Medical concerns with temporary shelters in natural disasters in Japan

Osamu Tokumaru[1], Masanori Fujita[2], Junnosuke Kumatani[2,3], Yoko Minamikawa[2,3], Saeko Nagai[2,3], Kunio Takada[2], Takatoshi Nakamori[2]

[1]Faculty of Welfare and Health Sciences, Oita University, Oita, Japan;
[2]Division of Environmental Medicine, National Defense Medical College Research Institute, Tokorozawa, Japan
[3]Medical student, School of Medicine, Oita University Faculty of Medicine, Yufu, Japan

BACKGROUND

- Medical concerns in evacuation shelters after natural disasters in Japan were surveyed.
- In the past 30 years, Japan was struck by many great earthquakes including the Great Hanshin-Awaji Earthquake (Mj7.3, GHAE, 1995, Fig. 1), typhoons, cloudbursts, volcanic eruptions, etc.
- The Great East Japan Earthquake (GEJE, Mw9.0) and the following great tsunami struck the northeast region of Japan on March 11, 2011, claiming more than twenty thousand lives. On April 16, 2016, a great earthquake (Mw7.0) following an Mw6.2 foreshock struck the Kumamoto area on Kyushu Island in the southwest Japan (Fig. 1).
- In areas struck by such natural disasters, a number of residents are forced to evacuate to temporary evacuation shelters. Accordingly, more than 400,000 residents were forced to stay at evacuation shelters after GEJE (Sakurai et al., 2016).
- Although operations of such temporary shelters have been much improved after the deep consideration on activities after GHAE, there were still a number of problems and concerns identified in the rescue activities in GEJE and recent KE.

PURPOSE

- To identify unsolved problems and medical concerns in evacuation shelters and to show constructive recommendations in preparation for future natural disasters.

METHODS

- A systematic review of literatures using the following databases
  - PubMed
  - Japan Medical Abstracts Society (for papers written in Japanese)
  - Google, Yahoo! USA and Yahoo! Japan for search for news and broadcasts

RESULTS

✓ PubMed search using the following keywords yielded:
((east Japan earthquake) OR (Kumamoto earthquake) OR (Kobe earthquake))
AND (shelter OR evacuation OR evacuee OR refugee)
+ AND (infection OR prevention OR guideline OR hygiene OR sanitary OR management OR latrine toilette) : 87 hits
+ AND (aphthous stomatitus OR astriction OR constipation OR dietary OR food OR nutrition): 18 hits
+ AND (drug OR medication OR medicine OR pharmacy): 83 hits
Among those papers, 30 were found to be relevant to this study.

✓ Papers found using Japan Medical Abstracts Society were also reviewed.
✓ Guidelines of the operation of evacuation shelters and articles in news sites were also empirically searched.

Suggestions

- Formulation of operation manuals of shelters according to the international guidelines for temporary shelters (Fig. 6; WHO, Red Cross, Japanese government)
  - minimum requirements of space per person
  - Minimum requirements of number of and maximum distance from the toilettes
  - at least one health personnel per 50 evacuees (Tokuda et al., 2014)
  - education on hand hygiene before food preparation and after toilettes (2011)
  - body temperature checks and standard precautions effective in preventing measles (Takahashi et al., 2013)
  - Improvement of relatively low readiness among local governments (Fig. 7)
- Infection control
  - Japan is still one of the TB middle-burden countries ; precautions against TB infection must be included in the national response to a large-scale disaster (WHO, 2008)
- Food and nutrition
  - Use of cereals recommended by FEMA (Table 2)
- Pharmacy in shelters
  - More consideration on drugs for chronic phase of the disaster and chronic diseases advised (Table 3)
  - NfM is of great help in collecting medical information. Application of patient information obtained from the health insurance claims to the medical care of the evacuees was also effective in GEJE (Tanihara, 2013).
- Emerging problems
  - "Tsunami lung"
  - "asbestosis" (Nukiwa, 2012)

Acknowledgement: Supported by "*Strategic Research Fund selected by the President of Oita University*".

Food and nutrition in shelters

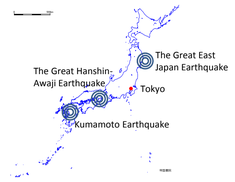

Fig. 1 Recent great earthquakes in Japan

Fig. 2 A meal offered at a shelter
http://bylines.news.yahoo.co.jp/horijun/20160421-00056849/

Table 1 Nutritional status in evacuation shelters

	Calorie [kcal]	Protein [g]	Vit B1 [mg]	Vit B2 [mg]	Vit C [mg]
Recommendation	2,000	55	1.1	1.2	100
Offered (%recommended)	1,546 (77.3%)	44.9 (81.6%)	0.72 (65.5%)	0.82 (68.3%)	32 (32%)

http://www.pref.miyagi.jp/uploaded/attachment/117132.pdf

Table 2 Food in an emergency

	merits	demerits
fresh vegetables	rich in vitamins/fibers	Difficult storage Need water to cook
vegetable juice	hygienic	Excessive sugar/salt Heavyweight
dried vegetable	easy storage/transport	Need water to eat
canned/ retort-packed food	easy storage/transport good filling, variety	heavyweight
cereals	lightweight nutritionally rich	Excessive sugars
food supplements	lightweight easy to take	poor taste

https://www.fema.gov/pdf/library/f&web.pdf

Concerns with food, diet and nutrition provided in evacuation shelters

- Food provided in shelters
  - nutritionally ill-balanced (Fig. 2):
    carbohydrate-based such as rice balls or bread (Inoue et al., 2011)
  - poor dietary intake of fruits and vegetables, meat, soybean products, and dairy products (Zhang et al., 2017)
  - nutritionally Insufficient in total calorie, the content of vitamin Bs and C (Table 1) and vegetable fibers (Tsuboyama-Kasaoka et at., 2014).
  - Excessive sodium intake (Amagai et al., 2014) + an increase in salt sensitivity by disrupted circadian rhythms (Kario, 2012)
- a number of evacuees suffered from weight loss (23%), decreased food intake (28%), constipation (10%), appetite loss (6.4%), vomiting (6.4%), nausea (2.1%) (Inoue et al., 2011) and stomatitis.
- Inappropriate diet raised the HbA1c level among diabetic patients (Kirizuka et al., 1997)
- In the expeditions in extreme environment (Antarctica, submarine, manned space flight), no nutritional problem documented (Fig. 3)
  => with thoroughly planned preparations, nutritional problems can be solved.

Infection control in shelters

Fig. 4 Shelter after the Kumamoto earthquake
http://mainichi.jp/articles/20160423/k00/00m/040/045000c

Fig. 5 Unsanitary condition in a toilette
http://www.toilet.or.jp/toilet-guide/pdf/311.pdf

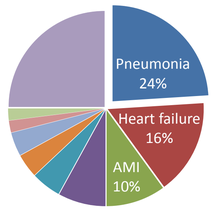

Fig. 6 Pneumonia as a leading cause of disaster-related deaths

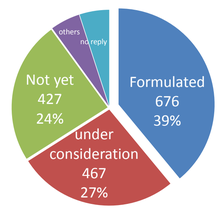

Fig. 7 Preparedness of operational manuals of evacuation shelters

Fig. 3 In extreme environments, no nutritional problems occur if well prepared

Concerns with infection in evacuation shelters

- Forced to reside in shelters under unsanitary conditions (Kanamori et al., 2011)
  - Difficulty maintaining a distance of at least 1 m between evacuee/each family (Fig. 4; Kanamori et al., 2011; Tokuda et al., 2014)
  - The averaged area per evacuee 1.8 m^2 in Ishinomaki (Tanno, 2014)
  - No electricity supply, running water, gas (Tsuboyama-Kasaoka et al., 2014)
  - Unsanitary, unsafe toilette settled outside of the shelter (Fig. 5)
    => inconvenient, especially for women and elderly
  - Poor ventilation (Kanamori et al., 2014)
- Increased risk of respiratory Infection (Fig. 6)
  - an increase in incidence of community-acquired pneumonia after GHAE (Matsuoka et al., 2000) and after GEJE, half of which originated in evacuation shelters (Ohkouchi et al., 2013)
  - an increase in incidence of tuberculosis (9.6 => 19.1 per 100,000, $p < 0.001$) (Sakurai et al., 2016)
  - The prevalence of latent tuberculosis infection as high as 20% where 50 evacuees in 60 m^2 (Kanamori et al., 2013; Kanamori et al., 2014).
  - Risk of imported measles from outside of the affected area
- With unsanitary condition of toilette (Fig. 5) and no supply of running water, hygienic handling of food and hand hygiene difficult (Tokuda et al., 2014)
  => increased risk of waterborne diarrheal diseases (Watson et al., 2007)
- Severe shortage of number of healthcare workers including physicians, RN, public health nurses (Kanamori et al., 2011) and pharmacists (Tann0, 2014)
  - a significant difference in digestive symptoms between the shelters with and without hygienic personnel (0.3% vs. 2.1%, respectively, $p < 0.001$, Tokuda et al., 2014)

Pharmacy in shelters

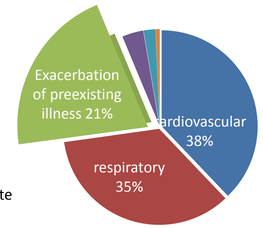

Fig. 8 Preexisting illness as a cause of disaster-related deaths in GHAE
http://www.toilet.or.jp/toilet-guide/pdf/311.pdf

Fig. 9 Temporary pharmacy in evacuation shelters

Table 3 Medical assistance team have medications only for the acute phase of natural disasters

organization	Acute phase			subacute ph.	Chronic ph.
	≤ 6 h	≤ 72 h	≤ 1 wk	2 wks–1 mon	≥ 2 months
JADM	○				
DMAT	○				
JPA	○	○			
Pref. gov.	○				
JSDF	closed				

JADM: Japanese Association for Disaster Medicine, DMAT: Japan Disaster Assistance Team, JPA: Japan Pharmaceutical Association, JSDF: Japan Self Defense Force

Table 5 The numbers of medical professionals deployed to Kumamoto (JMAT, 2016)

	#Deployed	#Licensed/ registered	Deployed per 10,000
Physician	734	311,205	23.5
Reg. Nurse	645	1,086,779	5.9
Pharmacist	144	288,151	4.9

Table 4 Source of medical information in an emergency

method	Merits/demerits	Japan	USA	UK	Germany	France	Australia
NfM*	need to carry	○	×	×	×	×	×
eNfM†	no need to carry	△	×	×	×	×	×
Cloud	no need to carry	×	○	○	△	○	△
IC card	need to carry	×	○	○	×	○	○

*NfM: Notebook-for-Medicine (*Okusuri-Techo*), †eNfM: electronic version of Notebook-for-Medicine

Concerns with pharmacy in evacuation shelters

- Loss of medical records
  - Many evacuees were left without medication and/or their prescription
  - Furthermore, the affected area had a large proportion of older people with chronic conditions and required medication to sustain their health (Fig. 8)
- Of 97 community pharmacies in Ishinomaki area (one of most damaged area in GEJE),
  - 69 (71%) pharmacies fully or partially damaged
  - Among undamaged 28 pharmacies, 10 (10%) did not function due to electricity loss.
  - Only 18 (19%) were able to function immediately after GEJE (Tanno, 2011)
  - >60% of drugs are stored in community pharmacies
    => only ~10% of drugs stored in the disaster area were usable after the disaster
- Pharmacy kits of medical response teams (Fig. 9, Table 3)
  - Focused on drugs necessary for the acute phase of activity
  - drugs necessary for chronic diseases were limited both in quantity and variety
  - patients with chronic diseases faced a fear of running out of their drugs such as antihypertensives and antidiabetic agents
  - a significant increase in HbA1c level after GHAE (7.7 ± 1.8% => 8.3 ± 2.1%, $P < 0.01$, Kishimoto et al., 2013).
- Notebook for Medicine (*Okusuri-Techo*, NfM, Japan Pharmaceutical Association, JPA)
  - great help in reconstructing the medical records of evacuees (Table 4)
    - ✓ Without NfM, interview by pharmacist required
    - ✓ Without pharmacists, physicians must take time for such interview (Tanno, 2014)
- Relatively small number of pharmacists deployed to the disaster area (Table 5)
  => more active participation of pharmacist should be encouraged