Medical Responses in Radiation Disaster

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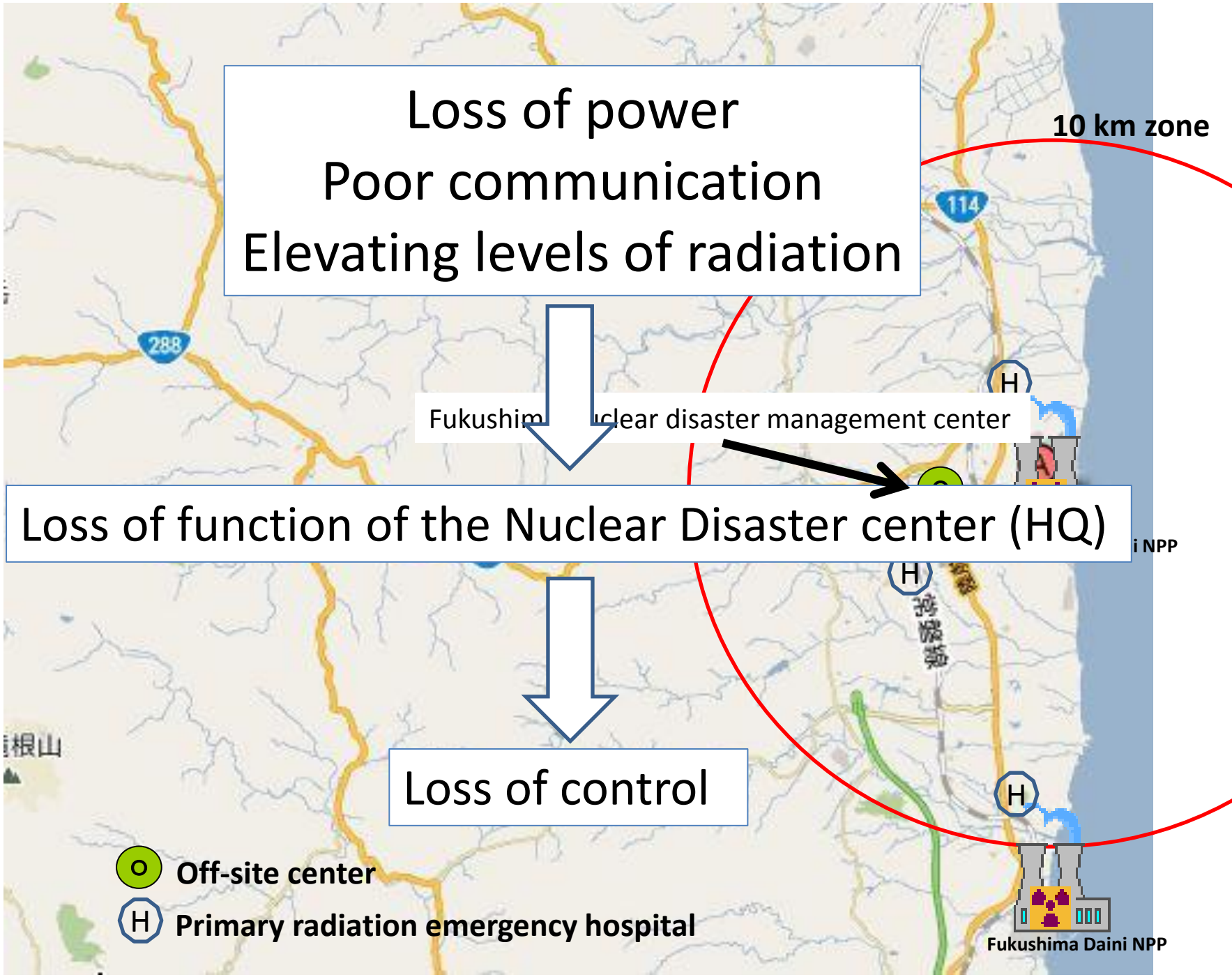
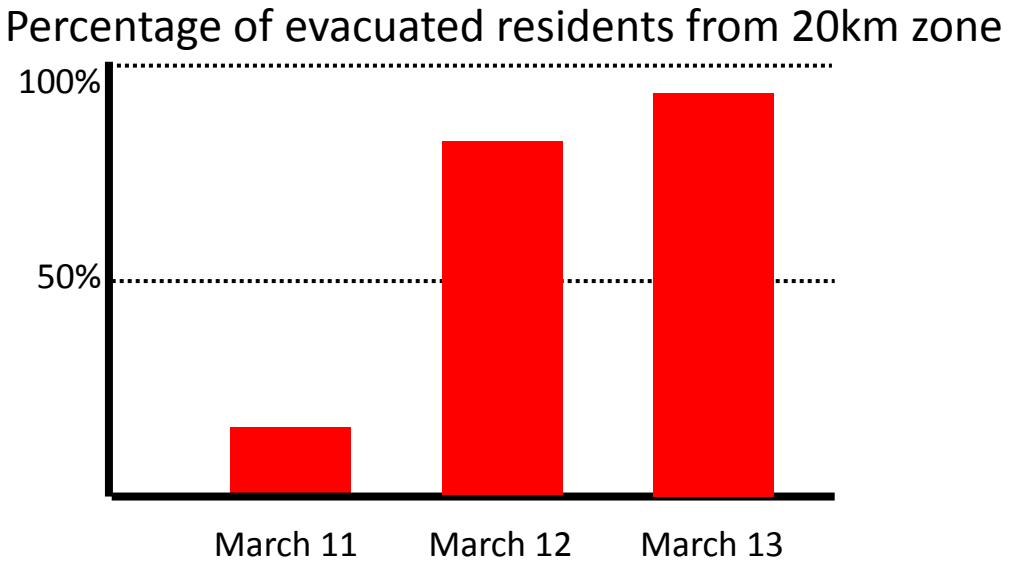
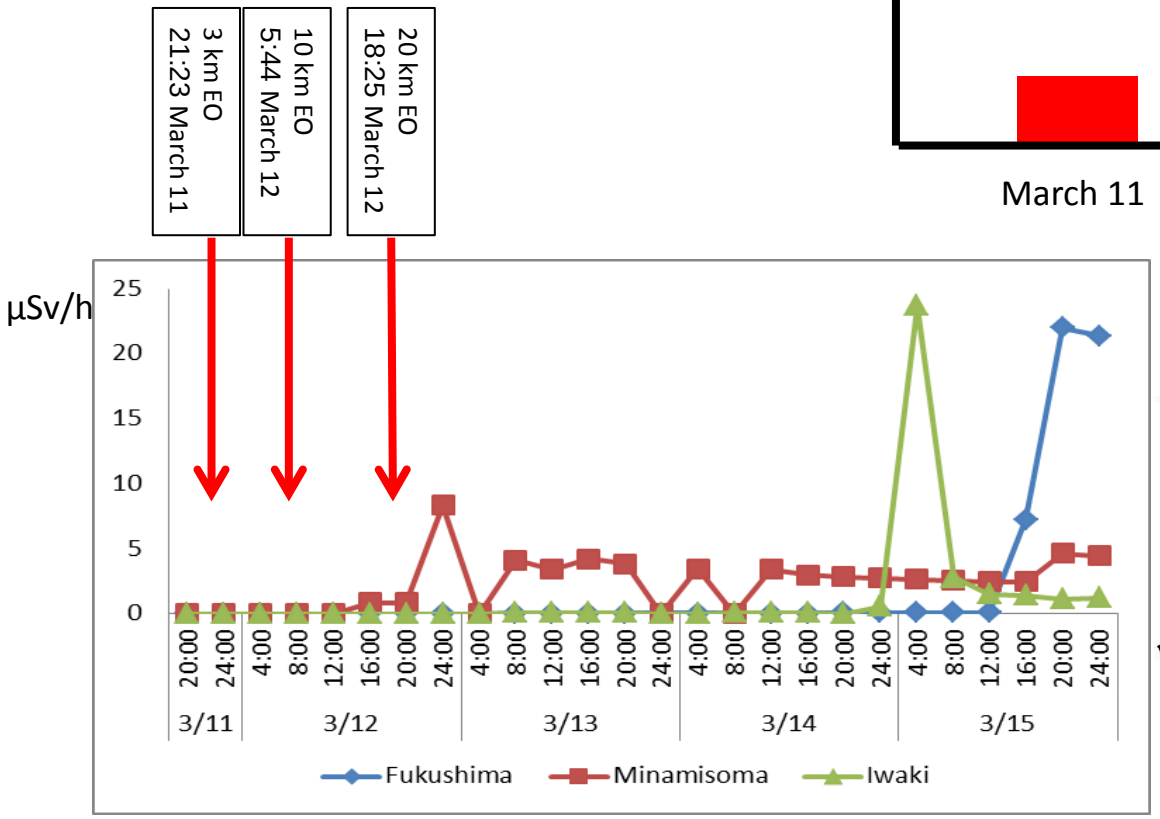
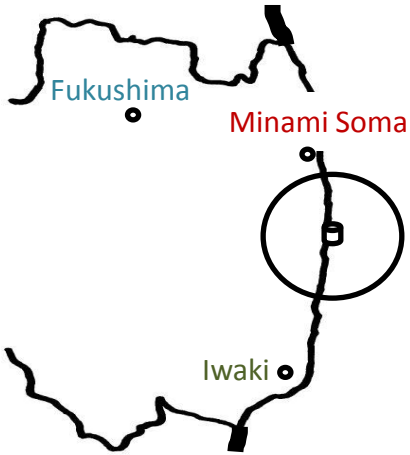
date	time	events
2011/3/11	14:46	A great earthquake hit the eastern Japan, followed by huge tsunamis.
	19:03	State of atomic emergency was issued by the national government
	21:23	Evacuation from 3 km zone and in-house sheltering from 3 to 10 km zone was ordered.
2011/3/12	5:44	Evacuation from 10 km zone was ordered for residents and hospitalized patients.
	15:36	The fisrt hydrogen explosion occurred at the No. 1 reactor building. Five workers sustained injury.
	18:25	Evacuation from 20 km zone was ordered. Residents left by car and busses. Evacuation of 2,200 patients at hospitals and facilities was arranged.
2011/3/13		Approximately 840 patients remained left within the 20 km zone.
2011/3/14	0:47	Emergency evacuation order was issued for these patients within the 20 km zone.
	11:01	The second hydrogen explosion occurred at the No. 3 reactor building. Eleven workers sustained injury.
2011/3/15	6:00	Severe damages of No.2 reactor, and explosion of No. 4 reactor occurred. Huge amounts of nuclear plumes were released.
	11:00	In-house sheltering from 20 to 30 km zone was ordered.

Major events in the early phase after Fukushima accident


Loss of power
Poor communication
Elevating levels of radiation
10 km zone
Fukushim clear disaster management center
Loss of function of the Nuclear Disaster center (HQ)
i NPP
Loss of control
Off-site center
Primary radiation emergency hospital
Fukushima Daini NPP







Serial changes of radiation levels at 3 main sites
(Minami-Soma, Iwaki, Fukushima-city)

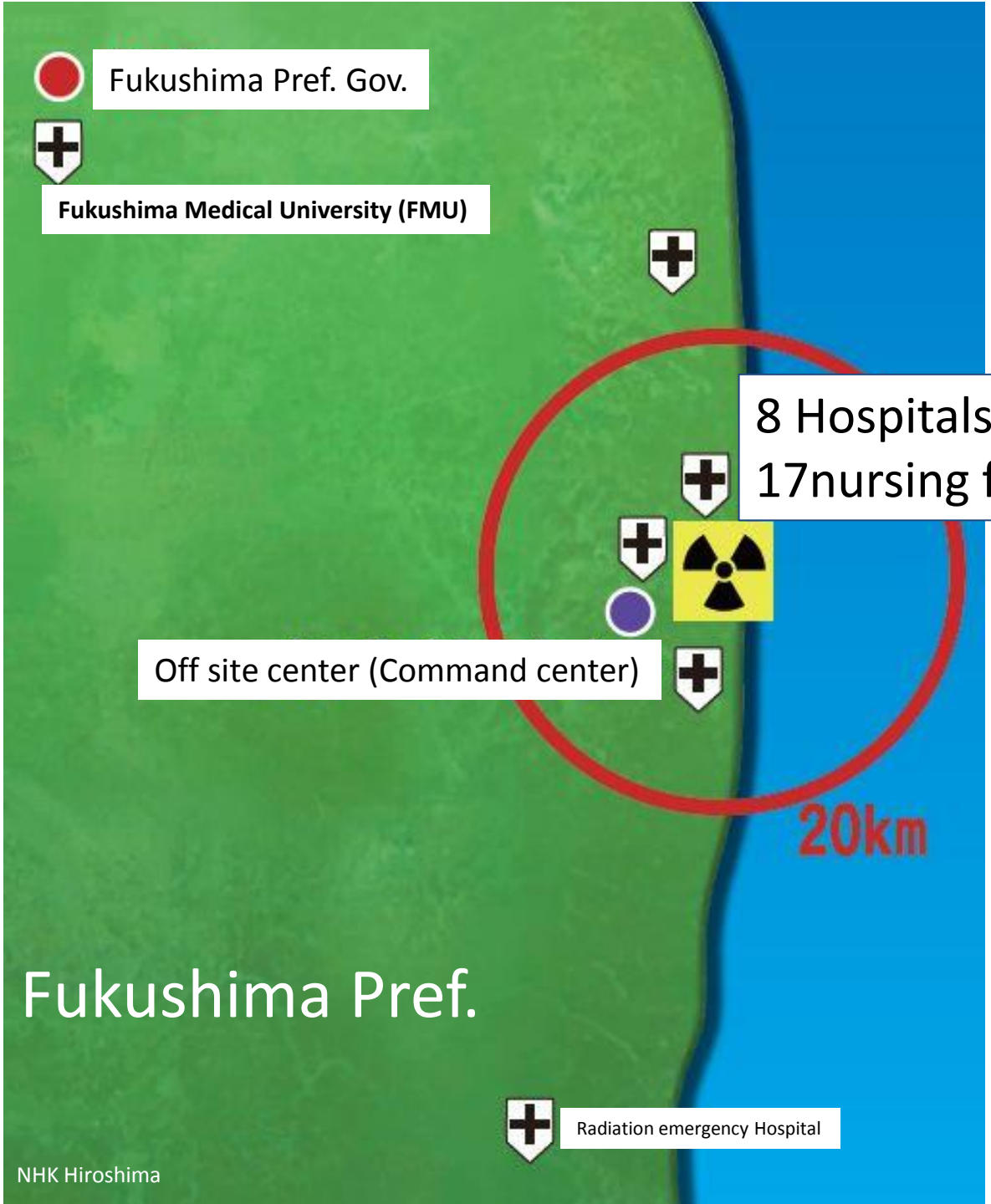
EO: Evacuation order

Provisional report by Fukushima prefectural government, March 2011

What we have seen in the evacuation of residents;

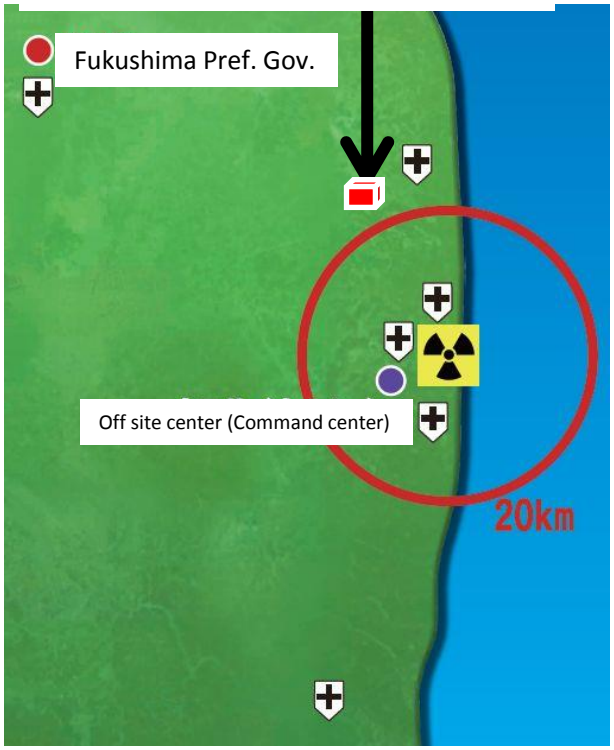
- No designated locations for evacuees outside the 10 km zone had been assigned in the plan. Some evacuees were required to relocate more than 6 times as the evacuation zone was expanded.
- Evacuated residents did not have sufficient information on the radiation levels, nor evacuation itself, i.e. how to prepare, how long it lasts, advice or instruction on how to protect themselves, and how to leave houses.
- Implementation of organized evacuation was not achieved mainly due to lack of plans, insufficient information on radiation levels, disruption of communication, and loss of function of the local nuclear emergency response head quarter at the off-site center.

Evacuation of patients from 20 km zone


Fukushima Pref. Gov.
Fukushima Medical University (FMU)
8 Hospitals, 1240 patients
17nursing facilities, 983 patients
Off site center (Command center)
20km
Fukushima Pref.
Radiation emergency Hospital
NHK Hiroshima

Screening of evacuated patients

Soso Health Care Center
(screening site for evacuees)



As of March 14th , at least 840 patients remained left within 20 km zone. A screening site for patients evacuated from hospitals and facilities within 20 km zone was set up at the Soso Health Care Center, 26 km north of the plant.

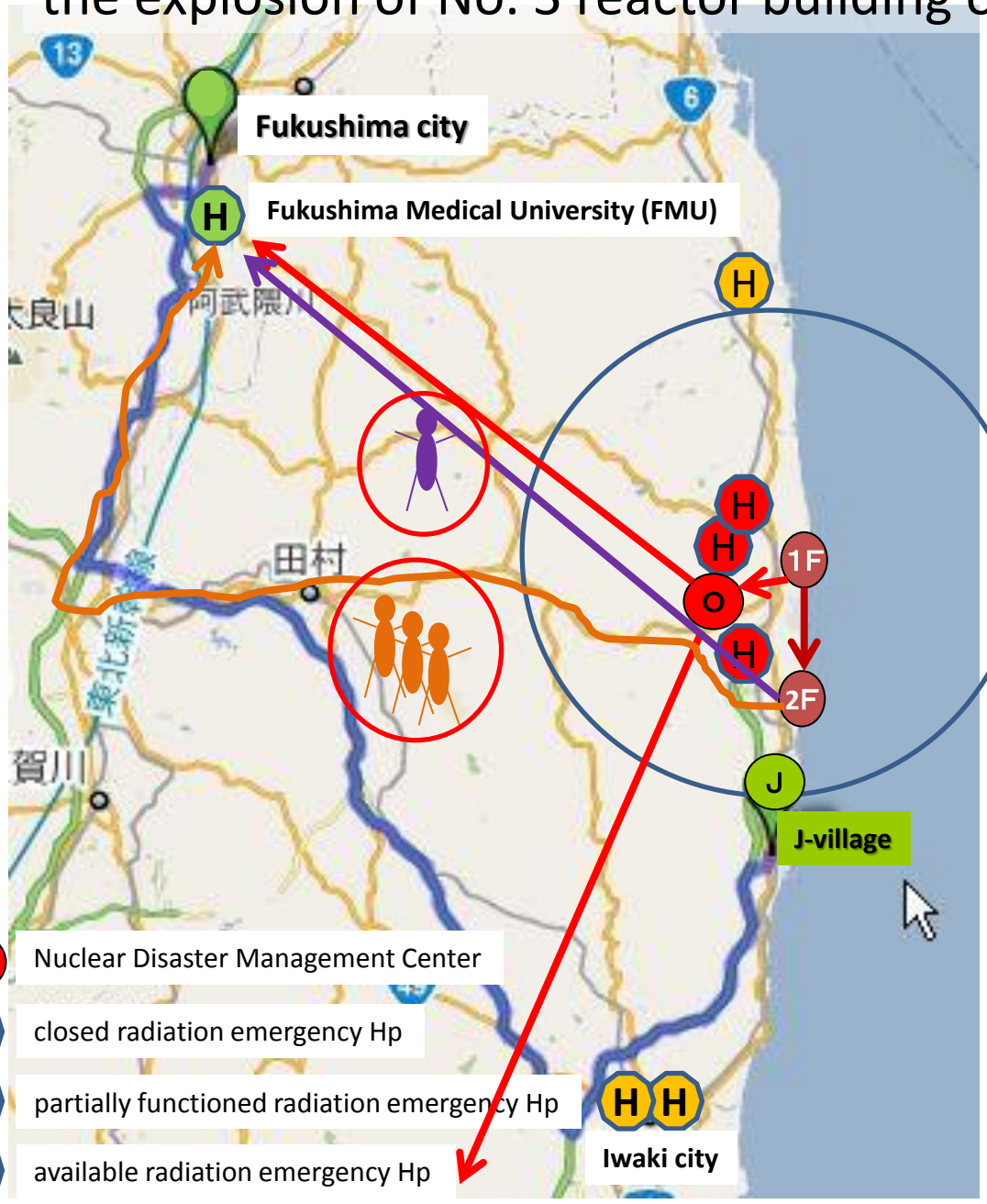
In the evacuation of patients of hospitals and nursing care facilities, what we have seen;

- during and soon after evacuation, appropriate medical care was not provided for inpatients or elderly in nursing facilities.
- difficulties were encountered in reallocating patients in hospitals and facilities in Fukushima, forcing them to stay in the confined space of the transporting vehicles without medical care for long hours.
- at least 60 patients died during or soon after evacuation. Deterioration of underlying medical problems, hypothermia, and/or dehydration were suspected causes of death.
- no radiological contamination was found among the patients because they stayed inside the hospitals or facilities before evacuation.

Tanigawa K, et al. Loss of life after evacuation: lessons learned from the Fukushima accident. Lancet 2012:379(10):889-891.
Government of Japan. Final report of the Investigation Committee on the Accident at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company. Tokyo, 2012

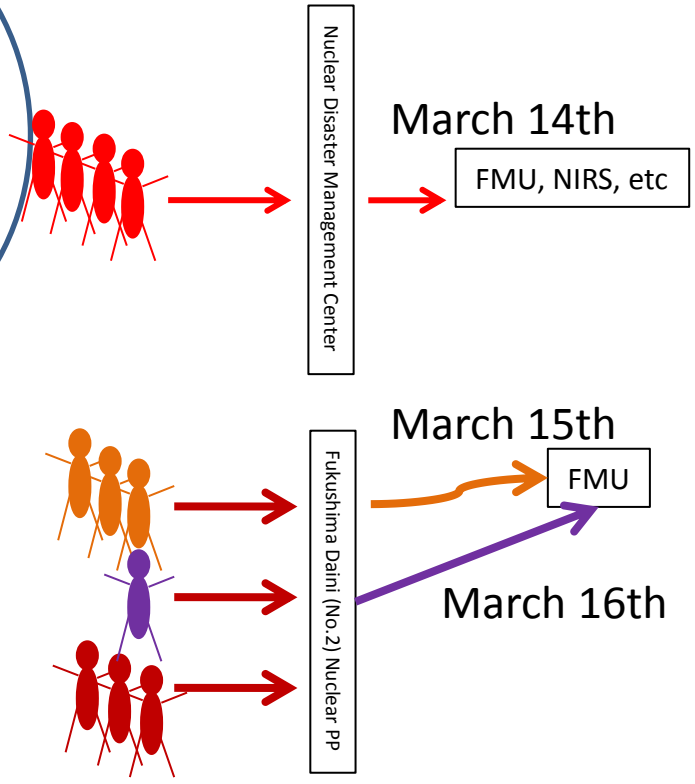
Collapse of radiation emergency medical system

Medical responses for patients who suffered injuries following the explosion of No. 3 reactor building on March 14th



1F Fukushima Daiichi (No.1) Nuclear PP

2F Fukushima Daini (No.2) Nuclear PP



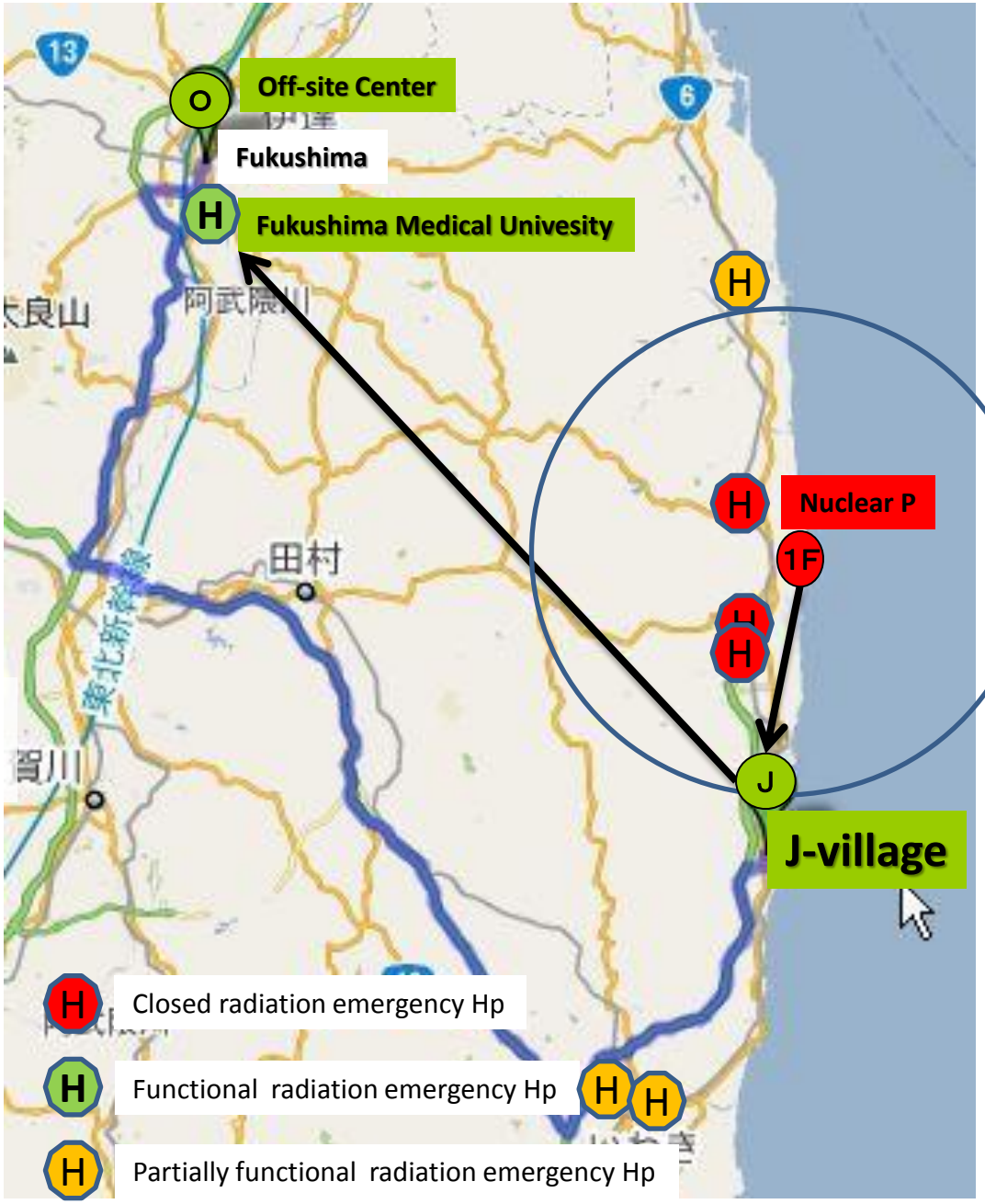
In the explosions of the reactor buildings, what we have seen;

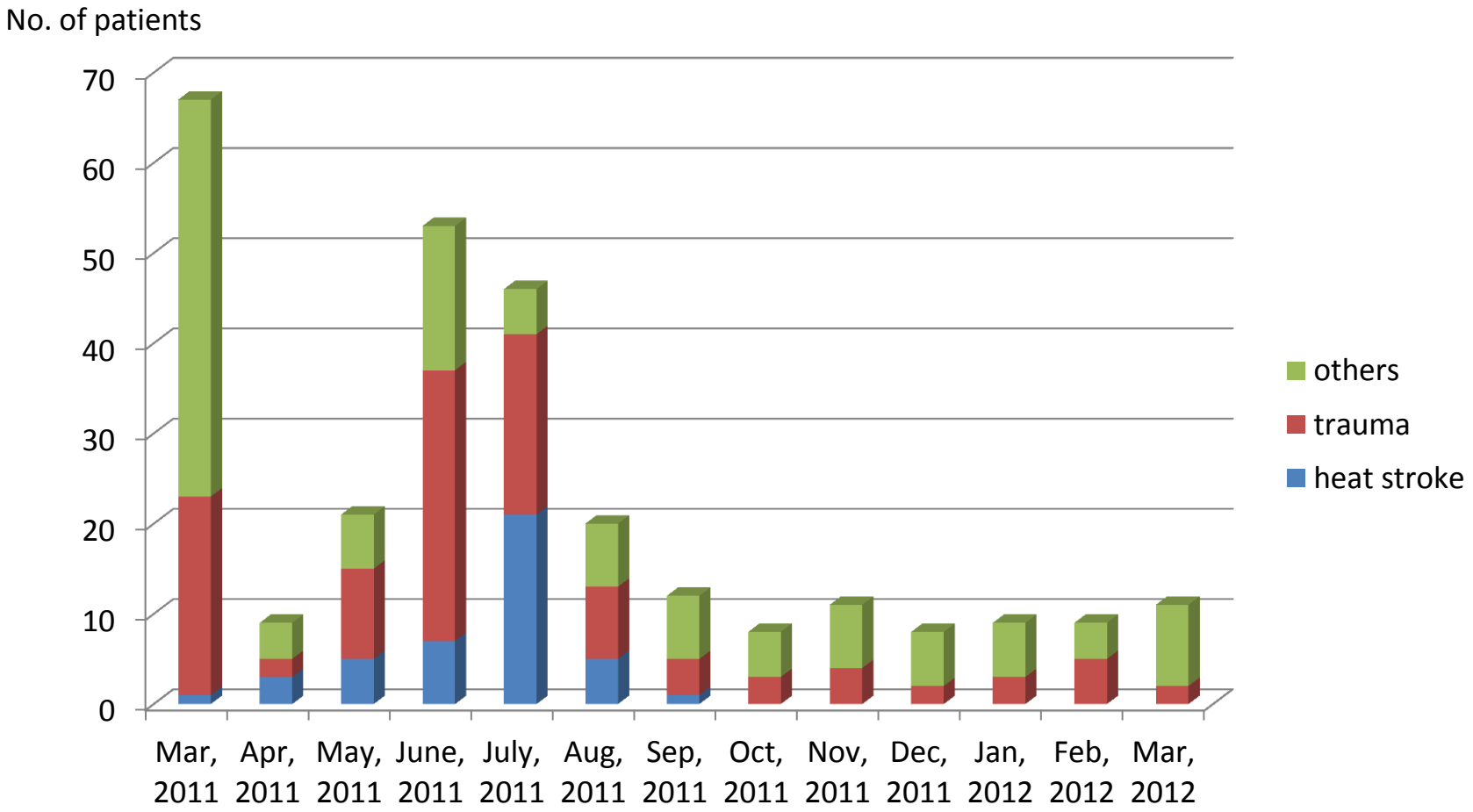
- Non of them suffered life-threatening injuries in two explosions. However, marked difficulties were encountered in finding hospitals to provide care for injured workers with or without contamination.
- Preventable trauma deaths could have been encountered if any life-threatening injuries take place.

Re-establishment of radiation emergency medical system

Re-establishment of the radiation emergency medical system

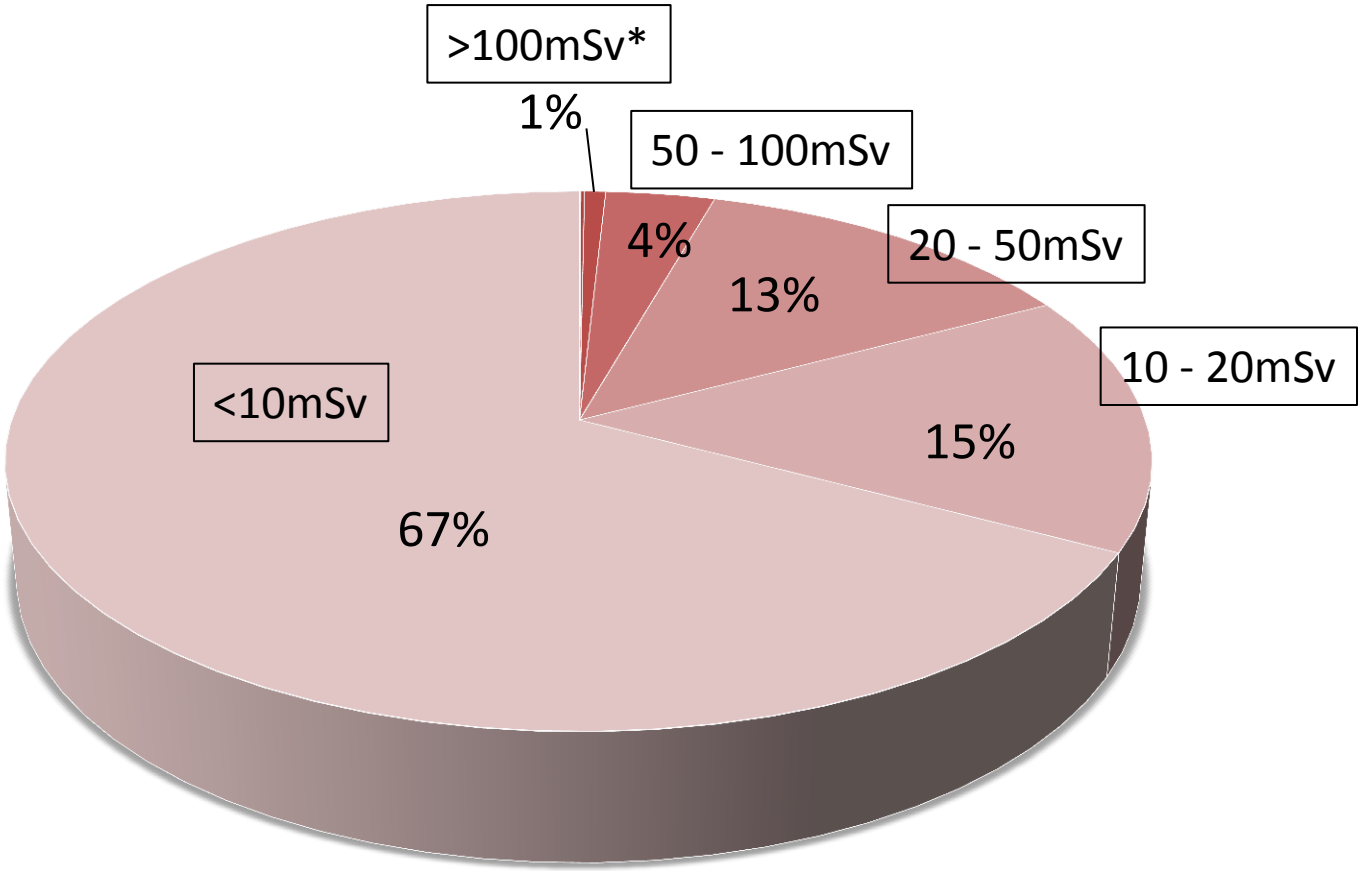
J-village
(Japanese Football Association Training Center)





Injuries and diseases treated at Fukushima No1. Nuclear Power Plant

Tokyo Electric Power Company



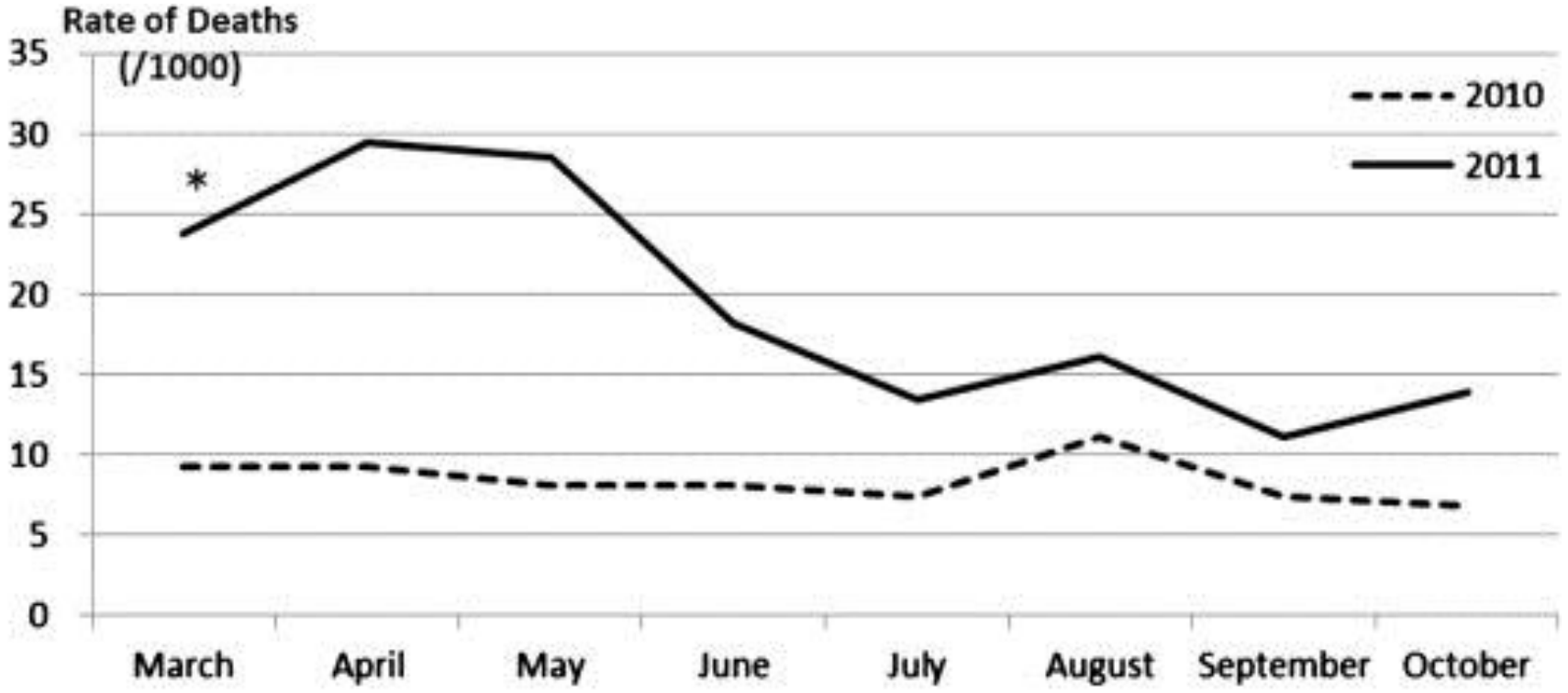
Exposure doses and percentages of workers of Fukushima Daiichi Nuclear Power Plant (Mar. 11 to Dec. 31, 2011).
A total of 19,594 workers were engaged with the operations.
*Maximal exposure dose: 678.08mSv (including internal exposure)

http://www.tepco.co.jp/cc/press/betu12_j/images/120131f.pdf

Fukushima Nuclear Power Plant Emergency Medical System Network meeting

What we discussed included;

- Coordination of emergency medical responses among Fukushima Daiichi and Daini NPP, J-Village and the radiation emergency medical hospitals
- Improvement of the occupational environment and preventive measures
- Follow-up of workers with chronic illnesses and mental health needs
- Recruitment of medical staff with competence in emergency and disaster medicine radiation in addition to a good understanding of radiation



*Thirty-two deaths due to the tsunami were excluded in this data.

Comparison of mortality rates among institutionalized elderly between 2010 and 2011

Yasumura S, et al. Excess mortality among relocated institutionalized elderly after the Fukushima nuclear disaster. Public Health, 2013, 127:2:186 – 188.

- Seventy percent of deaths after the disaster occurred among women, and majority of deaths occurred in individuals aged > 75, suggesting a particular vulnerability of the oldest people to relocation.
- Pneumonia was the most common cause of death, suggesting the influence of poor living conditions (low temperature and poor nutrition) during relocation.
- The impact of a disaster on the excess mortality of institutionalized elderly is most significant in the immediate aftermath, but has a lasting impact due to continuing changes in nutritional, hygienic, medical and general care conditions.

Lessons learned;

- The local emergency medical system is partially or completely lost because of the impact of radiation.
- Evacuation of hospitals or nursing care facilities poses severe health risks on vulnerable people.
- It usually takes an extended time period to ensure that the damaged facility is under control. In the early phase, isolated trauma cases or mass casualty events with or without contamination, are frequently observed during this period.
- Most of the medical needs are not related to radiation exposure, and managed with ordinary medical resources.
- Displaced people have to stay in shelters or other places for months or even years. This can lead to severe public health care issues.

Recommendations to medical education in radiation disaster

We need to discuss;

- Emergency medical responses
- Hospital vulnerability and roles of medical personnel in disasters
- Utilization of limited medical resources in difficult environments
- Long term care for displaced people