

Case Report

## Hospital Evacuation Assistance from Public and Private Resources: Lessons Learned from the 2018 Western Japan Floods

Mototaka Inaba<sup>a,b\*</sup>, Hiromichi Naito<sup>a</sup>, Tomoyoshi Muramatsu<sup>c</sup>, Taihei Yamada<sup>a</sup>,  
Taizo Sakata<sup>b</sup>, and Atsunori Nakao<sup>a</sup>

<sup>a</sup>Department of Emergency, Critical Care, and Disaster Medicine, Okayama University Graduate School of Medicine,  
Dentistry and Pharmaceutical Sciences, Okayama 700-8558, Japan,

<sup>b</sup>Peace Winds Japan, Jinseki, Hiroshima 720-1622, Japan, <sup>c</sup>Mabi Memorial Hospital, Kurashiki, Okayama 710-1313, Japan

During major flooding in June/July 2018, the Mabi Memorial Hospital in Kurashiki, Okayama, Japan was flooded and patients were stranded in the hospital. Peace Winds Japan, a non-governmental organization, collaborated with the Japanese Disaster Medical Assistance Team and Self-Defense Force Public to transport 8 critical patients from the hospital by helicopter. Ultimately, 54 patients and hospital staff members were safely evacuated. The evacuation was accomplished without any casualties, despite the severe conditions. Public and private organizations can work together and continue to seek ways to collaborate and cooperate in disaster settings.

**Key words:** natural disaster, transportation, rain, relief work, public-private sector partnerships

From June 28 to July 8, 2018, heavy rains fell in western Japan. In July, the total rainfall in all of western Japan was two to four times the monthly average, and some areas were hit with >1,000 mm of rain. At least 225 people died because of flash flooding and landslides triggered by the torrential rainfall. Flooding occurred in the Mabi area in Kurashiki City, Okayama Prefecture, due mainly to the collapse of the Oda River's embankments; 51 people died and 5,600 houses were destroyed. The only hospital in the region, Mabi Memorial Hospital, required a complete evacuation in the disaster. The evacuation was conducted with the cooperation of the Japanese Disaster Medical Assistance Team (DMAT), the non-governmental organization (NGO) Peace Winds Japan (PWJ) Rescue, and the Self-Defense Force (SDF). Hospital evacuation is a rare event, but many hospitals have had to be evacuated due

to earthquakes, flooding, and hazardous material spills; these evacuations were officially performed using public resources [1-3]. Here we provide the details of a complete hospital evacuation accomplished with collaboration between a Japanese NGO and the DMAT and SDF.

A hospital evacuation is a complicated process. Factors to consider during a hospital evacuation include much more than the immediate functional loss of crucial health services such as operating rooms, emergency departments, laboratories, intensive care units, rehabilitation facilities, and pharmacies [4]. This report describes the planning, modulation, and procedure of evacuating hospital patients. The ensuing discharge and care of patients, treatment of injuries, and incident command are addressed. Sharing this experience may help other hospitals develop hospital evacuation assistance plans.

### Report

**Setting.** Mabi Memorial Hospital is a private hospital with 80 adult beds and 23 dialyzers. It is the only general hospital in the Mabi area. Almost all of the hospital's inpatients are elderly and non-ambulatory due to frailty, reflecting Japan's super-aging society. The hospital is four stories high and located 800 meters north of the Oda River, which had collapsed from the heavy rain. As shown in the disaster map, the surrounding area is lowland, which subsequently flooded (Fig. 1).

The evacuation of the hospitalized patients was necessary due to the loss of water, electric, and sewage services. The arrival of external assistance was delayed because the hospital was completely surrounded by water and could not be accessed by land. In addition, the hospital's evacuation request was not received amid the confusion of the disaster information.

**Flooding.** The rainfall that caused the flooding was unusually powerful with the potential to cause terrible damage. From midnight on July 6 to the early morning of July 7, 2018, the rainfall caused the collapse of the embankments of the Oda River, and the Mabi area was subjected to flash flooding. At 5 : 00 am on July 7, emergency requests from area residents to firefighters peaked at 183 per hour. At 7 : 40 am, the immersion of Mabi Memorial Hospital began, and around 8 : 30 am, the supply of electricity and water stopped. Emergency generators failed. At that time, 76 patients and 31 hospital staff members were in the hospital, and many surrounding residents had also evacuated to the hospital. A total of over 300 people were obliged to stay overnight in the hospital, where access to critical services was interrupted.

July is Japan's summer season, and western Japan was also suffering from heat waves, with the maximum temperature exceeding 40°C at that time. As a result,

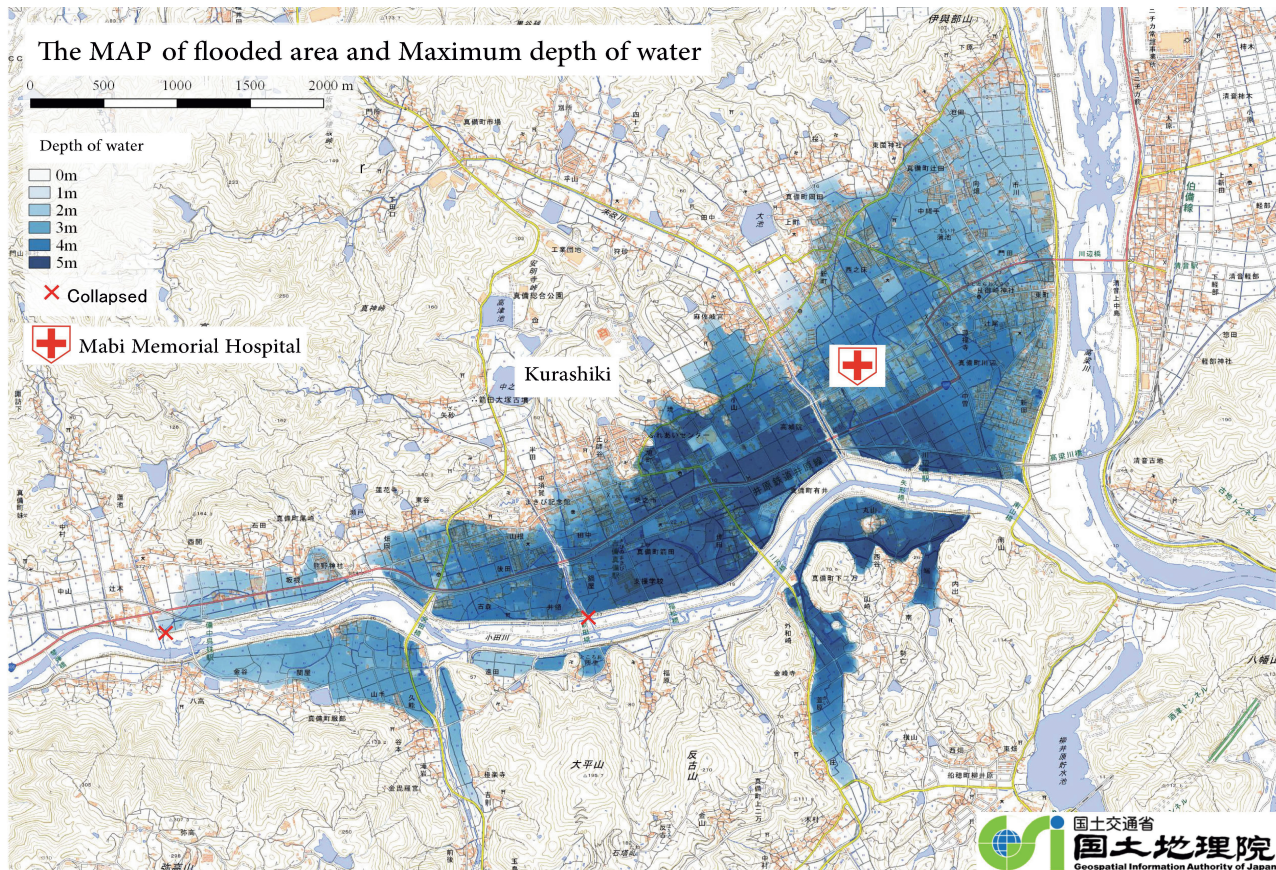


Fig. 1 The Oda River flowing into the Mabi area, and the location of Mabi Memorial Hospital. (Modified map created by the Geospatial Information Authority of Japan [D1-No.919])

elderly patients were even more debilitated in the hospital, where air conditioners could not be used because of the power failure. The hospital was thrown into darkness and patient records were not available because the computer system was down. Around mid-day, the maximum flood depth reached 5.38 meters and the flooded area reached approximately 1,200 hectares.

### *Evacuation assistance*

#### **1. Contribution of the DMAT and the government**

The Japan DMAT program was set up in 2001 by the Ministry of Health, Labor and Welfare (MHLW) based on the lessons learned from the Great Hanshin-Awaji earthquake in 1995. DMATs were defined as trained, mobile, self-contained medical teams that can act in the acute phase of disasters (48-72 hr after their occurrence) such as major earthquakes, plane crashes, and railway accidents to provide medical treatment in affected areas, and the MHLW directed prefectural health departments to include the promotion of training of DMAT personnel in their local disaster management plans. DMATs experienced hospital evacuations during the Kumamoto earthquake, but there have been no reports of cooperation with private resources such as NGOs. On the morning of July 7, government officers and some DMAT coordinators set up Okayama Prefecture Medical Headquarters (OPMH), which included DMAT Adjustment Headquarters, in the Okayama Prefectural government office. The OPMH prepared to follow up with Mabi Memorial Hospital after receiving information from the hospital that “hospital evacuation is currently unnecessary” on the morning of July 7. However, it became impossible to contact the hospital in the afternoon, and the OPMH thus considered dispatching a DMAT to assess the situation. Because the headquarters of the DMAT did not reach an agreement over safety concerns about dispatching to flooded hospitals, the OPMH gave up the plan to dispatch a DMAT at that time. Officials at the Okayama Prefecture governmental offices were also unaware of the need for a hospital evacuation since they had not received evacuation requests from the hospital

at that time and had received only the previous information provided by the hospital.

The next afternoon (July 8), following information from the NGO medical team, a DMAT was dispatched to relief tents set up by the city’s Fire Department. The DMAT cooperated with Fire Department emergency services to take care patients that the NGO and SDF had brought from the hospital by boats and trucks and adjusted the patients’ transfers to appropriate hospitals (Fig. 2).

#### **2. Contribution of the NGO, Peace Winds Japan**

At 9 : 30 am on July 8, the NGO PWJ Rescue and medical teams reached the Mabi area in Kurashiki City. The PWJ is a Japanese NGO that provides search-and-rescue and medical teams in conjunction with public organizations. They have not only a medical team but also an aviation team with resources including two helicopters and a maritime team with resources including amphibious cars. Initially, PWJ Rescue planned to rescue and treat the city’s residents left behind at home. When they reached Kurashiki City on the morning of July 8, one of the personnel at the OPMH asked a PWJ physician to assess and obtain information inside of Mabi Memorial Hospital. Because PWJ Rescue had maritime rescue equipment, they were able to safely reach the flooded hospital using amphibious cars, until 11 : 30 am (Fig. 3).

When the PWJ medical team got into the hospital, the incident command system was not working well.



Fig. 2 Patient transfer from the NGO physician to the DMAT.

Non-ambulatory 44 patients were left in the hospital despite the evacuation of surrounding residents and ambulatory patients by SDF boats; almost all of the patients left behind were elderly, frail patients (Table 1). The temperature was above 30°C in the hospital, and it was anticipated that the elderly patients would face life-threatening conditions without electricity and water. The hospital staff and SDF were burdened with figuring out how to evacuate the non-ambulatory patients. The

**Table 1** Patient characteristics

Characteristics	n=54
Age, yrs	82 (74.5–87)
Female	28 (51.9%)
<b>Mobility:</b>	
Bedridden	24 (44.4%)
Wheelchair	30 (55.6%)
<b>Type of illness:</b>	
Chronic renal failure	9 (16.7%)
Congestive heart failure	5 (9.3%)
Respiratory disorder	9 (16.7%)
Musculoskeletal disease	16 (30.0%)
Malignant disease	6 (11.1%)
Neurologic disorder	5 (9.3%)
Cirrhosis	2 (3.7%)
Others	2 (3.7%)
<b>Transportation:</b>	
Helicopters	8 (14.8%)
Boats	11 (20.4%)
Trucks	35 (64.8%)

PWJ physician discussed the situation with the hospital director, procured a transport method, and proceeded to triage patients for transportation. In addition, since all of the patients left behind needed continued hospitalization, Okayama University Hospital was asked to accept patients, and the PWJ medical team's helicopters transferred 8 patients there directly (Fig. 4).

Next, 11 patients were transported to the nearest shoreline by boats (Fig. 5); 35 patients were transported by the SDF trucks to where the DMAT was waiting, for further transportation. Finally, at 8:30 pm, 54 patients had been successfully and safely evacuated. The operation's success was a result of the cooperation between the NGO, a DMAT, and the SDF.

## Discussion

Considering these successful results, it is meaningful that this hospital evacuation could be accomplished under such severe conditions, without injuries or mortalities. It is also notable that this is the first case in which an NGO, a DMAT, and the SDF collaborated for a hospital evacuation. The medical assistance teams struggled with the decision to evacuate the hospital. The NGO, the DMAT, and the SDF collaborated to successfully execute the hospital's evacuation, transporting all patients without any victims.

The first factor to consider in this evacuation was the decision to dispatch the medical assistance team into the flooded hospital. On the morning of July 7, the OPMH did not dispatch medical teams, as they believed the hospital's initial "evacuation is unnecessary" message to be true. The decision to evacuate a hospital is difficult; an unnecessary evacuation subjects the hospital's patients to otherwise avoidable risks and is costly for the hospital [5]. Decision-makers must weigh the risks, uncertainty, costs, and shrinking time window for evacuations [6]. In retrospect, in this case the OPMH should have dispatched the DMAT to assist with decision-making and share correct information from inside the hospital. NGOs have supported the decision for hospital evacuations in such difficult circum-



**Fig. 3** The NGO team reached the flooded hospital by amphibious cars.



Fig. 4 Patient transport from the hospital rooftop via the PWJ's helicopter.



Fig. 5 Patients transport by SDF boats.

stances.

The second factor to consider is the triage of patients. Generally, in triage we prioritize critical patients; however, in a hospital evacuation, it is difficult to evacuate patients according to these priorities. Schultz [4] proposes that triage effectiveness varies depending on the scenario. As in this case, a hospital's evacuation depends on evacuation resources. It was

fortunate that in this scenario we could quickly use the NGO's helicopters for patients with serious conditions, but the process still took a long time. Evacuation was first started using a PWJ boat, which was available immediately, and we began transporting patients who were ambulatory, but less critical. The Hospital Evacuation Decision Guide [7] states that pairing patients with appropriately trained staff and proper transportation resources is more important than evacuating the sickest patients first, because of the dangers that come with moving these very frail patients.

Finally, communication problems should be discussed. Inadequate communication is a serious problem during disasters, and two aspects of communication problems should be addressed. One aspect is the problems caused by unusable electronic equipment, including telecommunications, and the other is the difficulties in disseminating information among the assisting organizations.

The loss of essential telecommunications systems and health information technology will, at the very least, seriously reduce a hospital's ability to efficiently care for patients [7]. Due to the severe flooding, Mabi Memorial Hospital had no power and the emergency generator broke down after being inundated. Since not all of the electrical and electronic devices in the hospital could be used and since the patient records were electronic, a great deal of effort was expended simply to get the patient information that was necessary for the patients' evacuation.

The NGO collaborated with the DMAT and the SDF for the hospital's evacuation, but we faced many challenges based on the communication problems among these entities. For example, it was impossible to share information on the NGO, DMAT, and SDF operations

among the organizations. Japan's DMAT program uses an Internet-based Emergency Medical Information System (EMIS) to share information on hospital disasters and DMAT activities. While the EMIS has been a very significant medical data sharing mechanism during disasters in Japan [8], only one PWJ physician and no SDF members could access the EMIS. Next, even though the SDF headquarters and OPMH were in the Okayama prefectural government office building, they were on different floors, making it difficult to share information with one another. The PWJ medical team, which provided the only medical assistance from outside the hospital, greatly assisted the hospital staff and triage patients with the selection and provision of appropriate transport resources. However, the PWJ medical team could not share enough information with the DMAT team outside the hospital.

To address these problems, we are planning to build a cooperative pre-disaster system which will include efforts such as a joint drill using each resource. Natural disasters are generally recurrent and unpredictable events that require integrated policies and the combined efforts of all of the local groups including NGOs, national-level, and international-level authorities.

### Conclusion

We reported hospital evacuation assistance from an NGO, a DMAT, and the SDF during the 2018 western Japan flood. Japan is one of the most disaster-prone countries in the world. The NGO, DMAT, and SDF

collaborated to safely and successfully evacuate >50 patients from a flooded hospital. Disaster response recoveries require coordinated efforts between various public and private entities including non-governmental organizations in order to be effective. Planning must involve everyone from these various sectors to ensure coordinated response and recovery efforts.

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