

Lessons Learned from the Aeromedical Disaster Relief Activities Following the Great East Japan Earthquake

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Keywords: Disaster Medical Assistance Team; disaster medical relief; doctor-helicopter; Emergency Medical Service; Great East Japan Earthquake; helicopter

Abbreviations:

DMAT: Disaster Medical Assistance Team
HEMS: helicopter emergency medical service
MHLW: Ministry of Health, Labour and Welfare
SDF: Self Defense Force

Received: August 10, 2011

Accepted: October 18, 2011

Revised: October 27, 2011

Online publication: January 22, 2013

doi:10.1017/S1049023X12001835

Abstract

Introduction: Since 2001, a Japanese national project has developed a helicopter emergency medical service (HEMS) system (“doctor-helicopter”) and a central Disaster Medical Assistance Team (DMAT) composed of mobile and trained medical teams for rapid deployment during the response phase of a disaster.

Problem: In Japan, the DMAT Research Group has focused on command and control of doctor-helicopters in future disasters. The objective of this study was to investigate the effectiveness of such planning, as well as the problems encountered in deploying the doctor-helicopter fleet with DMAT members following the March 11, 2011 Great East Japan Earthquake.

Methods: This study was undertaken to examine the effectiveness of aeromedical disaster relief activities following the Great East Japan Earthquake and to evaluate the assembly and operations of 15 doctor-helicopter teams dispatched for patient evacuation with medical support.

Results: Fifteen DMATs from across Japan were deployed from March 11th through March 13th to work out of two doctor-helicopter base hospitals. The dispatch center at each base hospital directed its own doctor-helicopter fleet under the command of DMAT headquarters to transport seriously injured or ill patients out of hospitals located in the disaster area. Disaster Medical Assistance Teams transported 149 patients using the doctor-helicopters during the first five days after the earthquake. The experiences and problems encountered point to the need for DMATs to maintain direct control over 1) communication between DMAT headquarters and dispatch centers; 2) information management concerning patient transportation; and 3) operation of the doctor-helicopter fleet during relief activities. As there is no rule of prioritization for doctor-helicopters to refuel ahead of other rotorcraft, many doctor-helicopters had to wait in line to refuel.

Conclusion: The “doctor-helicopter fleet” concept was vital to Japan’s disaster medical assistance and rescue activities. The smooth and immediate dispatch of the doctor-helicopter fleet must occur under the direct control of the DMAT, independent from local government authority. Such a command and control system for dispatching the doctor-helicopter fleet is strongly recommended, and collaboration with local government authorities concerning refueling priority should be addressed.

Matsumoto H, Motomura T, Hara Y, Masuda Y, Mashiko K, Yokota H, Koido Y. Lessons learned from the aeromedical disaster relief activities during the Great East Japan Earthquake. *Prehosp Disaster Med.* 2013;28(2):166-169.

Introduction

As a national project under the direction of the Japanese Ministry of Health, Labour and Welfare (MHLW) to establish a Japanese emergency medical service (EMS) system, a helicopter EMS (HEMS) system—the so-called “doctor-helicopter” system—has been developed and modeled on the ADAC in Germany, the REGA in Switzerland, and the London HEMS in the UK.¹ Since 2001, the HEMS system has been established at 40 bases across Japan. At the end of fiscal year 2012, however, less than half the coverage needed has been achieved. The HEMS system was established alongside that of a central

Disaster Medical Assistance Team (DMAT) composed of mobile and trained medical teams that can be rapidly deployed during the acute phase (within 48 hours) of a disaster.

Japan has one of the highest occurrences of earthquakes in the world, and ranks second in the world for the number of rotorcraft, but the utilization of helicopters in disaster situations is not as advanced. Since 2003, the DMAT Research Group has investigated the utilization and command of a “doctor-helicopter fleet” in major disasters.

This report examines the effectiveness of aeromedical disaster relief activities and presents an evaluation of assembly and operations of 15 doctor-helicopter teams that were dispatched for patient evacuation with medical support following the Great East Japan Earthquake. The experiences and problems encountered offer information for establishing nationwide aeromedical disaster relief systems that can respond effectively to major emergencies or disaster situations.

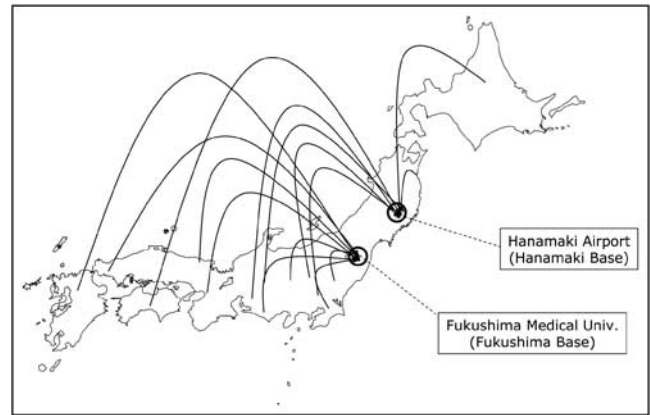
Aeromedical Disaster Relief Activities Undertaken

A magnitude 9.0 earthquake on March 11, 2011 off the Pacific coast of the Tohoku region of Japan caused widespread damage. The quake, one of the largest in recorded history, triggered a tsunami up to 30 meters high along parts of the country's eastern coastline. The tsunami swept away everything in its path, including houses, cars, and farm buildings, some of which were on fire.

From March 11th through March 22nd, approximately 340 DMATs were assembled in the affected areas of Iwate, Miyagi, Fukushima, and Ibaraki Prefectures, and from March 11th through March 13th, in the acute phase of the disaster, 15 DMATs were deployed to work out of two doctor-helicopter base hospitals at Fukushima Medical College Hospital and Hanamaki Airport (Figure 1). Dispatch centers for the doctor-helicopter fleet were established at the Fukushima and Hanamaki sites on March 12th. Doctor-helicopter teams were dispatched for the transport of patients with medical support from the disaster area either to hospitals outside the area or to a staging care unit for later wide-area transportation. The base at Hanamaki directed seven doctor-helicopter teams and transported a total of 39 patients from hospitals on the coast (mainly in Iwate Prefecture) that were damaged by the tsunami to sites outside the affected area. Each of the eight doctor-helicopter teams stationed at the Fukushima base transported a total of 22 patients from hospitals located on the coast of Miyagi and Fukushima Prefectures.

On March 13th, a serious problem was identified in Ishinomaki City on the coast of Miyagi Prefecture. Approximately 120 patients and 130 staff had been stranded at the severely damaged Ishinomaki Municipal Hospital, which had not been able to function as a hospital following the tsunami (Figure 2). Their escape route was blocked as the city was submerged, and they could not issue an SOS as there was no electricity supply with all generators and redundant communications such as satellite telephones damaged.

Early on the morning of March 14th, the advance headquarters of the DMAT based in the Miyagi Prefectural Office ordered that the patients in Ishinomaki Municipal Hospital be evacuated. All DMATs standing by at the Fukushima base were dispatched in five doctor-helicopters to execute the orders. Three DMATs worked in Ishinomaki Municipal Hospital to prepare the patients for evacuation and to transport the patients by doctor-helicopters to the nearby Ishinomaki athletics field, where



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Figure 1. Fifteen DMATs operating the doctor-helicopter were assembled at Fukushima Medical College Hospital and Hanamaki Airport.



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Figure 2. The tsunami destroyed the first and second floor of Ishinomaki Municipal Hospital.

two DMATs were stationed to receive the patients. From there the Self Defense Force (SDF) transported the patients by Chinook to Kasuminome Camp at Sendai and then onwards to a place of safety. In addition, two doctor-helicopters from Hanamaki base provided support on the afternoon of March 14th.

The operation started at 9:40 AM. However, it was temporarily suspended in the morning because of a precautionary warning of another tsunami following an aftershock before being restarted at 1:00 PM after the tsunami alert was lifted. The seven doctor-helicopter teams then worked to transfer patients from the hospital to the athletics field, while taking water, food and generators to the hospital. A total of 86 patients were evacuated by the doctor-helicopter teams during the daytime, with the remaining patients evacuated during the night of March 14th, and hospital staff evacuated the following day by SDF helicopters. Altogether, 148 patients were evacuated by the DMATs using 15 doctor-helicopters over a five-day period following the earthquake (Table 1). The doctor-helicopter teams completed their mission to transport patients with medical support by March 15th.

Doctor-Helicopter Teams Deployed	No. of Transports	Details of Transport		
		Within the disaster area	To outside the disaster area	Ishinomaki Municipal Hospital
Hokkaido (North)	10	10		2
Aomori	2	2		
Fukushima	5	5		
Gunma	13	13		3
Saitama	6	6		
Chiba (North)	30	27	3	27
Nagano	1	1		
Shizuoka (West)	18	18		16
Aichi	6	6		
Gifu	4	4		
Osaka	20	17	3	17
Hyogo	5	1	4	
Yamaguchi	18	18		16
Kochi	3	3		
Fukuoka	7	7		7
Total	148	138	10	88

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Table 1. Transportation by DMAT Using Doctor-Helicopters
Abbreviation: DMAT, Disaster Medical Assistance Team

Discussion

Sixteen years ago, Japan was rocked by an earthquake in the Hanshin-Awaji area. The number of fatalities was >6,000 and the number of “preventable deaths” has been estimated at >500.² This experience highlighted the need for medical services and transportation of injured and sick persons to be provided in a disaster area. Within the first 24 hours after the Hanshin-Awaji Earthquake, an estimated 380 people needed to be airlifted outside of the affected areas so they could receive emergency medical treatment; a further 120 casualties needed to be transported by air over the next 48 hours. On the day of the earthquake, however, only one patient was transported by helicopter and only 17 within the first 72 hours. The MHLW recognized from this event that even with the large number of helicopters in the country, they were not available to use in disaster situations unless they were already being utilized in handling daily emergencies.

Against this backdrop, the MHLW formulated two policies. One of these policies involved the Japanese government establishing a disaster medical system that deployed DMATs.³ The Japanese DMAT consists of teams of doctors and nurses who provide medical support and administrative staff to handle the logistics, and they rapidly deploy in the acute phase of a disaster (within 48 hours). Disaster Medical Assistance Teams focus on providing medical care and relief activities to save the

lives of severely-injured or ill casualties. Their most important role is to assist hospitals in the affected areas to receive casualties, for example, by providing triage, treatment, emergency care, and transportation by land and air. In the case of a large-scale disaster covering a widely damaged area, DMATs can be deployed to provide aeromedical disaster relief. As of May 2011, 430 medical facilities, 813 teams, and 5,094 individuals had been trained.

The second policy involved developing a government-funded HEMS system. The doctor-helicopter system has been operating since 2001 and provides “onsite emergency department capability,” such as advanced prehospital treatment by emergency physicians at the scene. It is now part of the established EMS system in daily use in Japan. Since 2003, the DMAT Research Group which is funded by a MHLW Health and Labour Sciences Research Grant has been investigating the utilization of doctor-helicopters in major disasters. They have worked under the assumption that rotorcraft from various organizations such as the police, fire department, and SDF will not be readily available for aeromedical transportation during disaster relief activities because these helicopters are not under direct control of the MHLW and are not for exclusive EMS use.

Although not all DMAT teams received advanced training for doctor-helicopters, it is a general rule that medical crews who are deployed to a disaster site, including the evacuation teams discussed in this report, work as doctor-helicopter staff in daily

HEMS activity. The first deployment of a doctor-helicopter by the DMAT for aeromedical disaster relief was in 2007 following the Niigata Chuetsu Off-Coast Earthquake. After the Iwate Miyagi Inland Earthquake in 2008, two doctor-helicopters with DMAT members onboard were deployed in the disaster area. From these deployments, the DMAT research group estimated that greater numbers of doctor-helicopters should assemble at each of the base hospital site in future disasters, forming a "doctor-helicopter fleet." The Research Group identified command and control of this fleet as an issue requiring further study.

Some important points were learned from the experiences following the recent Great East Japan Earthquake. First, the operations in Tohoku have made clear the vital role that doctor-helicopter teams play in disaster medical assistance and rescue activities. But, not all types of helicopters are suitable for aeromedical activities. It was clear that the "doctor-helicopter fleet" concept is superior to uncoordinated operations by each doctor-helicopter team; however, it is necessary to establish the legal grounds for the use of doctor-helicopters in a disaster, as there are no national rules regarding their deployment.

Second, there were many helicopters from various organizations present at the disaster sites which could not be used by DMATs for medical transportation without separate adjustments being made to the activities of these organizations, which would ultimately delay operations. The operations of the doctor-helicopter fleet ran smoothly because DMATs could be dispatched immediately whenever DMAT headquarters requested because the individual dispatch centers for the doctor-helicopter fleet were directly controlled by DMAT headquarters, unlike the rotorcraft of other organizations that are controlled by local government. Given this foresight, a DMAT could complete its mission as originally planned by the Research Group.

There were some futile operations because information about the patients needing transport was not centralized sufficiently. To maintain direct control over communication between DMAT headquarters and dispatch centers at the Fukushima and

Hanamaki sites, it was indispensable to establish information management concerning patient transportation. Such a command and control system for dispatching the doctor-helicopter fleet is strongly recommended.

As the third point, there is no rule of prioritization for doctor-helicopters to refuel ahead of other helicopters, such as those used by the press. This resulted in many doctor-helicopters having to wait in line to refuel. Collaboration with local government authorities concerning a refueling priority should be addressed. This was a strong recommendation following the event.

The literature contains reports describing aeromedical evacuation activities after a catastrophic earthquake^{4,5}. HEMS systems are an integral part of disaster relief measures undertaken and a clear understanding of the medical capabilities of DMATs in the aeromedical environment will help patients be evacuated in a safe and proper manner. The experiences and problems encountered following the March 2011 disaster clearly point to the need for DMAT to maintain direct control over communication between DMAT headquarters and the dispatch centers, information management concerning patient transportation, and operation of the doctor-helicopter fleet during the relief activities. Such information provides valuable information for establishing nationwide HEMS systems that can respond to major emergencies or disaster situations.

Conclusion

Although there had been few concrete plans laid down in Japan for aeromedical evacuation activities in the event of a major disaster and despite the fact that the many helicopters in the country remain largely unavailable for use by medical relief teams, the two policies of the MHLW that established the DMATs and the doctor-helicopter fleet proved successful for patient evacuation with medical support following the Great East Japan Earthquake. Moreover, it is apparent that the smooth and immediate dispatch of the doctor-helicopter fleet must occur under the direct control of DMAT, independent from local government authority.

References

1. Matsumoto H, Mashiko K, Hara Y, et al. Effectiveness of a "doctor-helicopter" system in Japan. *IMAJ*. 2006;8:8-11.
2. Ukai T. The Great Hanshin-Awaji Earthquake and the problems with emergency medical care. *Ren Fail*. 1997;19:633-645.
3. Kondo H, Koido Y, Morino K, et al. Establishing disaster medical assistance teams in Japan. *Prehosp Disaster Med*. 2009;24:556-564.
4. Martchenko J, Lynch T, Pointer J, et al. Aeromedical helicopter use following the 1989 Loma Prieta earthquake. *Aviat Space Environ Med*. 1995;66:359-363.
5. Nia MS, Nafissi N, Moharamzad Y. Survey of Bam earthquake survivors' opinions on medical and health systems services. *Prehosp Disaster Med*. 2008;23:263-268.