar with their duties and had proper equipment that had an effective role in prompt evacuation of the casualties.

Iranian authorities delayed launching international assistance until 13 hours after the earthquake, which led to the late deployment of some FFHs. Consequently, this also weakened the effectiveness of international teams in search and rescue. Nonetheless, their activity in providing medical care and triage and initial settlement was important. This is in accordance with the point of view indicated by those questioned in this study. Relief goods were collected from all over the country and transported to the affected areas, and numerous groups consisting of physicians, specialists, paramedics, and voluntary individuals were sent to the area.

## Discussion

The Iranian authorities' request for international aid was well-received. More than 40 countries, including the US, European Union, China, Russia, and Muslim countries dispatched relief and monetary help. Belgium, Italy, Morocco, Japan, Hungary, Jordan, the US, Ukraine, France, Saudi Arabia, India, Pakistan, and the International Federation of the Red Cross (IFRC) deployed field hospitals with >600 personnel and 150 doctors. It is estimated that >50,000 inpatient and outpatients were treated by these field hospitals.<sup>14,15</sup> Furthermore, hundreds of organizations also sent search and rescue teams, such as the Red Crescent Society, the United Nations Disaster Assessment and Coordination (UNDAC) team deployed by the Office for the Coordination of Humanitarian Affairs (OCHA), World Vision, the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), the Red Cross, and Doctors without Borders.<sup>15,16</sup> By 05 January 2004, 85 Search and Rescue relief teams were active in the Bam area in the following categories: (1) 35 urban search-and-rescue teams; (2) 26 medical and public health relief teams; (3) 12 field hospitals; (4) seven teams for providing logistical supports to disaster teams; (5) five assessment teams; and (6) one telecommunications team.<sup>17</sup> Foreign field hospitals (FFHs) deployed in the disaster-stricken areas also were active in providing medical and health facilities. International teams

were reported to be active in search and rescue, triage and initial stabilization, and final medical care. These teams were self-equipped with trained personnel, which allowed them to perform independently.<sup>14,15</sup>

Several factors made the Bam earthquake particularly devastating. The most important factor was that a majority of the buildings were 80 to 100 years old, constructed of the traditional mud bricks typically found in the area, and did not incorporate any anti-earthquake engineering standards. Main hospital buildings and most urban and rural healthcare facilities were heavily damaged, and much of their medical staff that were at work or sleeping in their homes either were injured or killed.<sup>14</sup> Moreover, ancient structures of the city, with narrow alleys and streets, were mainly closed by collapsed buildings, made it difficult for search-and-rescue teams to access the injured or dead who were trapped under the rubble.

Aeromedical evacuation systems and developing specialized aeromedical teams have become an integral part of the practice of critical care medicine.<sup>18–20</sup> Shortly after the earthquake, Iranian military helicopters and fixed-wing aircraft played a significant role in the transportation of resources required, performing emergency and medical operations in the field, and the evacuation of the casualties. It seems that one of the advantages of air evacuation was its ability to cover long distances in a short amount of time, and for the patients who were trapped under the rubble without any medical attention for long periods of time, this component of medical response provided positive impact. After the earthquake, most of the roads were blocked due to the rapid influx of rescue workers that were dispatched throughout the country and also of the victims' relatives who came from neighboring provincial cities. In addition, there is no railroad from the provincial center of Kerman to Bam. These situational realities highlight the important role of the aircraft missions. Also, the number of casualties was overwhelming, and those involved in the evacuation of such a massive number of injured victims faced many problems.

According to the results of the present survey, due to a lack of pre-defined responsibilities, ineffectiveness of local coordination activities, and a lack of modern communication devices, initial medical care provided, search and rescue operations, and the primary transportation of the injured had lower scores according to the results of the survey.

The lowest score in this study was recorded for health responses and reconstruction of health infrastructures of the city of Bam. Ninety-six health houses, 13 health centers, and three obstetrical facilities were available for the residents in rural areas. Seven health centers, five health posts with an emergency care unit, and three hospitals were the only urban health facilities available before the earthquake, almost all of which were destroyed.<sup>21</sup> The first important step in guiding relief efforts concerning populations affected by an earthquake is rapid assessment of health needs.<sup>22</sup> As previously reported by Akbari *et al*, almost immediately after the earthquake, the National Committee of Health for Disaster, part of Iran's Committee for Natural Disasters, convened in the Ministry of Health and Medical Education offices to coordinate national and international humanitarian relief assistance and to establish efficient systems for disease control, environmental health, nutrition, personal hygiene, and primary and preventive care.<sup>21</sup> Nearly two years after the earthquake, a majority of people participating in the study still were living in connexes that were not well-designed to meet the primary demands. Some of them had no latrines or showers and faced problems such as a shortage of safe drinking water and insufficient amounts and types of healthy foods. The shortages of fundamental health facilities can lead to poor environmental health conditions that facilitate the spread of both contagious and non-contagious diseases. It was mandatory for health authorities to provide further healthcare facilities through effectively coordinated, managed, and organized health service programs. The lack of sufficiently trained healthcare staff will cause all of these efforts to be ineffective.

### Conclusions

The Bam earthquake created a catastrophic disaster that challenged several aspects of medical and health activities. The results of this study indicate that there is a basic need to develop search and rescue strategies in accordance with the geographical and architectural characteristics of regions with a high risk for earthquakes. Furthermore, the readiness of the society, combined with effective air evacuation and relief missions (carried out by experienced and fully-equipped international teams) can be of great help in the proper management of earthquake victims in the future.

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