Contents lists available at ScienceDirect

International Journal of Disaster Risk Reduction

First aid stations and patient demand in tsunami-affected areas of Iwate Prefecture following the Great East Japan Earthquake

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ARTICLE INFO

ABSTRACT

We report the number of first aid stations established in tsunami-affected areas following the Great East Japan Earthquake of 2011 and the number of patient consultations, and discuss the demand and supply of medical services in a tsunami disaster. A total of 76,952 medical records from 188 first aid stations in coastal areas of Iwate Prefecture were analyzed and the numbers of daily consultations were calculated. There were only 25 consultations on the day of the disaster, the number rapidly increased to 1603 consultations seven days after the disaster, and reached a peak of 2090 consultations twelve days after the disaster. Request of prescribed drugs for daily use accounted for approximately 30–50% of all consultations during first four weeks after the disaster. We noted the number of first aid stations in each municipality and analyzed the number of consultations during the first four weeks after the disaster, calculated per 1000 residents in each municipality. In municipalities where hospitals and clinics were damaged, the number of first aid stations per 1000 residents and number of consultations during the first four weeks correlated well with the proportion of the resident population in the flooding area. The municipalities with extensive damage needed three first aid stations and 700 consultations per 1000 flooding population during the first four weeks after the disaster.

1. Introduction: background of this study and the Great East Japan Earthquake

In a major disaster, the demand for medical services increases because of the many people injured directly and the subsequent diseases that arise due to the adverse environment of the affected area [1,2]. In addition, medical services rendered can be reduced due to damage to medical facilities and the loss or unavailability of medical staff [3]. The increase in medical demand and decrease in medical services vary according with the type and scale of disaster, and the geographic and social factors. To reduce this gap between demand and supply, it is important to bring medical teams and services into the affected areas and transport sick and injured people out of them [4,5].

The Great East Japan Earthquake, a magnitude 9.0 earthquake that occurred off the Pacific coast of Japan on March 11, 2011, resulted in a giant tsunami that caused damage along a broad coastal area [6]. In Iwate Prefecture, almost all the building structures in the flooding area were damaged by the tsunami; however, away from the flooding area, there was less damage despite receiving severe shock waves from the earthquake, i.e., the extent of damage by the disaster, including to medical facilities, varied depending on the extent of the flooding area [7]. Following the disaster, many first aid stations, which were set up in tsunami-affected areas, supplied first aid to refugees and supplemented decreased medical supply in the area until medical services were sufficiently recovered. In Japan, tsunami disasters have been repeated since antiquity [8], and possibly the Pacific coast of central Japan will experience future earthquakes derived from the nearby Tonankai Trough [9,10]. However, the indicators of required number and medical needs of first aid stations in tsunami-affected areas have not been reported. The indicators of medical needs at disaster sites are crucial in preparing for future tsunami disasters.

This report describes the number of first aid stations set up in Iwate Prefecture following the Great East Japan Earthquake and medical needs of the first aid stations. In addition, it discusses the demand and supply of medical services following a tsunami disaster.

2. Material and methods

2.1. Data collection

The state of all first aid stations established in the coastal tsunami-affected area of Iwate Prefecture after the Great East Japan Earthquake were monitored by the prefectural government's headquarters for disaster control [7], and medical records of the first aid stations were preserved by the government of coastal municipalities or by the medical facilities that assumed the role of first aid stations. Subsequently, the Iwate Prefectural government aggregated these medical records from all first aid stations in Iwate Prefecture and created an anonymized database; further, they commissioned us to summarize the medical rescue activity of first aid stations during the Great East Japan Earthquake in Iwate Prefecture [11]. We were permitted by the Iwate Prefectural government to analyze this anonymized database for the present report.

The daily number of consultations at each first aid station was obtained for the period from the day of the disaster to the day the last first aid station closed. The database stored the following information for each patient consultation: the location of the first aid station, affiliation of the attending doctor, date of the consultation, sex and age of patient, patient's main complaint, diagnosis, treatment, and medications prescribed and utilized. The anonymized database did not contain any other personal information; therefore, an approval by an ethical committee was not required for the present study.

2.2. Data analysis

To investigate the time required for sufficient treatment at first aid stations and the needs of these stations, time-dependent changes in the total number of consultations at these stations and in the proportion of motives for consultation from the day of the disaster to the day all first aid stations closed were analyzed. Further, to investigate the quantity of medical needs of first aid stations based on flooding damage, the number of first aid stations and total number of consultations at first aid stations during first four weeks after the disaster was calculated and expressed per 1000 of the resident population of each municipality in the prefecture. The coefficient of correlation between the numbers of first aid stations per 1000 residents and flood damage indices defined as the percentage of the total population of the municipality living in a flooding area (PFA) were analyzed. In addition, the coefficient of correlation between the numbers of consultations per 1000 residents during the first four weeks after the disaster and PFA was analyzed. Data on the resident populations were obtained from the 2010 census, and the populations living in the flooding area of each municipality were estimated by the Bureau of Statistics of the Ministry of Internal Affairs and Communications [12]. The data of the damage to medical facilities (hospitals, clinics, and pharmacies) was obtained from the Iwate Prefectural government's website [13].

2.3. Role of the funding sources

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

3. Results

3.1. Damage of medical facilities in flooding area

Fig. 1 shows the location of the epicenter of the main shock with the coastal municipalities and their resident populations and PFAs. Table 1 lists the number of hospitals and clinics damaged in each municipality. In five municipalities (Iwaizumi, Hirono, Kuji, Fudai, and Tanohata), there was no flooding damage to hospitals and clinics. In other municipalities with PFA < 50% (Miyako, Kamaishi, and Ofunato), almost all the hospitals and clinics maintained their medical functions; but in municipalities with PFA ≥ 50% (Yamada, Noda, Rikuzentakata, and Otsuchi), most hospitals and clinics were damaged and lost their functions.
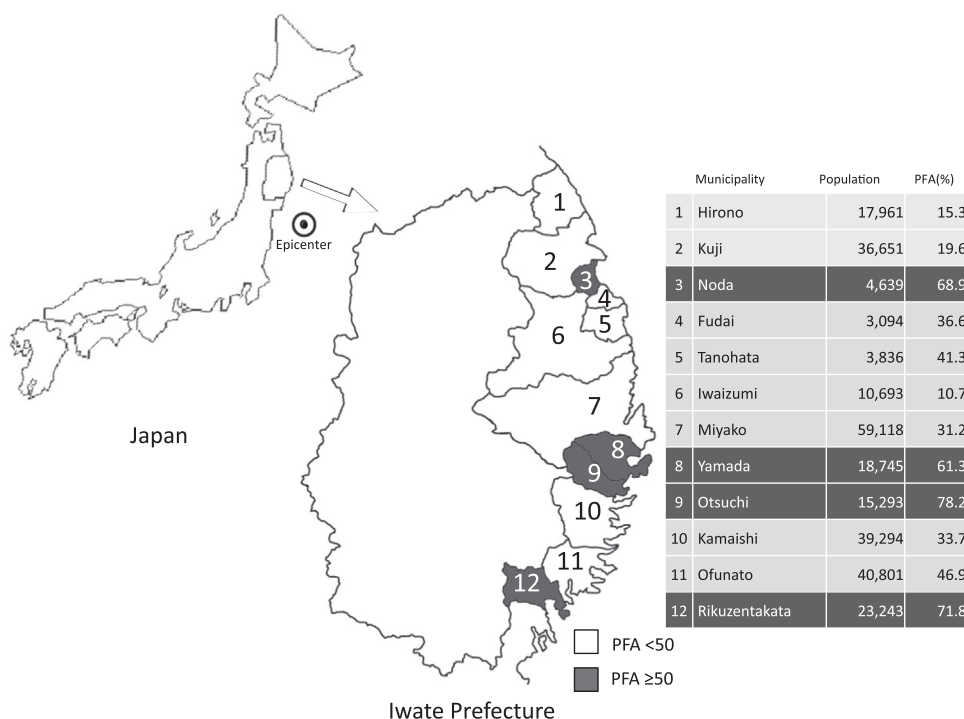

	Municipality	Population	PFA(%)
1	Hirono	17,961	15.3
2	Kuji	36,651	19.6
3	Noda	4,639	68.9
4	Fudai	3,094	36.6
5	Tanohata	3,836	41.3
6	Iwaizumi	10,693	10.7
7	Miyako	59,118	31.2
8	Yamada	18,745	61.3
9	Otsuchi	15,293	78.2
10	Kamaishi	39,294	33.7
11	Ofunato	40,801	46.9
12	Rikuzentakata	23,243	71.8

PFA <50
PFA ≥50

Iwate Prefecture

Fig. 1. Map of the reported area depicting the municipalities and their proportion of the population within the flooding area (PFA) of either < 50% (white areas) or ≥ 50% (black areas).