Cross-cultural Elaboration of Seismic Safety Augmentation Schemes of Medical Systems – Islamic Cities and Japan

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ABSTRACT :

Japan institutionalized nationwide dispatched medical assistance teams. Performance augmentation of existing information system of dispatched teams for strengthened navigation ability has been sought. We have so far developed and tested technical elements under dense collaboration with emergency medical doctors. This idea strengthens decisively the medical operations in stricken areas and very inexpensive. We are ready to finalize this implementation oriented technology with DRH members.

KEYWORDS: SAFETY OF HOSPITALS, DISPATCHED MEDICINE, ISLAMIC AND JAPANESE

1. INTRODUCTION

Earthquake Disaster Mitigation Frontier Research Center (EDM) of the National Institute for Earth Science and Disaster Prevention (NIED) has two authorized subjects: Engineering for Disaster Medicine (EDM1) and Emergency Digital Management (EDM2). The former consists of (1) protection of hospitals and (2) logistic capacity building of disaster medicine. Five-year research program starting in 2006 was approved by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of the Japanese government.

Current medical systems are increasingly becoming highly sophisticated and consequently becoming vulnerable to earthquakes; therefore, we need repeat full examination of every element like buildings, utilities, equipments, information systems and management practices. On the other hand, disaster medicine is played over a wide geography and every on-site clinical operation in disasters is not feasible without successful realization of logistic chains of medical staffs, instruments and supplies. A spider-web of tremendously huge number of logistic chains covers the society. EDM1's study of logistics aims at ensuring prompt delivery of effective medical services: dispatch of medical staffs and other personnel, transportation of victims and inpatients, medicines, supplies and equipments.

Dominated by the traditional principle of "almighty doctors", medical doctors in Japan are supposed to manage everything. But medicine itself contains many interdisciplinary components, and recent rapid progress in medicine has posed many heavy burdens on medical doctors. Accordingly, doctors as a leader of medical teams are forced to play a superman. If single humans have to carry out this role, a powerful supporting system is necessary. Basically, medicine is really a nation's rare treasure. It was bred at the expense of huge amount of national spending. We should not disperse this resource to unessential work but concentrate to its inherent function. Said differently, medicine is tactics; it needs strong support, whether strategic or logistic.

On the other hand, hospitals and medical staffs are near full up to capacity even in ordinary times. In many countries, national medical spending has been growing, and hospitals are under regular pressure toward cost reduction and income rise. As a result, hospitals, through chronic repression of vacancy and personnel reduction, have increasingly lost flexibility/redundancy already from daily work. Accordingly, EDM need stick to the cost efficiency of their outputs concerning medical services and local government's service. If EDM's products are costly, hospitals cannot accept, and this is logical and reasonable.

In the current Japanese public administrative framework, around six hundred big hospitals were designated core hospitals in Japan and appropriate national support was granted. Fig.1 shows their geographical distribution. This network defines the skeleton for national disaster medical response. But even the biggest of the designated hospitals cannot accommodate hundred victims at once. In normal times, these hospitals provide emergency service. Therefore, they are distributed around the country and their coverage is stretched thin. Therefore, once a

certain region is severely hit, it is imperative to disperse the burden of casualties as soon as possible. If we can manage it, the medical workers on the ground in damaged areas will be freed greatly.

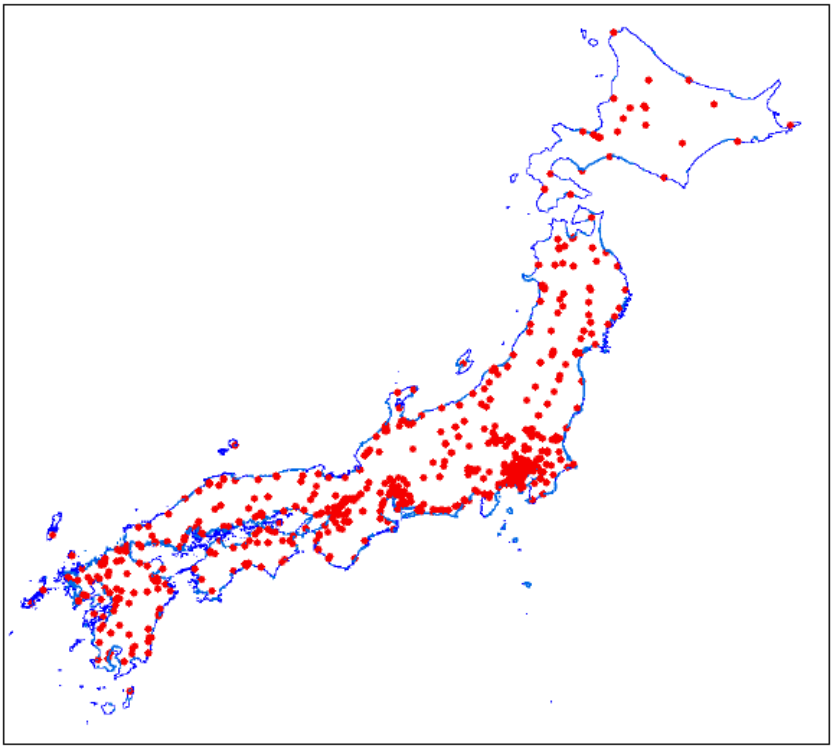

Fig.1 Designated base hospitals network

Surprisingly, at the start of the project, EDM1's mission was unprecedented within the Japanese research atmosphere; it was really a frontier. Consequently, we have had spent much effort for understanding a broad range of problems surrounding hospitals and disaster medicine. In contrast, EDM2 had a decade long history of development of an originally manufactured GIS and ample records of applications before the current term started. Its activity has enjoyed continued support of national funding, mostly from the MEXT. Accordingly, its system nourished a highly transparent publicity; it has a high degree of openness and freedom, with no curbs from oversea makers. There is no black box at all; *i.e.*, motivated users can freely customize. Appropriate customizations enable them to fit the system to various site-specificities.

Since the birth of the system in the aftermath of the Kobe disaster, EDM2 has mainly tried disseminating the software in local governments. This is because the local governments should assume the pivotal role in protection of the residents from future disasters. This will be detailed in Chapter 4. Combination of EDM1 and EDM2 is vital because real medical problems in a disaster always demand a compound of medical services and local public services. On the contrary, people's growing concern about stable and sustainable public health care delivery is demanding increasing involvement of medical elements in local governmental services.

Just like the case of hospitals, EDM2 is developing a comprehensive menu to augment the cost efficiency of local public service. Generally, EDM2's IT-driven approach has a broad potential for overall innovation. One motto of EDM is "to approach one step closer to objects and create one level sharper solution"; we have so far adhered to the real world of users: local governments, disaster responding agencies, hospitals and residents.

Every time a big earthquake hit, we used to meet reports of malfunction of IT systems. It is normal at all. If the tools had not been used in daily jobs, they would not function in emergency. Big earthquakes are rare. Therefore, post-earthquake-only tools would be of low cost-efficiency or useless. Therefore, we should build emergency response systems in a manner that they work in everyday tasks and not earthquake-only. This is a crucial point because this inevitably demands innovation of daily jobs. As a matter of fact, EDM2 has been seeking to create a kind of economical buoyancy in the local government, by replacing poorly productive handworks with their GIS system. EDM2's penetration is one step closer and they are implementing agressively. Recently, the MEXT granted new project money for this effort.

2. REFLECTION OF RESULTS INTO THE DRH-ASIA

Recent devastating disasters like the Sichuan earthquake, extreme weather events possibly linked to the climate change or emerging/resurgent epidemics are urging international cooperation in research and practice in disaster reduction. Fortunately, as a part of the EDM research plan, an international outreaching program was approved officially (EDM3), and this has kept close ties with the DRH-Asia. The above mentioned EDM's one step closer approach had been originally born in the DRH activity. We believe this harmonizes with the DRH's signature doctrine of implementation. While this paper tries to install a cross-road theme for the three EDM research subjects, it is also an attempt to follow up the DRH outputs. But we have to summarize basics of disaster reduction before entering into the subject.

To respond to a disaster, one needs simultaneous consideration of hazards/damage and available resources. Here, hazards are natural process, and common methods are applicable everywhere. But societies differ greatly and, accordingly, damage and available resources of the society differ. Thus, damage and responding capacity is society-specific. These site-specific issues have much better fitness to international collaboration than site-independent methodological discussion about hazards. In other words, heterogeneity across countries is the No.1 theme for international collaboration, and so are the social aspects of disasters[1]. DRH need raise much more arguments on social aspects of disaster reduction rather than hazards. Disaster response is an optimization of selection of series of actions under given resource constraints, in which preparedness or disaster planning results in relaxing the resources constraints. Resources involve physical and human, and physical resources involve various supplies and infrastructures.

In DRH-Asia, we proposed to acknowledge Chinese, Indian and Islamic as basic elements in terms of culture and other social settings[2]. All the more, through the decade-long international collaboration efforts, all headed by Prof Kameda, we learned that we needed something more from the Islamic world. Our study to date told that the Islamic world has many noticeable merits in terms of disaster resiliency, *e.g.*, grass-rooted, or decentralized, toughness of society. We even acknowledged seriously some superiority of the Islamic spirituality or mentality to our current, much selfish in the name of secularism or individualism, way of life. This is vital because resiliency of societies heavily depends on the cohesion in the society. What gives it matters!

But in Japan, while Chinese and Indian things are popular, Islamic elements are often perceived rather remote. Therefore, we have advocated explicit and intentional introduction of Islamic elements into the DRH-Asia. And yet there was the kind of Islam barriers in front of us once we wished to take the one step closer to the Islamic society. Collaboration with the natives appeared the unique solution toward breakthrough.

First category of candidates is a comparative research on protection of historical buildings from earthquakes. For example, in the DRH-Asia database, there are articles on the disaster reduction efforts in Casbah of Alger and Japanese practices of reinforcing historical wooden buildings. In fact, Japanese history witnesses profound influence of Western Asia. They used to be represented as being from 波斯(Persu). Many Persu people are known to have lived in Japan, serving Japanese rulers with their advanced technologies as early as seventh century, which the authors called "the great era of global political crust movement" [2]. There are even possibility that the fine devices for ancient wooden building cited above, which have been believed indigenous in Japan, should be linked to the fine stone cutting that was full-fledged in Sassanid Iran many centuries before. We do continue to explore this kind of indigenous wisdom in history.

This is a romantic notion and appeals to our soul. But if we want to learn today's living societies, we need more. Recently, Iranian team provided the DRH database with its disaster resilient urban planning of Tehran. Although details have yet to explain, we think this will offer many materials for our concern. Urban planning is in its nature holistic and comprehensive; it can contain a variety of implementation oriented technology, process technology and indigenous technology. Many Japanese DRH members have ample experiences about energy efficient and environmentally low-loading urban reform in Japan.

Motivated by this, we drafted a possible material for new cooperation. This is a GIS-based supporting system for dispatched disaster medical service teams, which is shown in Chapter 5. The concept of dispatched assistance teams is flexible, inexpensive and of broad applicability. We are planning bilateral collaboration, with no introduction of completed system at all. While we can offer materials and advices, our partners will do every crucial work by their own. Proud nation will appreciate this approach. At the same time, we must be aware that geographical information tends to be sensitive; it is often classified as national secrecy. We should acknowledge

the difference of the level of openness that is acceptable for the government; we will not enter inside the database created by others.
EDM's gain will be threefold. First, we will get a good partnership toward challenging bigger enterprises. Second, we can observe how the created model works well or not in a different socio-political setting. It will feedback us many suggestions toward advanced models. But the third will be most exciting. So as to accommodate our model, we will approach one step closer to the real population. This will teach us about Islamic world a lot more in detail than from books, something more vivid and lively

3. HOSPITALS IN EMERGENCY

Post disaster response of a hospital will include efforts toward maintaining ordinary function, evacuation if necessary, recovery of function from the damage, compensation of lost resources and procurement of additional resources for added needs. All these are showing the dimension of the works that fall on every hospital involved. Hospitals' role in big disasters is extensive. Even in normal times, hospitals are deeply rooted in the society and, in disasters, face rampant growth of needs from the surrounding communities. Thus, the essence of disaster medicine lies in how to overcome this sudden discrepancy between needs and capacities. Adding to the reconstruction of the hospital's function, the control of needs and the mobilization of resources are needed.
These must be done in a coordinated manner. It's because of a poor coordination that past disaster medical responses failed. Much of the deaths of the 1995 Kobe disaster occurred through the lack of mechanisms for cooperation among hospitals. We will revisit the subject in Chapter 4.
Safety of individual hospitals is most fundamental. But even the seismic safety of a single hospital contains many problems: protection of humans (patients, medical and paramedical or even non medical staffs, other workers and visitors), safety of buildings, medical equipments and supplies, acquisition of electricity and sanitized water, etc.
A hospital is an open system that interacts closely with the outside. It accepts injured patients from the surrounding, treats them and returns them back in an improved status, while it absorbs many resources, consumes them and discharges wastes or exhausted resources. Human resources including medical staff, co-workers or visitors have to refresh in the outer world, and consumed goods need replacement. A hospital is rather like a metabolic body[1]; it consumes a mass quantity of expensive resources and discharges many hazardous or perilous substances. All these resources must be supplied from outside and all the wastes must be absorbed by the outer world. Supply chain of foods, water, electricity etc. or medical instruments is vital to the business continuity of the hospitals; therefore, hospitals and surrounding society have to strengthen interaction in disasters. Network formation of hospitals, accommodated by powerful and robust communication and transportation is vital to the resiliency of disaster medicine. Even if a hospital remains intact after a big earthquake, if surrounding society loses function, the hospital would not function.
A hospital is also a rapidly changing dynamic body. Its situation and environment change incessantly. In normal times, moderate adjustment will suffice. But after a disaster, resources of the hospital are damaged, while health care needs for inpatients grow and outpatients gather rapidly. Loss of resources, shortage of manpower and loss of equipments and supplies, and rise of needs thus occur at once. Drastic shift into different schemes for management would be inevitable. Thus, development of emergency management scheme and corresponding capacity building are the core of hospitals preparedness.

4. NATIONAL DISASTER FIGHTING ARRANGEMENTS

As was mentioned in Chapter 2, disaster responding capacity is site-specific social characteristics. We therefore have to outline the shape of Japanese disaster responding as an introduction to the description of our research plan of a dispatched team supporting device. Japan's rapidly aging society with declining birth rate is threatening to lose disaster resiliency of the society. On the other hand, a great number of disaster fighting resources have been created and deployed, and if we manage them well, our disaster fighting will become much more effective than before.
Japanese public administration has three-layered hierarchy: the nation–prefecture–municipality. Basically, municipalities are responsible to protection and support of their residents. As the damage overwhelms the capacity of the municipalities, prefectures and the nation will strengthen their participation stepwise. Order

enforcing agencies like the Police, the Fire Department, the military etc. have national structure and a nationwide deployment. All these have created rapid dispatch specialty teams. They have self-supply capacity and completely disciplined manpower and can achieve heavy missions if orders are solidly given [3]. We call them solid agencies. Normal nations maintain established solid entities from normal times. We call them solid because they have sophisticated but nonflexible operating rules as well as solid organizational structure. These agencies can solve heavy problems at the expense of flexibility.

Japanese legal system poses comprehensive authority and responsibility to municipalities for safety and life of residents; accordingly they cannot be solid because the demands from live people will be scattered, random and anarchic. Medical care is similar. While enormous core hospitals are managed by a public government or a legally mandated corporation like *Japan Red Cross*, human services are hard to formalize or predict. The Police that are primarily responsible to law enforcement is unique because they require both power and flexibility. There is another kind of vein: deep penetration of national power. Japan is well-known for powerful national control of society. All the activities are under regular monitoring, control and help of the national government, which actually takes a role of last resort. Thus, public disaster responding administration as a whole, constitutes a broad spectrum in terms of their features and structures. Reviewing, recalibrating and rebalancing this spectrum as a whole, together with the development of coordination skills, is most crucial for organized national mass responding.

There are another group of entities that have behavioral solidity: utilities and providers of infrastructure for communication, transportation and others. In the aftermath, national associations of these facilities will devote themselves solely to recover their systems. Normally, they complete their missions sooner than expected. Managerial and governance structure of broad infrastructures like roads and highways, railways, electric power, water and gas have tightly coordinated through traditional pervasive national administrative presence and multiple networking of post disaster mutual assistance agreements.

There are a variety of nonsolid organizations or groups, from the local governments and hospitals to commercial firms or voluntary groups. In Japan, commercial firms have got deeply involved in disaster responding actively, too. Still surviving loyalty of majority workers to the firm realized this. This sector is representing emerging resources in disaster responding that has long been regarded as exclusively public matters. As economic activity becomes dense, industrial chains from the materials to final products develop; if some makers of crucial parts for, *e.g.*, autos or electronic appliances, the influence can spread across the country. International influence is undeniable too. The concept of “business continuity” or “service continuity” is being spotlighted in recent earthquakes. Private bodies have exceptionally unique strength; very fast decision making. Time is money in disasters. Lastly, Japanese corporations traditionally hesitated the capitalist pursuit of profit and are sensitive to social reputation. Intrinsic publicity within Islam commerce is widely known, too. This may be one of truly ethnic Asian characteristics.

Thus, ever growing nation-wide support systems will relieve the local responding bodies in a stricken area from the burden of massive post-disaster operations. But they are now facing another new mission: coordination of massive actors gathering from all over the country. In disaster, drastic discrepancy between needs and resources is inevitable. Competitions and conflicts for scarce resources are also doomed. Someone has to carry coordination and reconfiguration capabilities of external help and survived resources. This is the key responsibility of the local governments because they are familiar with the area; *i.e.*, they should take charge of management of inflow of various supporting resources from exterior. Mobilization of hidden resources and development of brand-new ones are also desirable. Actually, however, few local governments are prepared in Japan.

This is crucial for national disaster medicine, too. In Kobe earthquake, many hospitals were heavily damaged. Even the survived hospitals lost function soon, first by the power failure and then by the cut off of water supply because most emergency generators were water-cooled. acute medicine was completely paralyzed and thousands of deaths were believed preventable. Mismatching of needs and capacity at medical facilities has been condemned for this dramatic inability. While some hospitals sank in the flood of coming victims, much fewer victims visited other hospitals. Coordination of dense but scattered national medical force is the central question to be addressed.

Recently, several moderate earthquakes in Japan attacked sparse and aged region with poor infrastructure. Stricken local governments died almost immediately after the main shock. While newly created nation-wide assistance teams from the Police, the Fire Department and the Self Defense Force worked, sudden death of the

local governments impeded this effort very much[3]. They are familiar with every local matter, and if they had taken charge of coordination and guidance, the dispatched assistance forces would have achieved more success. Local governments need capacity building.
EDM2 engineers observed this in the Kobe earthquake and began developing GIS system and tried applying it to disaster resistant capacity building of municipalities. Interested local governments have introduced this software, aiming at rationalization of peacetime jobs, overall cost reduction and capacity enhancement of personnel.
This system is workable for daily services; *e.g.*, the management of social infrastructures or the welfare of some weak cohorts etc. The data for these daily services is workable as it is in disasters; neither additional cost nor time is needed for data building. Last but not least, thanks to its multi-lingual capacity, this system has been used in oversea countries.

5. JAPANESE DISASTER MEDICAL ASSISTANCE TEAM

As mentioned above, recently, nation-wide emergency search and rescue teams within the Police and the Fire Department have been created. Available procedures for mobilization of the Self Defense Force were also arranged. Correspondingly, dispatched disaster medical assistance teams (DMAT) were also institutionalized. These anti-disaster resources enhancing efforts have been enormous. National business networks, public as well as commercial, were actively sought and developed. Many commercial firms for recovery of infrastructure and facilities constituted associations for mutual aid. In Chapter 4, we saw the criticality of formation of coordination mechanisms of these growing anti-disaster resources. While we have to establish a complete, whole coverage coordination scheme in the long run, we have to first solve particular problems. This is what we want to explain here.
The DMAT was created in the United States. Their teams are very huge, self-contained and heavily equipped. Similar ideas have long been embraced publicly in Japan since the 1995 Kobe event. But Japanese financial authority was not so generous, and eventually, Japanese DMAT is a small group of two doctors, two nurses and one secretary. One team can travel on a wagon car (Fig.2). While this appears lean, its advantages have become recognized: highly mobile, flexible and inexpensive. Agile mobility means Japanese DMAT have chance to arrive in time for acute medical operations within 48 hours of the event.

Arrival of a DMAT team at a designated core hospital in a stricken area of 2007 Niigata-Chuetsuoki earthquake

In order to exploit the potential mobility of the Japanese DMAT, augmentation of navigation capability is urgent. While the Japanese DMAT are seen to have been achieving their missions successfully, massive casualty cases like Kobe would still be far beyond reach; there are many points to be improved. Above all, many criticisms and complaints arose about poor performance of its expensive information system.
After a rather lengthy debate with medical doctors, we concluded that the creation of a new, GIS-based high performance model would be needed. This will have the Japan's DMAT fleet acquire high intelligence and mobility. This idea was welcomed by many frontline emergency medical doctors of Japan. But the concept of intelligent and powerful dispatched teams is very widely applicable and not restricted to the DMAT use only.

Even in Japan, this has extensive and immediate application areas. But we really think this has greater fitness to other Asian countries, specifically continental ones.
Each DMAT team carries a stand alone laptop. The installed GIS-based software will receive many geographical information: location of operation headquarters, designated core hospitals and other responding bodies, base for refugees, road condition including blockage by landslides or others, logistical setting, and so on. These information will be incessantly monitored and revised at supporting sites and circulated among the dispatched teams. Each team will feedback information they acquired on the ground to the supporting sites, enabling them track the dispatched teams.

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