

Revisiting Blood Transfusion Preparedness: Experience from the Bam Earthquake Response

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IBTO = Iranian Blood Transfusion Organization

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Abstract

Blood transfusion plays a critical role in the provision of medical care for disasters due to man-made and natural hazards. Although the short-term increase in blood donations following national disasters is well-documented, some aspects of blood transfusion during disasters remain under study. The 2003 earthquake in Bam, Iran resulted in the death of >29,000 people and injured 23,000. In total, 108,985 blood units were donated, but only 21,347 units (23%) actually were distributed to hospitals around the country. Kerman Province, the site of the disaster, received 1,231 (1.3%) of the donated units in the first four days after the disaster. The Bam experience revealed crucial missteps in the development of a post-event strategy for blood product management, and led to the development of a detailed disaster preparedness and response plan that addresses issues of donation, distribution, communication, transportation, and coordination. The current plan requires the Iranian Blood Transfusion Organization to convene a disaster task force immediately as the main coordinator of all disaster preparedness and response activities.

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Introduction

Blood transfusions play a critical role in providing medical care for victims of disasters caused by man-made and natural hazards.¹ Depending on the type of event and the associated injuries, a number of casualties should benefit from blood products provided in a timely and sufficient manner. A major concern on the efficacy of disaster response by blood transfusion organizations was raised after the 11 September 2001 World Trade Center tragedy.^{1–3} In order to respond to a disaster effectively, many of the activities that normally are involved in the provision and use of blood products should be adjusted in regard to the characteristics of the disaster.

During major disasters due to natural hazards, a strong community response is observed.⁴ Many people donate food, clothing, and other essential items to express their altruism. This often comes with a strong willingness to donate blood.⁵ Although the short-term increase in blood donations during national disasters is well-documented, some aspects of blood transfusion following disasters are receiving further study, including:⁶ (1) necessity of a mass appeal for donation; (2) long-term impact of the disaster on blood supply; (3) safety of donated blood; (4) rate of discarded collections and its impact on the people's attitude; and (5) first-time donor return rate.

Iran is one of the most disaster-prone countries in the world.⁷ In 2003, an earthquake registering 6.5 in Bam, located in the Province of Kerman, resulted in one of the largest disasters in the number of reported deaths (>29,000) and injuries (>23,000).^{7–8} The water supply network, electricity, telephone lines, and ground transportation paths were disrupted,⁹ but air transportation through the Bam airport remained functional. The health facilities in the area nearly were destroyed, and approximately 50% of the health personnel were

Situation	Daily Average No. of Blood Units Donated in the Country	Daily Average No. of Blood Units Distributed in the Country	Daily Average No. Blood Units Distributed in Kerman
The first four days	27,246 (6.9-fold increase)	7,519 (1.3-fold increase)	458 (3.7-fold increase)
Normal situation	3,458	3,250	98

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Table 1—Blood donation and distribution in the first four days following the earthquake and in a normal situation

reported to be dead or missing.¹⁰ The great burden of caring for the injured and traumatized patients fell on the health system in Kerman Province. Treatment of blood loss, resuscitation, emergency surgical interventions, and medical life-saving support activities consumed the capacities of neighboring hospitals and healthcare units. Many hospitals around the country received a total of >12,000 injured patients within the first 24 hours after the earthquake.¹¹

The disaster response by the Iranian Blood Transfusion Organization (IBTO) following the earthquake and the post-disaster review of the disaster preparedness and response plan follow.

Iranian Blood Transfusion Organization Response

The Blood Collection Center in Bam nearly was destroyed as the result of the earthquake. The IBTO immediately convened a Disaster Response Committee within the first hour after the earthquake. Since the event had occurred on a holiday morning, representatives of several sectors of the IBTO had to be notified using emergency procedures. The Committee recognized that it had the immediate responsibilities for:

1. Developing a revised disaster national strategy based on current information and victim status of the disaster;
2. Facilitating coordination among the IBTO and its affiliated centers with other disaster organizations and agencies;
3. Appointing a representative of the Committee to be liaison with other emergency responder organizations;
4. Ensuring continuous contact with the transfusion team quickly established in Bam, the provincial center of Kerman, and major coordinating center in Tehran; and
5. Utilizing lessons learned from this disaster to catalyze the development of a permanent IBTO disaster preparedness and response plan.

Even though this strategy determined that blood collection centers in all of the provinces were to be activated in order to provide the required blood units using their inventory or blood collection capabilities, initially, several obstacles hindered the timely execution of the plan and the evaluation of its effectiveness. Primarily, these obstacles related to the disruption of telephone lines in the disaster zone that prevented the effective and timely coordination of the response process, and the breakdown of ground transportation to the zone delaying the shipment of blood units to the area. Therefore, by default, air transportation through the Bam

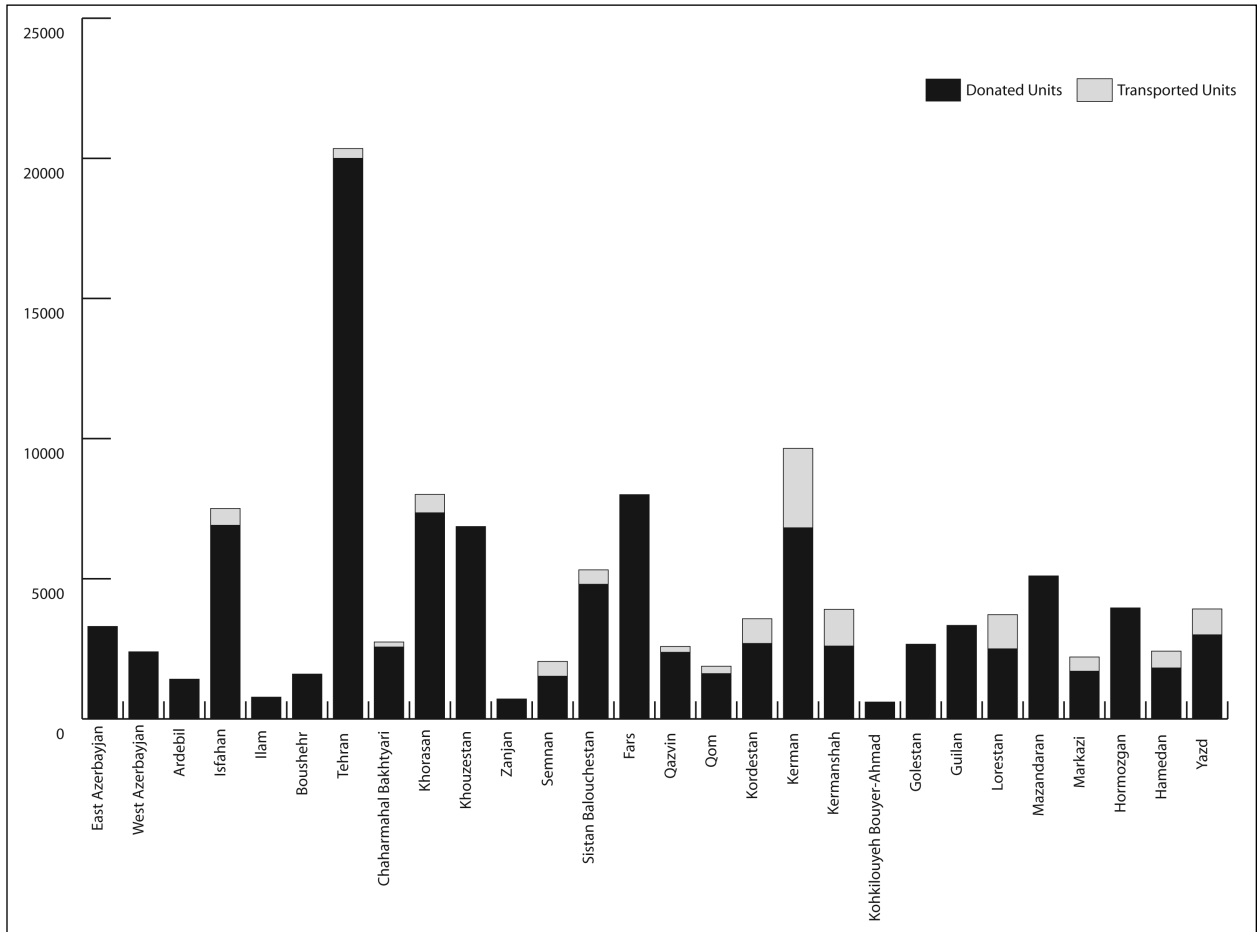
airport became the main access route to the zone. However, the Disaster Response Committee, through frequent review of reports of casualties, blood unit requests, and updates on blood product availability, eventually determined the number of units required. This Committee remained active until the problems exposed by the event were resolved.

Simultaneously, there was a large influx of donors to blood collection centers, reminiscent of experiences with previous disasters. Some blood collection centers resorted to staffing temporary assisting blood collection centers to manage the surge of donors, and several centers registered volunteers for later contact to ensure timely donation. Since blood collection and processing are managed by the IBTO, the donor influx did not distract hospitals and other health-care centers from their main activities. The daily average number of blood units donated, distributed in hospitals around the country, and distributed in the Kerman Province hospitals during the first four days post-disaster is in Table 1. A total of 108,985 units were donated, but only 21,347 units (23%) actually were distributed to hospitals around the country, with 1,231 units (1.3%) distributed in Kerman Province hospitals during the first four days alone. The number of blood units donated and sent to Tehran or Kerman in the first four days post-earthquake is in Figure 1. The Tehran Coordinating Center received 6,830 blood units from several provinces. In normal situations, the blood inventory of Iran and Kerman Provinces contains 22,249 and 1,140 units, respectively. However, due to a national measles-rubella vaccination program, to ensure blood safety, health authorities recommended that those recently vaccinated not donate blood, which resulted in the inventory in Kerman Province to slip to only 270 blood units by the morning of the earthquake. Two hundred blood units were provided to the Kerman transfusion center by regional centers of the province, and 2,736 units by other provinces. The final number of blood units provided by Tehran, neighboring, and distant provinces to the Kerman center is in Table 2.

Disaster Response Plan Review

Although the amount of blood provided by the IBTO in the immediate aftermath of the earthquake was sufficient, a post-disaster review determined that there were some deficiencies in the response to the Bam earthquake. Critical to the management of the IBTO was that no formal, detailed disaster response plan existed before the earthquake. This was compounded by major disruptions in communication, transportation, and coordination between collection centers.¹² The greatest difficulty for the IBTO was not lack of supply, but lack of coordination of the blood supply system. The Bam experience catalyzed the requirement for a detailed disaster preparedness and response plan primarily covering the determination of the need for blood, options for facilitating transportation of blood products to the disaster zone, and a means to effectively communicate needs to the donating public.

The first step of the IBTO was to designate and convene an *ad hoc* disaster task force as the main coordinator of all future disaster preparedness and response activities. This



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Figure 1—Blood units donated and transported to Tehran or Kerman by each province

	Province	No. of Blood Units Provided
Neighboring Provinces	Sistan Balouchestan	514
	Hormozgan	--
	Yazd	923
	Khorasan	654
	Fars	--
Center	Tehran	350
Distant Provinces	Qom	115
	Chaharmahal-Bakhtiyari	180

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Table 2—Number of blood units provided by Tehran, neighboring, and remote provinces to Kerman during the first four days

task force consists of representatives from different sectors of the IBTO who are involved in disaster preparedness and response activities, including blood collection and processing, transportation, security and safety, communications, and supply and personnel management. Under this plan,

sector representatives communicate decisions of the task force to their respective constituencies. The required products, supplies, and services for disaster response are identified by the task force, and their availability is inventoried on a regular basis. The IBTO task force study process indicated that 76% of blood units sent to Kerman Province were provided by neighboring provinces. Provinces with rapid access to the affected area play a considerable role in meeting the emergent need for blood within the affected area. Therefore, the current IBTO plan has designated these “assisting provinces” as the “first responders” for blood products to avoid unnecessary donations and overload from other remote provinces. Additionally, this plan includes those provinces with access to the most rapid means of transportation to affected provinces.

Blood transfusion center personnel now receive disaster-specific education and training in all the provinces. Response maneuvers are performed periodically to keep the personnel prepared and updated. To ensure that the task force, blood collection centers, and hospitals are able to communicate effectively with each other during a disaster, a staff member at each blood collection center and its affiliated hospitals is identified as the contact person, and the contact information of these personnel is verified periodically.

The current plans provide for the blood collection center in the affected area to communicate with the contact person of the customer hospitals to assess the need for blood and blood products. The assessment helps determine if the needed blood products could be provided from the local inventory; the results are communicated to the task force. If there is need for assistance from outside sources, the task force will activate the appropriate centers of the assisting provinces. The task force also will recognize if there is a need for emergent, mass collection of blood. The method used to assess the need for blood and blood collection utilizes the methodology recommended by the American Association of Blood Banks.¹² Dealing with the great influx of donors post-disaster is one of the main challenges. The mainstays of the donor management strategy of the task force include communicating a unique message to the population about the need for emergent donation and registration of first-time blood donors to ensure the timely call-up if necessary. All considerations taken by the task force address the main drawbacks of the previous experiences in areas of communication, transportation, and coordination.

Discussion

Whereas, it is commonplace that there is a large increase in the number of blood donations by the public during a disaster, the Bam disaster confirms once again, that in most cases, all the blood needed for victims already is available in the inventory of blood collection centers.² However, blood donation during disasters is not based solely on medical need. After 11 September 2001, Robert Jones, President of the New York Blood Center, observed that, "People needed to be with one another, friends, neighbors and strangers. Blood donation sites gave them that opportunity along with something personal to do for the cause. As the response was disproportionate to the medical need, the social value of blood donation at once became far more important to the community than its medical value."¹³

This review confirms the adequacy of normal blood inventory of developed countries to meet the needs in the aftermath of a large-scale, injury-creating disaster. The number of blood units distributed in the Kerman Province hospitals (1,231 units) was less than the sum of blood

inventory of Kerman Province and the blood units provided by regional and other provincial inventories (2,736 units). In other words, the required amount of blood units was available without any emergent donation. Regular donation and sufficiency of the blood inventory is more important than emergent donation to save lives in times of crisis and in normal times.^{2,14} Furthermore, without any change in frequency, the absolute number of donors testing positive for transfusion-transmissible infections increases during a disaster and doubles the burden on the transfusion system.^{3,14} Based on these observations, the current preparedness plan of the IBTO consists of two main components: (1) donor recruitment; and (2) coordination of the emergent disaster response.

A considerable proportion of the increase in disaster donations is driven by the large increase in the number of first-time donors. The return rate of highly motivated, first-time donors during disasters is as low as the usual return rates.¹⁴ Although the usual low return rate means missing a considerable portion of donors, the increased number of first-time donors is an opportunity to increase the absolute number of returning donors. Based on the Bam experience, the IBTO recently has concluded a donor recruitment plan. Mainstays of the recruitment plan include informing the media and the public about the importance of regular donation, registering donors and their contact information, and contacting donors and asking them for donation on determined intervals, particularly during times of crisis. The recruitment plan has the potential to mitigate many of the major problems faced after the Bam earthquake. These issues will be tested, monitored, and evaluated during regularly scheduled exercises and planning document reviews.

Conclusions

The post-Bam earthquake disaster response committee was successful in determining the blood requirement. However, this process was hindered by a lack of advanced planning that should have exposed potential difficulties in the areas of transportation, communication, and coordination. Future responses under a formally designated disaster plan and an IBTO disaster task force is expected to result in a higher level of function and effectiveness.

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