ZEMMOURI, MIYAGIKEN- HOKUBU AND TOKACHI-OKI EARTHQUAKES AND THEIR IMPACT ON HOSPITALS

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Introduction

In this paper the authors present results of several studies about hospitals after the occurrence of three major earthquakes in the year 2003, Zemmouri earthquake, *M*=6.8, of May 21, Algeria, Miyagiken-Hokubu earthquake, *M*=6.2, of July 26, Japan and Tokachi-Oki earthquake, *M*=8.0, of September 26, Japan. Some lessons learned from the damage to health care facilities will be presented as well as the weak points that caused the malfunction of the facilities. Results were obtained through visits to the damaged areas and through results that were presented in some reports.

Comparison

At first the PGA, magnitude and the number of victims will be considered. In Algeria the PGA was about 500gal, in Japan, Tokachi-Oki earthquake, the PGA was 972.6gal at Hiroo station, according to *k-net.bosai.go.jp*. After recognizing the PGA and the magnitude mentioned above, anyone can expect that the damage in Japan is much more severe than the case in Algeria. The following figures represent the number of injuries and the number of deaths caused by the earthquakes in both countries:

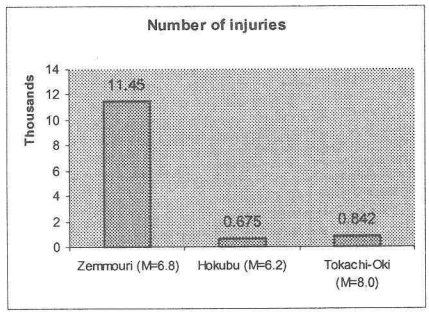

Fig. 1 Injuries toll

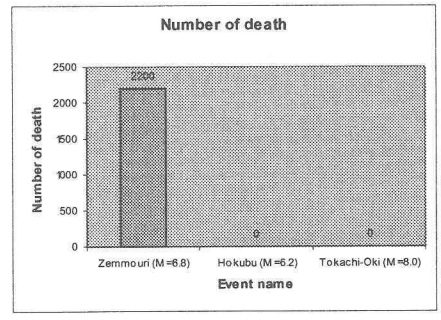

Fig. 2 Death toll

According to the results in Figs. 1 and 2 the difference is very clear. Despite the strength, the biggest number of injuries as well as death was in Algeria. So it quite clear that the preparedness in Algeria is not taken seriously. The following data were collected during the visit of the authors, July 2003, to some hospitals in Algeria.

Damage to the hospitals in Algeria

The following information was collected through interviews with some of the personnel and some investigations within the facilities. Two hospitals were visited; the first, Thenia Hospital, was very old. It was built in 1870 and the second, CHU Centre Hospital, was newer than the first but relatively old too. The first hospital suffered very severe damage to its structure, since it was built using non-reinforced masonry. The main building was rendered inoperative and so some prefabricated buildings were brought by the Ministry of Health to be used instead of the actual building, as shown in Photos.1 and 2.The second hospital did not suffer severe damage to its structure, although it suffered some cracks, as shown in Photo.3, and damage to its lifelines.

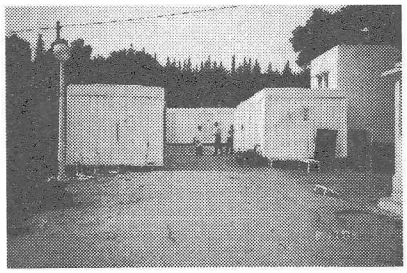

Photo. 1 Prefabricated buildings- Thenia hospital

Photo. 2 Structural damage – Thenia Hospital

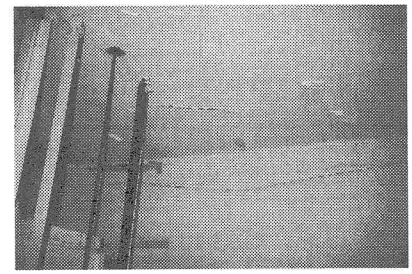

Photo. 3 Cracks – CHU Centre Hospital

Both hospitals suffered from interruption to the water supply, electric power, telecommunications and gas supply. In some cases there were alternative sources for some lifelines and in others there was none, such was the case of telecommunication. Equipment was noted to have fallen and in some cases they were rendered inoperable. The hospitals were inaccessible, a fact that made movement within the facilities very difficult. The number of staff was not sufficient, even before the earthquake; almost all of them did not have any special training for such a disaster. Some staff members were injured and could not work with the rest of their colleagues while some others could not even reach the facility because of the damage to the roads.

Damage to the hospitals in Japan

In Japan the situation was much better. However, there were two hospitals, Kashimadai hospital (built in 1968) and Hakuya hospital (built in 1969) that suffered very severe damage to their structures by the Miyagiken-Hokubu earthquake. Both hospitals are reinforced concrete structures. Columns in the second floor of the Hakuya hospital suffered shear failure. In Kashimadai hospital similar damage as the previous hospital was suffered to some of its columns. The Kushiro Urinary Organs Clinic suffered damage to some of its equipment as well as to its water system, as shown in Photos 4, 5 and 6 by the Tokachi-oki earthquake.

Photo. 4 Equipment damage – Kushiro Clinicl

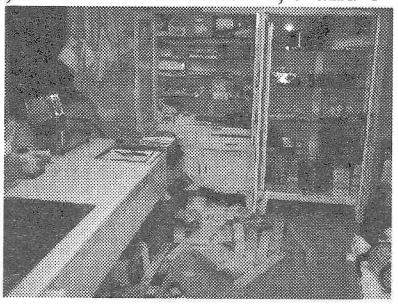

Photo.5 Fallen equipment- Kushiro hospital

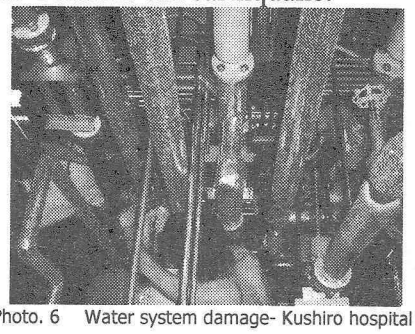

Photo. 6 Water system damage- Kushiro hospital

Conclusion:

The case of Algeria is very difficult since many factors are included in the saving, rescuing and treating of victims. As we have seen so far, hospitals suffered two important forms of damage: structural and non-structural (including lifeline and equipment) damage. These forms of damage have a huge impact on human life as they resulted in many injuries being transferred to others hospitals, others couldn't even receive treatment as the hospitals themselves were severely damaged or the failure of the equipment hampered treatment, such as the case of the radiology service in the CHU hospital. Organizational aspects had a big impact too, since the majority of the personnel were not able to work in such conditions. The majority of the hospitals staff confirmed that they did not receive any kind of training for such a kind of disaster. Outside of the hospitals had an influence on saving lives too, since many roads were closed injuries, as well as many personnel, were not able to reach the hospitals. The number of personnel was a big problem too, even before the earthquake.

In Japan, the situation was not very good either as the state of hospitals such as Kashimadai and Hakuya hospitals show. Some hospitals suffered damage to their equipment as we have seen in one clinic in Kushiro city. Some roads were severely damaged, but no information about their impact on hospitals was found to be available. Information regarding hospitals in Japan was difficult to find, therefore we have circulated a questionnaire survey to find out the vulnerable points of some hospitals.

Lastly, the Algerian case needs a lot of work to be done, in particular with regards to the organizational aspect. Especially since the first step in preparing hospitals for an event/disaster is organizing its capacities (structural, human, equipment). The Japanese case needs more attention to the non-structural elements in particular equipment. The equipment needs to be well anchored with flexible connections to not cause any secondary damage.

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References:

Nebil Achour et. al, Proceedings of the Fifth International summer Symposium, JSCE , July 2003 Tokyo, Japan, pp-65-68.