Misdistribution of Disaster Medical Assistance Team: Preliminary Analysis of DR. HOPE Registry

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Abstract

To investigate the appropriateness of the distribution of Disaster Medical Assistance Team (DMAT) in Taiwan, we analyzed the personnel data registered in Disaster Response HOspital and PErsonnel registry (Dr. Hope registry) database and correlated them with the frequencies and severities of the earthquakes (from January 2001 to December 2001), one of the most possible devastating events in Taiwan. The relative risk of perceptive earthquake is highest in Hualien county and lowest in Taoyuan county, Taipei city, and Kaohsiung city. The DMAT personnel is highest in Taipei city (total 1,042 persons) and lowest in Keelung city, Taipei county, Ilan county, Hsinchu county, Miaoli county, Yunlin county and Taitung county. A linear regression model revealed that poor correlation between the relative risk of the earthquakes and DMAT personnel (R^2=0.018). The covariance value was –2.75. The linear regression model also demonstrated that poor correlation between the population density at risk and the distribution of DMATs (R^2=0.024). The covariance value was –913.39. In conclusion, we find that the distribution of DMAT personnel is not correlated with the relative risk and damage of earthquakes in each geographic area at present in Taiwan. Detailed reevaluation and redistribution of DMAT resources may be vital in good preparedness of disasters nowadays. *(Ann. Disaster Med 2002;1:1-10)*

Key words: Disasters; Earthquake; DMAT

Introduction

Taiwan is an island country with a high population density. Located in the junction of Philippines and the Euro-Asia tectonic plates, Taiwan is prone to natural disasters such as earthquake, typhoon, floods and landslides. For examples, the average number of earthquake is more than two thousands events per year and 200 of them are perceptible.[1] Chi-chi earthquake, one of the most

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deliberating earthquakes in 20th century, hit Taiwan at 1:47 AM on September 21, 1999.[2] After that, the government has hurried up to be engaged in the establishment of a good disaster response system. Disaster Medical Assistance Team (DMAT) set-up was one of the most important links and has been begun since July 2000. Two National DMATs have been established in Taipei and Tainan, corresponding to Northern and Southern National DMAT. With powerful assistances from the Department of Health and National Fire Administration, local DMAT program has also been promoted. However, the adequacy in the distribution of all the DMAT resources has not been verified yet.

Because some natural disasters such as earthquake and landslide may be unpredictable, appropriate emergency medical services and DMAT support may be the key points to reduce mortality and morbidity.[3] Response time is critical in the administration of emergency medical care and special field hospitals established one week later might be too late to prevent early mortality. Many previous epidemiological data confirmed the role of DMATs in disaster response.[4-8] It is therefore logical for us to consider implementing more DMAT personnel and resources in the high-risk areas.

Our society has set up a registry program in our website (http://www.disaster.org.tw)[9] for Disaster Response HOspital and PErsonnel registry (Dr. Hope registry) under partial grant from the Department of Health since 2001. With the preliminary data in this registry (till November 30 2001), we tried to analyze the distribution of these DMAT personnel and their correspondence of the frequency of natural disasters in different areas. The purpose of this study is also attempting to find out the adequacy of DMAT distribution and to provide the guide for adjustment of further resource utilization.

Methods

Dr. Hope registry

We have established Dr. Hope registry for registration of disaster response hospital and medical staffs in the website of Taiwan Society of Disaster Medicine since January 2001. All participants of DMATs (either national or local) have to fill in their basic data such as name, gender, location of residency, and specialties. The specialties include mainly the background of previous training in emergency care such as Emergency Medical Technician-I (EMT-I), EMT-II, basic life support (BLS), advanced cardiovascular life support (ACLS), advanced pediatric life support (APLS), advanced trauma life support (ATLS) and emergency trauma training course (ETTC). All inputted data were kept confidential and analyzed by only

specified personnel of our society. The data were summarized mainly under the categories of different locations of residency.

To avoid the possible missing of data processing, all of the data were reconfirmed by phone communication with every local health bureau. Final data were presented only after the exact registration was keyed in to this database.

Disaster Epidemiology and Demographic Data

The epidemiological data about natural disasters such as earthquakes were surveyed from the web of the Central Weather Bureau, Ministry of Transport and Communication, Taiwan (http:// www.cwb.gov.tw). The demographic data including total population, population density and total area of each locality were assessed from the web of the Department of Interior (http:// www.ris.gov.tw).

Statistic Analysis

All the data were processed and analyzed with SPSS 8.0 for Windows (SPSS Inc. Chicago, IL). The techniques applied to data analysis included descriptive statistics generating and linear regression modeling. On the basis of a review of the medical literature and the availability of data, explanatory variables included sex, intensity of earthquake, age, population density (persons/100km^2), and local DMAT resources, which were data mainly from Dr. Hope registry. A linear regression modeling was used for the correlation of DMAT personnel distribution and earthquake risks and the goodness of fit was checked by F value, with significance level set at α =0.05. Correlation coefficient was recorded. In addition, covariance analysis was also performed to justify if the correlation from linear regression model was comparable.

Results

Earthquake Epidemiology and Demographic Data

Table 1 depicts demographic data such as population and population density and frequency of perceptive earthquake in each city and county of Taiwan. The population is highest in Taipei county and lowest in Taitung county. The population density is highest in Taipei city and lowest in Taitung county. During the observation period, the total earthquake number is 14,454 in Taiwan. The total number of perceptive earthquake is 233 (1.6%). As shown in Table 1, relative risk of perceptive earthquake is highest in Hualien county and lowest in Taoyuan county, Taipei city, and Kaohsiung city.

Adequacy of DMAT Distribution

The personnel of DMATs are also depicted in Table 1. The DMAT personnel is highest in Taipei city (total

1,042 persons) and lowest in Keelung city, Taipei county, Ilan county, Hsinchu county, Miaoli county, Yunlin county and Taitung county (no personnel data and assumed as zero). The relative risk of earthquakes was measured as relative frequency compared with that in Taipei county. A linear regression model revealed that poor correlation between the relative risk of the earthquakes and DMAT personnel (R^2=0.018) (Figure 1). The covariance value was –2.75 that meant the distribution of DMAT personnel was somewhat negatively associated with the relative risk of the earthquakes.

In consideration of the impact of natural disaster on various areas of different population densities, we calculated the population density at risk by timing population density in each area and its correlating relative frequencies of earthquakes. A linear regression model still demonstrated that poor correlation between the population density at risk and the distribution of DMATs (R^2=0.024)(Figure 2). The

Table 1. Demographic data and frequency of perceptive earthquake in Taiwan

County City	Square measure (km2)	Population	Density (People/km2)	National Ratio	Perceptive earthquake	Ratio	DMAT
Taipei county	2052.5667	3606602	1757.12	16.11%	1	0.43%	
Ilan county	2143.6251	465818	217.30	2.08%	38	16.31%	
Taoyuan county	1220.9540	1760435	1441.85	7.86%	0	0.00%	102
Hsinchu county/city	1531.6895	818365	534.29	3.65%	3	1.29%	
Miaoli county	1820.3149	560376	307.85	2.50%	7	3.00%	
Taichung county/city	2214.8968	2483994	1121.49	11.09%	7	3.00%	150
Changhua	1074.3960	1313839	1222.86	5.87%	2	0.86%	
Nantou county	4106.4360	541748	131.93	2.42%	24	10.30%	26
Yunlin county	1290.8351	742980	575.58	3.32%	0	0.00%	
Chiai county/city	1961.6981	831665	423.95	3.71%	23	9.87%	93
Tainan county/city	2191.6531	1847932	843.17	8.25%	13	5.58%	135
Kaohsiung county	2792.6642	1236737	442.85	5.52%	1	0.43%	49
Pingtung county	2775.6003	908673	327.38	4.06%	4	1.72%	79
Taitung county	3515.2526	244338	69.51	1.09%	26	11.16%	
Hualien county	4628.5714	353044	76.27	1.58%	83	35.62%	100
Keelung city	132.7589	390757	2943.36	1.74%	1	0.43%	
Taipei city	271.7997	2634614	9693.22	11.77%	0	0.00%	1042
Kaohsiung city	153.6029	1493909	9725.79	6.67%	0	0.00%	236
Total		22393488			233	100.00%	

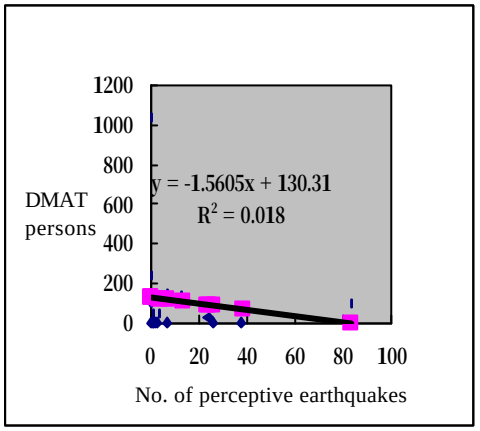

Figure 1. A linear regression model revealing that poor correlation between the relative risk of the earthquakes and DMAT personnel

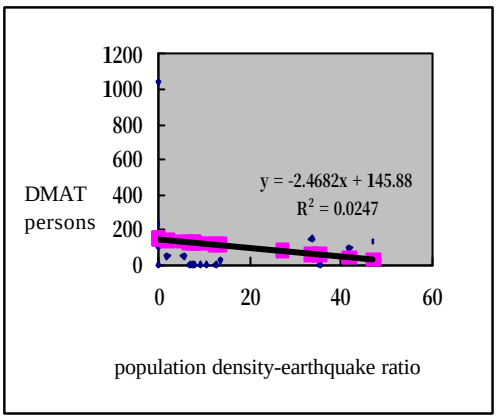

Figure 2. A linear regression model demonstrating that poor correlation between the population density at risk and the distribution of DMATs

covariance value was-913.39.

All of the above results that the distribution of DMAT personnel is not correlated with the relative risk and damage of earthquakes in each geographic area at present.

Discussion

In Taiwan, there are 700 private and public hospitals that can provide more than 120,000 beds for inpatient care.[10] National medical insurance covers more than 95% of citizens and nearly all-personal health care expenses. It has been divided into 17 emergency medical service regions that incorporate emergency medical care facilities and local fire departments since 1989. Fire fighters provide out-of-hospital medical care and ambulance services. All of them have received emergency medical technician (EMT)-1 training (a 60-hour course), and half of them have received EMT-2 training (a 260-hour course).[1] Fire fighters and some volunteer groups were responsible for search and rescue work. Most of them have received primary rescue training and were equipped with simple extrication equipment; and most of medical professionals did not have enough experience or expertise in the management of multiple casualties.

The devastating effects of earthquakes on human life have been demonstrated repeatedly in the past decade, as several major earthquakes have struck in urban areas. The earthquakes in 1999 in Turkey,[11,12] Greece,[13] and Taiwan[1] collectively took the lives of more than 10,000 individuals and injured perhaps hundreds of thousands more. There have been several devastating earthquakes in Taiwan in this century resulting in heavy casualties, collapsed buildings, and heavy losses in property.[14] With rapid economic development, increased population, and higher concentration of tall buildings, disaster medicine has become more urgently needed. Besides well-

organized local emergency medical response systems, DMAT systems are pivotal to providing a successful disaster response. Safar,[15] studying the 1980 earthquake in southern Italy, concluded that 25 to 50 percent of those who were injured and died slowly could have been saved if first aid had been rendered immediately. Studies by Pretto et al. of earthquakes in Armenia[16] and Costa Rica[17] identified people whose deaths might have been prevented had they received medical attention in the first six hours after the temblor.

The responsibilities of DMAT include responding to the disaster need with emergency medical personnel and equipment, initiation under incident command post, emergent management of the injured (triage, stabilizing, and transportation), coordination with other responding medical teams, and back-up of consequent medical care. To get good cost-effectiveness, the priorities of DMAT set-up should depend upon the necessity of different localities. And the establishment of adequate and effective DMAT systems is one of the key components in disaster medicine.

However, in our study, the distribution of DMAT in Taiwan is still not adequate at present although the central and local governments have been engaged in this work. In other words, the distribution of DMAT personnel is not correlated with the relative risk and damage of earthquakes in each geographic area. The conditions may deserve to be re-evaluated except that the mutual assistances among different DMATs are perfectly on the way. For example, the Northern National DMAT can reach Hua-Lien within 6 hours when the latter met with devastating earthquakes. Otherwise, the function of the present DMAT system will be limited.

There are some limitations in this study. First, the registration in Dr. Hope registry is not complete. Although we have tried to complete the data by contacting with Department of Health and Local Health Bureau, many results are disappointed. Some bureaus may refuse to provide the data due to the reason of confidence. It may be due to misunderstanding to the aim of our survey. Our secondary aim is to provide open and available disaster medical resources in order to get immediate aids when disasters do happen. We shall do our best to communicate with every health bureau to establish together a good DMAT system. Second, we only studied the adequacy of DMAT distribution for possible devastating earthquakes because of limited disaster information. Many other natural disasters and man-made disasters are not taken into consideration. For example, the risk of terrorism may be highest in Taipei city. Because no comparable data could be enrolled for analysis at present, we also expect the research departments involved in

disaster survey can provide more detailed information for every kind of disaster. It will be of benefit in disaster planning and management in the future.

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災難醫療救援隊地區分佈的適當性：DR. HOPE Registry 的初步分析

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摘要

為研究災難醫療救援隊在台灣各地區分佈的適當性， 我們分析了登記在災難應變醫院及人員資料庫（Disaster Response HOspital and PErsonnel registry**，即** Dr. Hope registry**）中有關人員的資料，並與** 2001 **年１月至** 2001 **年** 12 **月間台灣各地區發生地震的頻率及嚴重度做比對。有感地震的相對危險性在花蓮縣為最高，而最低的縣市包括桃園縣、台北市及高雄市。相對地，災難醫療救援隊人員在台北市登錄的總數最高（共** 1,042 **人），而在基隆市、台北縣、宜蘭縣、新竹縣、苗栗縣、雲林縣及台東縣則沒有人員登錄。我們以線性迴歸模型來作分析，可發現各地區發生地震的相對危險性，與災難醫療救護隊的人員編制並無良好正相關** (R^2=0.018)**。共變數值為**–2.75**。該線性迴歸模型也顯示各地區處於地震危險的人口密度，與該地災難醫療救護隊的人員編制，同樣沒有正相關** (R^2=0.024)**。 而其共變數值為**–913.39**。因此，我們的結論是當前在台灣各地區，災難醫療救護隊人員的編制及分佈，並不對應於該區域地震所可能造成的傷害危險性。謹慎的對災難醫療救護隊人力資源的重新評估及再分配，乃是當今台灣做好災難準備的重要步驟。***(Ann. Disaster Med 2002;1:1-10)***

關鍵詞：災難；地震；災難醫療救援隊

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