

# The 2003 Bam Earthquake: Overview of First Aid and Transport of Victims

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**Keywords:** Bam Earthquake; first aid; Iran; safe hospital; transport

## Abbreviations:

None.

Received: 26 March 2007

Accepted: 12 April 2007

Revised: 14 June 2007

Web publication: 27 December 2007

## Abstract

**Introduction:** In December 2003, the residents of Bam, Iran experienced an earthquake that measured 6.6 on the Richter scale and destroyed more than 90% of the city.

**Problem:** The purpose of this study was to assess the status of the rescue, evacuation, and transportation of the casualties during the early stages following the earthquake.

**Methods:** A cross-sectional study of 185 casualties who were transferred to and hospitalized in the university hospital during the first week period following the earthquake was conducted. Information regarding different places of settlement after being removed from the rubble, initial medical care, and the means of transportation was obtained by reviewing medical records and interviewing the victims.

**Results:** The mean value of the duration of times taken for the first rescuers to reach the scene and remove the casualties from the rubble was  $1.7 \pm 2.7$  and  $0.9 \pm 1.1$  hours, respectively. Sixty-nine (37.7%) of the patients stayed within the area immediately surrounding their home for average times of  $8 \pm 10$  hours. The majority of casualties (57.6%) were transferred manually to a first place of settlement; 45.8% were taken to a second place of settlement using blankets. Of the patients studied, 159 (85.9%) did not receive any basic medical care at the first place and intravenous fluid therapy was the most common treatment provided for 24 (13%) patients at the second place of settlement. Patients received medical care at the first place of settlement for a mean time of  $16.8 \pm 13.5$  hours after escaping the rubble.

**Conclusions:** These findings indicate that the emergency medical service system in Bam was destroyed and not able to respond adequately. In order to reduce the negative effects of such disasters in the future, there is an essential need for a comprehensive disaster management plan and improvement of hospital structures, healthcare facilities, and communication between the different governmental departments for better coordination and planning.

Mirhashemi S, Ghanjal A, Mohebbi HA, Moharamzad Y: The 2003 Bam earthquake: Overview of first aid and transport of victims. *Prehospital Disast Med* 2007;22(6):513–516.

## Introduction

During the past 20 years, disasters caused by natural hazards have claimed >3 million lives worldwide, affected at least 800 million people, and resulted in property damage exceeding (US)\$500 billion.<sup>1,2</sup> They disturb the normal order of life in a society and often involve a situation beyond the response capacity of local facilities, making the mobilization of outside assistance and patient transportation to undamaged, backup hospitals necessary.<sup>3,4</sup> Compared to other disasters caused by natural hazards, earthquakes cause great loss of life and materials.<sup>5,6</sup> Following earthquakes, rescue teams play a critical role by providing first aid to and providing transportation of the casualties to appropriate areas.<sup>4,7</sup>

Review of the calamitous earthquakes in Iran over the last century indicates that the Iranian plateau is one of the world's most seismically active areas.<sup>8</sup> At 05:26 hours (h) local time on 26 December 2003, the residents of



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**Figure 1**—Area affected by Bam Earthquake, 26 December 2003

Source: USAID

the ancient city of Bam in southeastern Iran experienced an earthquake that lasted 10 seconds and measured 6.6 on the Richter scale (Figure 1). It destroyed much of the city center and caused extensive damage to residential and commercial buildings, as well as emergency response facilities. More than 40,000 people were presumed to be dead, tens of thousands were injured, and almost 20,000 homes were destroyed, leaving >45,000 people homeless.<sup>9</sup> Essential services, including water supply, electrical power, telephone services, healthcare services, the main roads, and the city's only airport, were crippled.<sup>8</sup> The earthquake ruined 95 of the area's 96 community healthcare units, all 23 health centers, and two of three hospitals. Therefore, a large number of injured people were evacuated and transferred to hospitals throughout the country, including Tehran, Iran's capital.<sup>10</sup> There have been some previous reports describing medical experiences, international responses, and management of the casualties of this "catastrophic" incident; however, no report has been published about the rescue situation

at the scene during the early stages before the arrival of outside disaster relief forces from foreign countries, larger cities, and/or the capital.<sup>3,11–15</sup>

The purpose of this descriptive study was to assess the status of rescue, evacuation, initial stabilization, and transportation of 185 casualties who were transferred to a hospital in Tehran. Interpretation of the results of this study and including both positive and negative points of the responses may help to increase the quality and efficiency of the medical care in response to probable future disasters caused by natural hazards.

### Methods

During the first seven days following the earthquake, a total of 185 survivors were transferred to the University General Hospital in Tehran that is located approximately 1,000 kilometers (km) (620 miles) away from the disaster scene, as a tertiary referral center for further treatments. They were admitted to wards such as general surgery,

Places of Settlement	First n (%)	Second n (%)
Within home boundaries	69 (37.7)	1 (0.6)
Street	49 (26.8)	9 (5.1)
Alley	46 (25.1)	3 (1.7)
An open area in the city	11 (6.0)	47 (26.6)
At relatives'	5 (2.7)	17 (9.6)
Airport	0	75 (42.4)
Near hospital	0	7 (4.0)
Suburb	3 (1.6)	8 (4.5)
Helal-e-Ahmar* station	0	10 (5.6)
Missing	2	8
<b>Total</b>	<b>185</b>	<b>185</b>

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**Table 1**—Distribution of patients according to reported first and second places of settlement in Bam  
\*Persian acronym for the Red Cross

orthopedics, and internal medicine. All were interviewed individually by the authors, and their medical records were examined to obtain information about the first rescuers who reached the scene, the time required to remove them from the rubble, the means of transportation from affected areas to safe places, the first and second places of settlement, the types of medical care initially received, and the approximate time it took to receive this care. Information was collected using a checklist consisting of 21 questions. Descriptive indices including frequency (percentage), mean values and standard deviation (SD) were calculated. All analyses were performed using SPSS software for Windows (version 13.0) (SPSS, Inc., Chicago, IL).

## Results

This study involved 185 patients, of which 93 (50.3%) were male. The mean value  $\pm$ SD of the ages of the victims was 29.8  $\pm$ 14.1 years. At the time of the earthquake (05:26 h local time), 156 (84.8%) patients were asleep. The first help to arrive was provided by relatives of the victims in 110 (59.5%) cases, local residents in 55 (29.7%) cases, and other groups in 20 (10.8%) cases. The mean value of times from the earthquake taken for the first rescuers to reach the scene was 1.7  $\pm$ 2.7 hours, and of the time required to remove the victims from the rubble was 0.9  $\pm$ 1.1 hours. Of the casualties, 37.7% stayed within the area immediately surrounding their home as the first place of settlement, and 42.4% were evacuated to the city's only airport as the second place of settlement (Table 1). Patients stayed in the first and second places of settlement for duration of 8.0  $\pm$ 10.0 and 8.1  $\pm$ 11.9 hours, respectively.

One-hundred five (57.6%) patients were transported to the first place of settlement manually (transferred without any transport equipment) whereas using blankets (instead of stretchers) was the most common means of transportation between the first and second places of settlement for

Mode	To first place n (%)	To second n (%)
Stretcher	1 (0.5)	24 (13.5)
Blanket	51 (27.6)	81 (45.8)
Without equipment	105 (57.6)	51 (28.8)
Self	25 (13.5)	21 (11.9)
Missing	3 (1.6)	8 (4.3)
<b>Total</b>	<b>185</b>	<b>185</b>

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**Table 2**—Means used to transport patients to first and second places of settlement

81 (45.8%) patients (Table 2). Finally, 77 (41.7%) patients were transported to the hospital by aircraft, by private car in 28 (15.1%), by ambulance in 42 (22.7%), and by ambulance and aircraft in 38 (20.5%) cases, taking an average 25.2  $\pm$ 16.3 hours to reach the hospital.

With respect to initial medical care, nothing was done for 159 (85.9%) in the first place of settlement, and the remaining patients received treatment using limb stabilization and/or hemorrhage control. In the second place of settlement, 134 (72.4%) received no medical care, while 13.0% received intravenous fluid therapy (Table 3). On average, patients received the first medical intervention 16.8  $\pm$ 13.5 hours after being removed from the rubble.

## Discussion

According to seismological studies, 97% of urban and rural areas in Iran are at risk for earthquakes. Iran is the fourth most stricken country in the world in terms of disasters due to natural hazards.<sup>15</sup> During the past two decades, Iran has experienced three earthquakes and a number of floods that have caused huge numbers of casualties. In comparison with similar earthquakes of similar intensity, the Bam Earthquake resulted in greatest number of mortality among the population. For example, an earthquake that occurred with the same intensity a week before the Bam Earthquake claimed only two lives in Paso Robles, California USA.<sup>8</sup> There are a number of factors that contribute to this difference, including the type of earthquake, built structures, shortage of trained personnel and equipment, and low capabilities of triage and transportation systems. Bam is an ancient city, and the majority of houses, mainly composed of mud bricks, were built >100 years before the Earthquake. Because of the ancient architecture of the city, the collapse of buildings and the resulting rubble led to road closures, which made it difficult for rescue workers to reach the scene quickly. Furthermore, the hospitals were old or were not built according to high building standards. These conditions combined to form a serious shortage of personnel, equipment, and medical facilities, and regular and standard emergency medical transport systems were filled beyond capacity.

The majority (89.2%) of first responders were local people (relatives and inhabitants). Thus, a lack of personnel with predefined responsibilities who could perform distinct duties was noted. It has been shown experimentally that



Initial medical care	First n (%)	Second n (%)
Intravenous fluid therapy	0	24 (13.0)
Limb stabilization	11 (6)	19 (10.2)
Hemorrhage control	15 (8.1)	7 (3.8)
Airway management	0	1 (0.6)
No care	159 (85.9)	134 (72.4)

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**Table 3**—Distribution of initial medical care provided for patients in first and second places of settlement

being under rubble for more than six hours reduces the likelihood of survival.<sup>16</sup> Unfortunately, due to limited medical facilities, personnel, and therapeutic supplies, as well as an influx of huge numbers of patients during a short time following the earthquake, there was a substantial delay in providing the first medical care to the patients. Due to the chaotic conditions after the earthquake, this care was bypassed at the scene, and for a majority of patients, was neither provided at the first nor second place of settlement. As a result, a great number of patients had to wait to receive the simplest medical care, such as intravenous fluid administration or limb and spine stabilization, until they reached a hospital. Furthermore, since most of the initial rescuers were untrained, local residents, patients mostly were moved to safe places by non-standard medical methods (such as blankets or without equipment) rather than by stretchers.

Casualty statistics on major disaster incidents usually do not meet proper standards of healthcare research, especially where registration systems are not fully developed. In this study, data were obtained from medical documents recorded by healthcare personnel at the scene and by interviewing the casualties. This is a limitation in the study.<sup>4</sup>

Disasters caused by natural hazards with such a vast impact create a number and type of casualties that exceeds the capacity of the existing medical facilities.<sup>4,16–18</sup> As a result, the provision of supplemental personnel, equipment,

supplies, and facilities from outside resources are essential to care for the thousands of victims. Timely responses require previously organized disaster response systems that can provide needed aid rapidly, ideally within 24 hours.<sup>4</sup> A consistent medical approach to disasters, based on an understanding of their common features and the response expertise they require, is becoming the accepted practice throughout the world. This strategy, called the mass-casualty incident response, has four critical medical components: (1) search and rescue; (2) triage and initial stabilization; (3) definitive medical care; and (4) evacuation.<sup>14</sup> In the Bam disaster, almost all of the major hospital facilities were destroyed, and a number of their doctors and nurses were injured seriously or killed. This resulted in the need to transport a great number of people to hospitals in unaffected backup areas. Some of these hospitals were located in Tehran. For such a long distance, there is an indispensable need for air transport, and it is considered the ideal means of transportation. Unfortunately, during the first 24 hours following the earthquake, this type of transport was not performed at a satisfactory level, which in turn led to a higher mortality rate.

### Conclusions

The Bam Earthquake caused policy-making health professionals to take a serious and fresh look at the preparation for similar events in the future. This survey has identified areas of critical need, including the initiation of a comprehensive disaster management plan, educational programs for the public, training courses on cadavers, and work with computer simulations of triage in disaster conditions for emergency medical care providers. In addition, a very important goal is to achieve a high standard in the construction of buildings, especially hospitals and healthcare facilities. This allows doctors, nurses, and other healthcare professionals (as key responders) to initiate rescue operation and resuscitation as quickly as possible, which will result in better survival chances for the victims and a lower death toll in disasters caused by natural hazards. Regarding Iran's geological characteristics, further earthquakes are inevitable, and taking these steps towards reducing the loss of lives to a minimum is essential.

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