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Preparedness for Ebola Virus Disease

JMAJ 57(5·6): 289, 2014

Takashi NAGATA,[1] Masami ISHII[2]

The outbreak of Ebola Virus Disease (EVD) expanded fiercely in West African Countries during 2014. On October 24th, Japan Medical Association (JMA) President Yoshitake Yokokura, along with members of the Executive Board Dr. Takashi Komori and Dr. Masami Ishii, visited the Ministry of Health, Labour and Welfare (MHLW), and met with Minister Yasuhisa Shiozaki. During that meeting, they agreed to collaborate to prepare for the occurrence of cases of EVD inside Japan in the near future.

This meeting was held following a strong request from Minister Shiozaki. On that day, Mr. Shiozaki mentioned "It is mandatory for Japanese citizens, administration, and medical associations to collaborate to prevent an EVD outbreak in Japan." He also said "The MHLW makes a maximum effort to enhance the quarantine; however, if an EVD suspicious patient visits a clinic occasionally, the doctor is requested to ask about travel history to Western Africa, and then inform the health center as quickly as possible. This policy should be distributed to all JMA members."

Dr. Yokokura replied that the JMA had updated the situation regarding EVD to all members through the JMA website, providing information to citizens, etc. He also mentioned "We experienced Severe Acute Respiratory Syndrome (SARS) in 2003 and swine influenza in 2009. We will also work for EVD together with the MHLW at this time."

Additionally, Dr. Yokokura described that EVD is not an airborne disease, but is rather a blood-borne disease, spread by contagion, and emphasized that Japanese citizens should be informed appropriately. He also pointed out "If the outbreak is spread more widely in the world, the possibility of contact infection in the airport will occur, and the primary target should be widen, not only focusing on people with a travel history to Western Africa."

Dr. Ishii also reported that the World Medical Association (WMA) Council Resolution on Ebola Viral Disease was adopted by the 198th WMA Council Session, Durban, October 2014.[1] The WMA General Assembly adopted the WMA Resolution on Unproven Therapy and the Ebola Virus at the same time.*1 Additionally, Dr. Komori spoke with the Minister about the donation of supplies such as personal protective equipment, and infection screening kits.

So far, not a single patient with EVD had yet been reported inside Japan; however, Japanese citizens working abroad are always faced with the risk of EVD infection. Considering the situation of the EVD epidemic in Japan, and infections among Japanese people working abroad including those in the overseas diplomatic establishment, business, Japan Self Defense Forces, and media, Favipiravir (Avigan), a novel viral RNA polymerase inhibitor which is effective against EVD, should be stocked in advance.

Reference

1. Nagata T, Lefor AK, Hasegawa M, Ishii M. Favipiravir: a new medication for the Ebola virus disease pandemic. Disaster Med Public Health Prep. 2015;9:79-81.

*1 See the following pages for the WMA Resolutions. The Resolution on Ebola Viral Disease was initially adopted as an emergency resolution by the WMA Council and adopted by the General Assembly later.

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THE WORLD MEDICAL ASSOCIATION, INC.

WMA Resolution on Unproven Therapy and the Ebola Virus

Adopted by the 65th WMA General Assembly, Durban, South Africa, October 2014

In the case of Ebola virus, the WMA strongly supports the intention of Paragraph 37 of the 2013 revision of the Declaration of Helsinki, which reads:

In the treatment of an individual patient, where proven interventions do not exist or other known interventions have been ineffective, the physician, after seeking expert advice, with informed consent from the patient or a legally authorized representative, may use an unproven intervention if in the physician's judgement it offers hope of saving life, re-establishing health or alleviating suffering. This intervention should subsequently be made the object of research, designed to evaluate its safety and efficacy. In all cases, new information must be recorded and, where appropriate, made publicly available.

THE WORLD MEDICAL ASSOCIATION, INC.

WMA Resolution on Ebola Viral Disease

Adopted by the 65th WMA General Assembly, Durban, South Africa, October 2014

BACKGROUND

A number of viral diseases have caused occasional health emergencies in parts of Africa, with local or wider spread epidemics. These include Lassa, Marburg and Ebola Viral Diseases (EVD). The 2013-14 outbreak of EVD in West Africa has proven far more difficult to control than previous epidemics and is now present in Sierra Leone, Liberia and Guinea with more than 2,000 deaths. This epidemic appears to have a case related mortality of approximately 55% against a range for EVD of 50-95%.

Following infection, patients remain asymptomatic for a period of 2-21 days, and during this time tests for the virus will be negative, and patients are not infectious, posing no public health risk. Once the patient becomes symptomatic, EVD is spread through contact with body fluids including blood. Symptoms include diarrhea, vomiting and bleeding, and all these body fluids are potentially sources of infection.

Management is primarily through infection control, the use of personal protective equipment (PPE) by health care workers and those disposing of body fluids and of bodies, and supportive care for sick patients including using IV fluids and inotropes. Contact tracing is also important but may be difficult in many of the communities currently affected. Vaccines are in development as are some antivirals, but they will arrive late in this epidemic if they are proven successful.

Evidence from those treating patients in affected communities is that a shortage of resources, including health care workers and PPE, as well as poor infection control training of health care workers, caregivers and others at risk are making epidemic control difficult.

Some governments have indicated that they will build new treatment centres in affected areas as a matter of urgency, while others are directly providing personal protective equipment and other supplies.

RECOMMENDATIONS

1. The WMA commends those countries that have committed resources for the urgent establishment of new treatment and isolation centres in the most heavily burdened countries and regions. The WMA calls upon all nations to commit enhanced support for combatting the EVD epidemic.
2. The WMA calls on the international community, acting through the United Nations and its agencies as well as aid agencies, to immediately provide the necessary supplies of PPE to protect health care workers and ancillary staff and reduce the risk of cross infection. This must include adequate supplies of gloves, masks and gowns, and distribution must

include treatment centres at all levels.

3. The WMA calls on all those managing the epidemic, including local and national governments and agencies such as WHO, to commit to adequate training in infection control measures, including PPE for all staff and caregivers who might come into contact with infective materials.
4. The WMA honours those working in these exceptional circumstances, and strongly recommends that national governments and international agencies work with health care providers on the ground and offer stakeholders training and support to reduce the risks that they face in treating patients and in seeking to control the epidemic.
5. The WMA calls on national and local governments to increase public communication about basic infection control practices.
6. The WMA calls upon WHO to facilitate research into the timeliness and effectiveness of international interventions, so that planning and interventions in future health emergencies can be better informed.
7. The WMA strongly urges all countries, especially those not yet affected, to educate health care providers about the current case definition in addition to strengthening infection control methodologies and contact tracing in order to prevent transmission within their countries.
8. The WMA calls for NMAs to contact their national governments to act as described in this document.

The Communication of Information Such as Evacuation Orders at the Time of a Nuclear Power Station Accident

—Recommendations for responses by the national government and electric power utilities to the "Information Disaster"—

JMAJ 57(5·6): 293-319, 2014

Takashi HATANAKA,[1] Sumito YOSHIDA,[2] Mayo OJINO,[3] Masami ISHII[4]

Abstract

This research was carried out from the perspective that the damage to the people of Fukushima and others from the Fukushima Daiichi Nuclear Power Station (NPS) accident was an "information disaster." It evaluated the critical problems raised by and actual condition analysis on the process of events in the Fukushima Daiichi NPS disaster and responses of the governments and others, notification of the occurrence of the accident and evacuation order by the national and local governments and the evacuation of residents, and guidance for distribution and intake of stable iodine tablets. The research aimed to provide a basis for the implementation of effective distribution and intake of stable iodine tablets and responses to the "information disaster" in the nuclear power disaster.

On March 15 at the time that the most radioactive substances were dispersed, even when the average wind speed at the site area was 1.6 m/s, the radioactive substances had reached the outer boundary of Urgent Protective action planning Zone (UPZ, the region with a radius of 30 km) within about five hours. Because of this, every second counted in the provision of information about the accident and the issuance of evacuation orders. This study evaluated the actual condition of information provision by the national government and others from the perspective of this awareness of the importance of time.

On the basis of the results of this kind of consideration, we come to the following recommendations: The Nuclear Emergency Response Guidelines and the system for communication of information to medical providers should be revised. The national government should make preparations for the effective advance distribution and intake of stable iodine tablets.

Key words Information disaster, Fukushima Daiichi, SCRAM, TEPCO, Venting, Evacuation order

Problems and the Actual Conditions of Evacuation Orders and Order to Take Iodine Tablets in the Fukushima Daiichi Nuclear Power Station (NPS) Accident

Problems in the response of the national government and other bodies to the main events in the Fukushima Daiichi NPS

Table 1 summarizes the timeline of the main events in the Fukushima Daiichi NPS accident and actions of the national government such as the evacuation orders.[1-3] This table shows the date and time of the responses of the national government and others to the events which occurred as well as the elapsed time from the time of the emergency shutdown (SCRAM) of the reactor subsequent to the Great East Japan Earthquake (**Table 1** and other similar tables are

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Table 1 Chronology of main events and evacuation orders in the Fukushima Daiichi NPS Accident[1-3]

Date	Time	Main events and evacuation orders	Elapsed time (hours:min)
3.11	**14:46**	**Great East Japan Earthquake (SCRAM—Automatic shutdown of reactor)**	**0**
	ca. 15:37	Largest tsunami hits	0:51
	15:42	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 10 of Nuclear Emergency Act (all AC power sources are lost)	0:56
	16:45	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 15 of Nuclear Emergency Act (Emergency core cooling system fails)	1:59
	18:33	TEPCO/Notification of special situation occurrence at Fukushima Daini NPS based on Article 10 of Nuclear Emergency Act	3:47
	19:03	**Government/Declaration of Nuclear Emergency**	**4:17**
	20:50	Evacuation Order related to Fukushima Daiichi NPS issued by Governor of Fukushima Prefecture Evacuation of residents within radius of 2 km from NPS	6:04
	21:23	Evacuation Order related to Fukushima Daiichi NPS issued by Chief of Nuclear Emergency Response Headquarters (NERHQ) Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	6:37
3.12	5:44	Evacuation of residents within 10 km of NPS	14:58
	7:45	Evacuation Order related to Fukushima Daini NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	16:59
	14:30	**Venting at Unit 1**	**23:44**
	15:36	**Explosion of Unit 1 reactor building**	**24:50**
	17:39	Evacuation Order related to Fukushima Daini NPS issued by NERHQ Chief Evacuation of residents within radius of 10 km from NPS	1 day 2:53
	ca. 18:00	Safety relief (SR) valve (containment vessel pressure relief valve) opened at Unit 2	1 day 3:14
	18:25	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 20 km of NPS	1 day 3:39
3.13	**9:20**	**Venting at Unit 3**	**1 day 18:34**
3.14	**11:01**	**Explosion of Unit 3 reactor building**	**2 days 20:15**
	18:06	**Venting at Unit 2**	**3 days 3:20**
3.15	**6:12**	**Explosion of Unit 4 reactor building**	**3 days 15:26**
	6:12	**Serious damage to Unit 2 pressure suppression chamber**	**3 days 15:26**
	11:00	Residents between 20 km radius and 30 km radius from NPS shelter in place	3 days 20:14
3.25		Recommendation for voluntary evacuation of residents within 20 km radius and 30 km radius from NPS	14 days
4.21	11:00	Order to establish a Restricted Area within 20 km radius from NPS in accordance with the Disaster Countermeasures Basic Act	40 days
	11:00	Evacuation Order, etc. related to Fukushima Daini NPS issued by NERHQ Chief Evacuation zone changed from within 10 km radius of NPS to within 8 km radius of NPS	40 days
4.22	9:44	Evacuation Order, etc. related to Fukushima Daiichi NPS issued by NERHQ Chief Lifted order to shelter in place between 20 km radius and 30 km radius from NPS, established planned evacuation zone and emergency evacuation zone (removing Iwaki City)	41 days

Note: Items shaded gray are related to Fukushima Daini NPS.

in the same format).

Because of the large-scale earthquake at 14:46 on March 11, and the arrival of the largest tsunami at about 15:37, all AC power supply was lost at 15:42. As a result of this, Tokyo Electric Power Company (TEPCO) notified the national government of occurrence of a specific incident under Article 10 of the "Act on Special Measures

Concerning Nuclear Emergency Preparedness" (hereinafter, "Nuclear Emergency Act"). About one hour later, at 16:45, the emergency core coolant system cooling water injection function was lost and the national government was notified under Article 15 of the Nuclear Emergency Act.

At 19:03, two hours and 18 minutes (hereinafter: T+2:18) after receiving this notification, the national government issued a "Declaration of Nuclear Emergency" under Article 15. After this declaration, significant events occurred and TEPCO emergency responses were carried out (**Table 1**).

Problem 1: Delay in the issuance of the declaration of nuclear emergency

The time interval was not even one hour between the notification under Article 10 of the occurrence of a situation as a result of the station blackout (SBO) (Article 10 notification) at 15:42 on March 11, and the notification under Article 15 of the occurrence of a situation due to the emergency core coolant system cooling water injection function loss (Article 15 notification).

In the newly revised "Nuclear Emergency Response Guidelines,"[4] the response to an emergency situation on the facility premises equivalent to an Article 10 notification and the response to a general emergency situation equivalent to an Article 15 notification are stipulated separately, but from looking at the Fukushima Daiichi NPS accident, both of these should be responded to in an integrated manner.

In addition, at 16:45 on March 11, notification was made of a special situation based on Article 15, Section 1 of the Act. Regardless of the fact that it is stipulated in Article 15, Section 2, two hours and 18 minutes passed until the declaration was issued (four hours and 17 minutes after the earthquake struck) (**Table 1**).

Problem 2: Insufficient contents of the declaration of nuclear emergency and Chief Cabinet Secretary press announcement

Because in the content of the declaration of nuclear emergency, the specific details of the notification, etc. are left out, the imminent state of the reactor ends up not being communicated at all. As a result, the information communicated to residents in the region and citizens throughout the country was essentially that since there was no problem with the reactor, they should just remain calm and wait. In other words, there was no communication at all that conveyed the fact that the situation was one in which "all reaction cooling functions had been lost, and that the injection of water by the emergency core cooling system was not functioning," which was the most significant situation for local governments involved.

In addition, in the Chief Cabinet Secretary press announcement concerning the declaration held on March 11, the urgency of the reactor situation was not communicated at all, and the specific details ended up being omitted. In particular, the notification that the situation was such that "all water supply functions to the reactor had been lost, and that water injection to the reactor by all of the emergency core cooling system was not functioning," had not been publicly announced at all.

On the contrary, the information conveyed to the public, that "there is at this time no problem with the reactors themselves," was different from the contents of the notification.

Problem 3: Delay in the evacuation orders for within the 3 km zone and for within the 10 km zone

After the Article 15 notification was made at 16:45 on March 11 (T+1:59), nearly five hours elapsed before the evacuation order for residents within a 3-km radius of the NPS was issued at 21:23 on March 11. In addition, the evacuation order for residents within a 10-km radius of the NPS was issued after an interval of about thirteen hours at 5:44 on March 12 (**Table 2**).

Although the Article 15 notification should have been a report of extremely severe conditions for residents, preparations for evacuation were greatly delayed by the time required for the procedures of the government to actually communicate information to residents and the insufficiency of awareness about the emergency conditions (**Table 1**).

Problem 4: Delay in resident evacuation within a 10-km radius

Subsequent to the issuance of the declaration of nuclear emergency, the government issued an evacuation order for residents within a radius of 3 km from the NPS and an order to shelter in place for residents between a radius of 3 km and a radius of 10 km from the NPS. However, quite a lot of time passed before the government announced the evacuation order for residents within a radius of 10 km from the NPS as an additional measure at 5:44 on the next morning,

Table 2 Venting at Unit 1 of Fukushima Daiichi NPS and chronological response[1]

Date	Time	Chronology leading up to Unit 1 venting operation	Elapsed time (hours:min)
3.11	**14:46**	**Great East Japan Earthquake (SCRAM—Automatic shutdown of reactor)**	**0**
	ca. 15:37	Largest tsunami hits	0:51
	15:42	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 15 of Nuclear Emergency Act (all AC power sources are lost)	0:56
	16:36	Confirmation of vent opening procedures begins in central control room of Fukushima Daiichi NPS	1:50
	16:45	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 15 of Nuclear Emergency Act (Emergency core cooling system fails)	1:59
	19:03	**Government/Declaration of Nuclear Emergency**	**4:17**
	20:50	Evacuation Order related to Fukushima Daiichi NPS issued by Governor of Fukushima Prefecture Evacuation of residents within radius of 2 km from NPS	6:04
	21:23	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	6:37
3.12	0:06	Site Superintendent Yoshida orders preparations for Unit 1 containment vessel vent operation	9:20
	3:06	Joint press conference held by Kaieda, Minister of Economics, Trade and Industry (METI Minister Kaieda), Nobuaki Terasaka, Director-General of the Nuclear and Industry Safety Commission (NISA Director-General Terasaka), and TEPCO Managing Director Akio Komori announcing vent operations to begin at about 3:30	12:20
	3:30	Venting at Unit 1 not possible	12:44
	5:44	Evacuation of residents within 10 km of NPS	14:58
	6:50	METI orders TEPCO to open vents based on the Law on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (Law No.166, 1957, hereinafter "Nuclear Reactor Regulation Law")	16:04
	8:37	TEPCO gave notice to Fukushima Prefecture that vent operation would take place at about 9:00 after confirming the evacuation status of residents	17:51
	9:00	Venting operation at Unit 1 not possible	18:00
	14:30	Venting at Unit 1	23:44
	15:36	**Explosion of Unit 1 reactor building**	**24:50**
	18:25	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 20 km of NPS	1 day 3:39

Note: Items shaded gray are related to evacuation orders.

March 12 (T + 14:58) (**Table 2**).

In the eyes of residents living between the zones with a radius of 3 km and 10 km of the NPS, if the evacuation order had been issued the previous day at 21:23, just over eight hours could have been effectively used to prepare for evacuation, and this time ended up being spent unproductively (**Table 2**).

Timing of venting, hydrogen explosion of the building, and resident evacuation

At the Fukushima Daiichi NPS of TEPCO, venting the containment vessel was considered from the beginning. That is, two hours after the SCRAM on March 11, at 16:36 (T + 1:50), confirmation of the procedure for conducting the venting had already begun in the Fukushima Daiichi NPS Central Control Room (**Table 2**).

After that, at 0:06 on March 11 (T + 9:20), Site Superintendent Masao Yoshida gave the order to prepare for venting the Unit 1 containment vessel, and subsequently Minister of Economics, Trade and Industry Banri Kaieda ("METI Minister Kaieda") and Nobuaki Terasaka, Director-General of the Nuclear and Industrial Safety Agency (NISA) held a joint press conference and announced that the venting operation would be carried out at about 3:30 (T + 12:44). However, even at 3:30, the venting operation could not be carried out, and the vents were opened

only at 14:30 (T+23:44) (**Table 2**).

Problem 5: Time of venting at Unit 1 (T+23:44)

Meanwhile, at 5:44 on March 12, an evacuation order was issued for residents within a radius of 10 km from the NPS. However, if the venting had been implemented as planned at 3:30, it would have been extremely dangerous for many residents, who would have been exposed to radiation only two hours after venting.

It is questionable whether the initial plan for venting was to be done in such a way as to coordinate with the evacuation order for residents within a 10-km radius.

Problem 6: Evacuation order for residents within a 20-km radius two hours after the hydrogen explosion (T+27:39)

As the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC) pointed out, at 13:45 on March 12 (T+22:59), "there is a passage in a memorandum on the proceedings prepared by the intelligence team of the Kashiwazaki-Kariwa NPS, saying, 'We are concerned about hydrogen at 1F-1 (Unit 1 of the Fukushima Daiichi NPS).'"[1]

However, there are no signs that TEPCO considered the risk of a hydrogen explosion until the actual hydrogen explosion at Unit 1 (**Table 3**).

Amidst this, even though the Unit 1 vents were opened at 14:30 (T+23:44), the Unit 1 reactor building exploded at 15:36 (T+24:50). But the order of the national government at 18:25 (T+27:39) was for residents to evacuate within a radius of 20 km of the NPS.

There was no doubt that the order from the national government to residents within a radius of 20 km, because it was the first one, and furthermore was an order coming just three hours after the reactor building of Unit 1 had exploded, not only caused confusion for the residents but also left them exposed to radiation.

Problems in the information provision to residents and citizens which avoided the condition of the core and fuel at Fukushima Daiichi NPS

Problem 7: Problems in the expressions used in information provided by the NISA

From March 12, information began to be provided by NISA concerning the condition of the core and fuel at Unit 1, but according to the NAIIC report,[2] there was a dramatic change in the content of the expressions around the time when the Unit 1 vents were opened and the reactor building exploded.

Before the Unit 1 vents were opened at 14:30 on March 12 (T+23:44), the condition of the core and fuel used the expressions "core meltdown" and "fuel meltdown" (**Table 4**).

But after the Unit 1 reactor building explosion at 15:36 on March 12 (T+24:50), there was a change of personnel in charge of communication, and the expressions related to the condition of the fuel also changed to avoid the terms "core meltdown" and "fuel meltdown" and the words used were "core damage" and "cladding damage" (**Table 4**).

These kinds of expressions were found to be a handicap for residents, citizens and others to correctly understand the situation of the fuel inside of the reactor, which is a "black box" environment.

Actions by the National Government and Local Governments Such as the Notification of Incident Occurrence and Evacuation Orders

Problems in the communication from the national government to local governments

Problem 8: Decision making and information communication led by the Prime Minister's Office instead of existing nuclear disaster prevention organizations

Previously, when a declaration of a nuclear emergency situation was issued, responses would be carried out by designated administrative structure, but for a variety of reasons such as the collapse of the communications and transportation networks, delays in assembling personnel, the loss of function of the Local Nuclear Emergency Response Headquarters (Local NERHQ or "Off-site Center"), the administrative structure as a whole was unable to respond.

Then, in the case of the accident this time, against the backdrop of these various factors, decisions and communications about matters such as the declaration of nuclear emergency, evacuation orders, and mandatory evacuation zones were made largely by the some of the members of the Nuclear Emergency Response Headquarters (NERHQ) with the Prime Minister at the center, on the fifth floor of the Prime Minister's Office. As a result, the NISA could not perform its duties at that time.

Table 3 Chronology of responses to hydrogen explosion of Unit 1 reactor building[1,3]

Date	Time	Chronological responses to the hydrogen explosion	Elapsed time (hours:min)
3.11	**14:46**	**Great East Japan Earthquake (SCRAM—Automatic shutdown of reactor)**	**0**
	ca. 15:37	Largest tsunami hits	0:51
	15:42	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 10 of Nuclear Emergency Act (all AC power sources are lost)	0:56
	16:45	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 15 of Nuclear Emergency Act (Emergency core cooling system fails)	1:59
	19:03	**Government/Declaration of Nuclear Emergency**	**4:17**
	20:50	Evacuation Order related to Fukushima Daiichi NPS issued by Governor of Fukushima Prefecture Evacuation of residents within radius of 2 km from NPS	6:04
	21:23	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	6:37
3.12	5:44	Evacuation of residents within 10 km of NPS	14:58
	13:45	There is a passage in a memorandum on the proceedings prepared by the intelligence team of the Kashiwazaki-Kariwa NPS, saying, 'We are concerned about hydrogen at 1F-1 (Unit 1 of the Fukushima Daiichi NPS).' However, there are no signs that TEPCO considered the risk of a hydrogen explosion until the actual hydrogen explosion at Unit 1.	22:59
	14:30	**Venting at Unit 1**	**23:44**
	15:36	**Explosion of Unit 1 reactor building**	**24:50**
	18:25	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 20 km of NPS	1 day 3:39
3.13	**9:20**	**Venting at Unit 3**	**1 day 18:34**
	9:42	There was concern that there was a possibility that a hydrogen explosion similar to that of Unit 1 could occur for Unit 3 as well. Request by Site Superintendent Yoshida to TEPCO headquarters to consider actions to prevent a hydrogen explosion: "Although it is not completely certain that hydrogen was the cause of yesterday's explosion, what is extremely important is that we take action to prevent an explosion like in Unit 1. I would like to draw on the experience of others including TEPCO HQ."	1 day 18:56
	10:43	Order issued from NISA to consider actions such as opening the blowout panel for Unit 3 as well because an explosion similar to that of Unit 1 was considered possible.	1 day 19:57
3.14	5:54	Warning issued from Site Superintendent Yoshida that the D/W pressure in Unit 3 is increasing and possibility of explosion similar to that of Unit 1 is increasing.	2 days 15:08
	6:48	Possibility of Unit 3 hydrogen explosion increases, and the situation is such that work in yard becomes difficult	2 days 16:02
	11:01	**Explosion of Unit 3 reactor building**	**2 days 20:15**
	18:06	**Venting at Unit 2**	**3 days 3:20**
3.15	**6:12**	**Explosion of Unit 4 reactor building**	**3 days 15:26**
	6:12	**Serious damage to Unit 2 pressure suppression chamber**	**3 days 15:26**
	11:00	Residents shelter in place between a radius of 20 km and a 30 km from NPS	3 days 20:14

Note: Items shaded gray are related to evacuation orders.

It has been found that the inadequate and late response to the accident may have been because of the fact that responses and other matters could not be carried out within the administrative structure originally foreseen, and that instead the lead was taken by some members of the NERHQ with the Prime Minister at the center, on the fifth floor of the Prime Minister's Office.

Problem 9: Notification by telephone to the local governments at the site and no notification to the local governments in the surrounding area concerning the occurrence of the accident

There are two towns, Okuma and Futaba at the

Table 4 Provision of information by NISA related to the condition of the core and fuel of Fukushima Daiichi NPS[1,3]

Date	Time	Provision of information of the condition of the core and fuel	Elapsed time (hours:min)
3.11	**14:46**	**Great East Japan Earthquake (SCRAM—Automatic shutdown of reactor)**	**0**
	ca. 15:37	Largest tsunami hits	0:51
	15:42	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 10 of Nuclear Emergency Act (all AC power sources are lost)	0:56
	16:45	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 15 of Nuclear Emergency Act (Emergency core cooling system fails)	1:59
	19:03	**Government/Declaration of Nuclear Emergency**	**4:17**
	20:50	Evacuation Order related to Fukushima Daiichi NPS issued by Governor of Fukushima Prefecture Evacuation of residents within radius of 2 km from NPS	6:04
	21:23	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	6:37
3.12	5:44	Evacuation of residents within 10 km of NPS	14:58
	9:45	It was found that part of the cladding **had begun to melt**. It was not possible to rule out the chance that some of the fuel had begun to melt.	18:59
	13:00	It was probably too soon to determine whether a **fuel meltdown** was occurring at Unit 1.	22:14
	14:00	There was a possibility of a core meltdown. Was the **core meltdown** already in progress?	23:14
	14:30	**Venting at Unit 1**	**23:44**
	15:36	**Explosion of Unit 1 reactor building**	**24:50**
	18:25	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 20 km of NPS	1 day 3:39
	21:30	(in response to a question about meltdown in Unit 1) We are not aware of the degree to which it is occurring. We believe that it is highly likely that there is **core damage** but we do not know precisely. At this point it is probably the case that a meltdown is not in progress.	1 day 6:44
3.13	5:30	(in response to a question about core meltdown in Unit 1) It should be kept in mind that the possibility cannot be ruled out.	1 day 14:44
	9:20	**Venting at Unit 3**	**1 day 18:34**
	17:15	About half of the fuel in Unit 3 was out of the water, and it was suspected that **the fuel rods had been damaged**.	2 days 2:29
3.14	9:15	(in response to a question about Unit 3 core meltdown) It is not at the meltdown stage. For part of the fuel, the proper expression is that there is **damage to the external cladding**.	2 days 18:29
	11:01	**Explosion of Unit 3 reactor building**	**2 days 20:15**
	16:45	(in response to a question about Unit 3 core meltdown) It is true that there is at least **damage to the core** of Unit 3. We do not really know whether it has reached a meltdown.	3 days 1:59
	18:06	**Venting at Unit 2**	**3 days 3:20**
	21:45	High possibility of Unit 2 **core damage**	3 days 6:59
3.15	**6:12**	**Explosion of Unit 4 reactor building**	**3 days 15:26**
	6:12	**Serious damage to Unit 2 pressure suppression chamber**	**3 days 15:26**
	11:00	Residents shelter in place between a radius of 20 km and a 30 km from NPS	3 days 20:14

Note: Items shaded gray are related to evacuation orders.

site of the Fukushima Daiichi NPS within the zone 3 km from the NPS. In the surrounding area, four towns are within the zone 10 km; two cities, five towns and two villages are within the zone 20 km, and three cities, six towns and three villages are in the zone 30 km from the NPS.

The local governments at the site, Okuma and Futaba, received a communication from TEPCO concerning the Article 10 and Article 15 notifications, by telephone. Although the timing was about the same as the reports from TEPCO to the national government, since all of these were telephone communications, it could not be confirmed whether the proposed notifications were appropriately detailed including the severe status in which all of the water supply functions to the reactor had been lost, and all feed-water injection capability from the emergency core cooling system had also been lost (**Table 5**).

An even larger problem was the communication to the local governments in the surrounding areas.

Of the local governments in the surrounding area, within the 20 km zone are the towns of Namie, Tomioka, Naraha and Hirono; the villages of Kawauchi and Katsurao, and the cities of Minamisoma and Tamura. Among these, at least Namie town, Minamisoma and Tamura cities, and Katsurao village either became aware of the accident through media reports, or became aware when they received requests from the local governments at the site to accept evacuees (**Table 5**).

This time, the evacuation order from the national government was limited to the local governments within the 20 km zone. On the other hand, evacuation planned by the local governments themselves, evacuation by advisory orders for voluntary evacuation or voluntary evacuation of residents took place even in surrounding areas in the 30 km region. It was a big problem that at the time of the occurrence of the accident, the local governments in this region had not received any notice from the national government or anyone else.

Problem 10: Notification to the local governments at the site and no notification to the local governments in the surrounding area about the evacuation order

The evacuation order was issued in stages according to the distance of the zones from the Fukushima Daiichi NPS (**Table 6**).

Concerning the evacuation order for residents in the 3 km zone of March 11 at 21:23 (T + 6:37), Futaba town received a communication from the national government but Okuma town became aware of it from media reports.

Concerning the evacuation order for residents in the 10 km zone of March 12 at 5:44 (T + 14:58), notice was received at 6:29 in Futaba town by fax from the national government, and at about 6:00 in Okuma town by a telephone from the Prime Minister aide Goshi Hosono. However, Naraha town became aware of it from media reports, the towns of Tomioka and Okuma became aware of it through the Disaster Prevention Radio System. All of these local governments are within the 10 km zone of the Fukushima Daiichi NPS.

Notice of the evacuation order for residents within the 20 km zone on March 12 at 18:25 (T + 27:39) was sent from Fukushima Prefectural Government to Tamura City, but for the rest, the towns of Namie and Hirono, Minamisoma City, and the villages of Kawauchi and Katsurao, they either received no communication or became aware of it from media reports.

Then, on March 25 (T + 14 days), residents between a radius of 20 km and 30 km from the NPS were requested by the national government to evacuate voluntarily. In this way, information from the national government concerning evacuation orders was not carried out appropriately, and it became a situation which depended on media reports. A deep feeling of distrust about the information provision aspect of the evacuation orders remains, and will be a large problem on the occasion of future occurrences of nuclear accidents.

Because of this, the situation was such that Kawauchi village mayor Yuko Endo complained that at the time of the Fukushima Daiichi nuclear disaster "he spent the time as if paralyzed with fear. This disaster was in a sense an 'information disaster.'"[5]

Problems with the evacuation order to residents from the local governments

Problem 11: Evacuation order without any scientific data or other information necessary for evacuation

From 6:12 in the morning of March 15 (T + 3 days 15:26) until March 16, an exceptional increase in the radiation emission level near the main gate of the NPS was observed. As a result,

Table 5 Communication of information from national government to local governments concerning the occurrence of the Fukushima Daiichi NPS accident[1]

Date	Time	Communication of information concerning the occurrence of the ccident		Elapsed time (hours:min)
3.11	**14:46**	**Great East Japan Earthquake (SCRAM—Automatic shutdown of reactor)**		**0**
	ca. 15:37	Largest tsunami hits		0:51
	15:42	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 10 of Nuclear Emergency Act (all AC power sources are lost)		0:56
		after 16:00	Okuma (in zone 3 km from Fukushima Daiichi NPS): Article 10 notification by telephone	ca. 1:14
		ca. 16:36	Futaba (in zone 3 km from Daiichi NPS): Article 15 notification by telephone	ca. 1:50
	16:45		TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 15 of Nuclear Emergency Act (Emergency core cooling system fails)	1:59
		ca. 17:00	Okuma (in zone 3 km from Daiichi NPS): Article 15 notification by telephone	ca. 2:14
		ca. 17:00	Hirono (in zone 10 km from Daiichi NPS): Learned of Fukushima Daiichi NPS Accident from media reports	ca. 2:14
	18:33	TEPCO/Notification of special situation occurrence at Fukushima Daini NPS based on Article 10		3:47
	19:03	**Government/Declaration of Nuclear Emergency**		**4:17**
	20:50	Evacuation Order related to Fukushima Daiichi NPS issued by Governor of Fukushima Prefecture Evacuation of residents within radius of 2 km from NPS		6:04
	21:23	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS		6:37
		ca. 22:30	Naraha (in zone 3 km from Daiichi NPS): Explanation of situation by two TEPCO employees from Fukushima Daini NPS	ca. 7:44
		—	Tomioka (in zone 3 km from Daiichi NPS): Received Article 10 and Article 15 notifications concerning Fukushima Daini NPS	—
		—	Hirono (in zone 10 km from Daiichi NPS): Received Article 10 and Article 15 notifications	—
		—	Namie (in zone 5 km from Daiichi NPS): Learned of accident from media reports	—
		—	Tamura (in zone 20 km from Daiichi NPS): Learned of accident from media reports	—
		—	Minamisoma (in zone 20 km from Daiichi NPS): No communication concerning occurrence of accident	—
		—	Katsurao (in zone 20 km from Daiichi NPS): Learned of accident from media reports	—
		—	Iitate (in zone 30 km from Daiichi NPS): Learned of accident from media reports	—
3.12	**0:00**	**Local NERHQ (Off-site Center) loses all electrical power. All functionality subsequently lost, except for satellite telephones.**		**9:14**
	4:00	**All nuclear safety inspectors at Fukushima NPS withdrawn from the Off-site Center.**		**13:14**
	5:44	Evacuation of residents within 10 km of NPS		14:58
		Morning	Kawauchi (in zone 20 km from Daiichi NPS): Learned of accident when mayor of Tomioka requested to accept evacuees	—
	15:36	**Explosion of Unit 1 reactor building**		**24:50**
	18:25	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 20 km of NPS		1 day 3:39
		—	Kawamata (in zone 50 km from Daiichi NPS): Learned of accident when mayors of Futaba and Namie requested to accept evacuees	—
3.13		ca. 10:00	Kawauchi (in zone 20 km from Daiichi NPS): Received explanation of situation from Site Supervisor of Daini NPS	ca. 1 day 19:14
3.15	**—**	**Local NERHQ (Off-site Center) moves to Fukushima Prefectural Office Building**		**4 days**
3.25	—	Residents within the zone between a 20 km radius and 30 km radius of NPS recommended to evacuate voluntarily		14 days

Note: Items shaded gray are related to evacuation orders.

Table 6 Evacuation orders, etc. to residents from each local government[1,3]

Date	Time	Evacuation orders, etc. to residents from each local government	Elapsed time (hours:min)
3.11	**14:46**	**Great East Japan Earthquake (SCRAM—Automatic shutdown of reactor)**	**0**
	ca. 15:37	Largest tsunami hits	0:51
	15:42	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 10 of Nuclear Emergency Act (all AC power sources are lost)	0:56
	16:45	TEPCO/Notification of special situation occurrence at Fukushima Daiichi NPS based on Article 15 of Nuclear Emergency Act (Emergency core cooling system fails)	1:59
	19:03	**Government/Declaration of Nuclear Emergency**	**4:17**
	20:50	Evacuation Order related to Fukushima Daiichi NPS issued by Governor of Fukushima Prefecture Evacuation of residents within radius of 2 km from NPS	6:04
	21:23	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	6:37
	0:30	Okuma (in zone 3 km from Fukushima Daiichi NPS): Evacuation to Tamura, Koriyama, Miharu, Ono	9:44
	0:30	Futaba (in zone 3 km from Fukushima Daiichi NPS): Evacuation to Kawamata	9:44
3.12	5:44	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 10 km of NPS	14:58
	6:00	Namie (in zone 10 km from Fukushima Daiichi NPS: Ordered evacuation on its own initiative to outside the 10 km zone	15:14
	ca. 6:21	Okuma: evacuation order for all citizens	15:35
	7:30	Futaba: evacuation order for all citizens	16:44
	7:45	Evacuation Order related to Fukushima Daini NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	16:59
	8:30	Naraha: evacuation order for all citizens (evacuation to Iwaki)	17:44
	11:00	Namie: Ordered evacuation on its own initiative to outside the 20 km zone (evacuation to Tsushima district of Namie, in a northwesterly direction from Fukushima Daiichi NPS)	20:14
	Morning	Tomioka: Ordered evacuation of all residents on its own initiative (6,000 people evacuated to Kawauchi)	—
	14:30	**Venting at Unit 1**	**23:44**
	15:36	**Explosion of Unit 1 reactor building**	**24:50**
	18:25	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 20 km of NPS	1 day 3:39
	Evening	Hirono: Appeal for voluntary evacuation to outside of the town (all residents evacuated to Ono)	
	—	Tamura: Ordered on its own initiative the evacuation of citizens in the Miyakoji district (all residents within the Miyakoji district evacuated to the Funabiki district)	—
	—	Katsurao: Evacuation order for residents within the 20 km zone	—
3.13	**9:20**	**Venting at Unit 3**	**1 day 18:34**
	6:30	Minamisoma: Evacuation order for all residents within the 20 km zone (evacuation to Fukushima City, Niigata Prefecture, Gunma Prefecture, etc.)	—
	11:00	Hirono: Evacuation order for all residents	1 day 20:14
	—	Kawauchi: Evacuation order for all residents within the 20 km zone (evacuation to Kawauchi Elementary School)	—
3.14	9:15	Katsurao: Evacuation order on its own initiative for all residents (to Fukushima City)	2 days 18:29
	11:01	**Explosion of Unit 3 reactor building**	**2 days 20:15**
	18:06	**Venting at Unit 2**	**3 days 3:20**
3.15	**6:12**	**Explosion of Unit 4 reactor building**	**3 days 15:26**
	6:12	**Serious damage to Unit 2 pressure suppression chamber**	**3 days 15:26**
	11:00	Residents shelter in place between radius of 20 km and 30 km from NPS	3 days 20:14
	—	Kawauchi: Voluntary evacuation recommendation	—
	—	Kawamata: Planned evacuation of residents of Yamakiya district begins	—
	—	Iitate: Planned evacuation begins (evacuation of 500 residents from areas of high radioactivity to Kanuma, from March 19-20)	—
	—	Kawauchi: Ordered evacuation of all residents on its own initiative	—
3.25	—	Residents within the zone between 20 km radius and 30 km radius of NPS recommended to evacuate voluntarily	14 days

Note: Items shaded gray are related to evacuation orders by the national government.

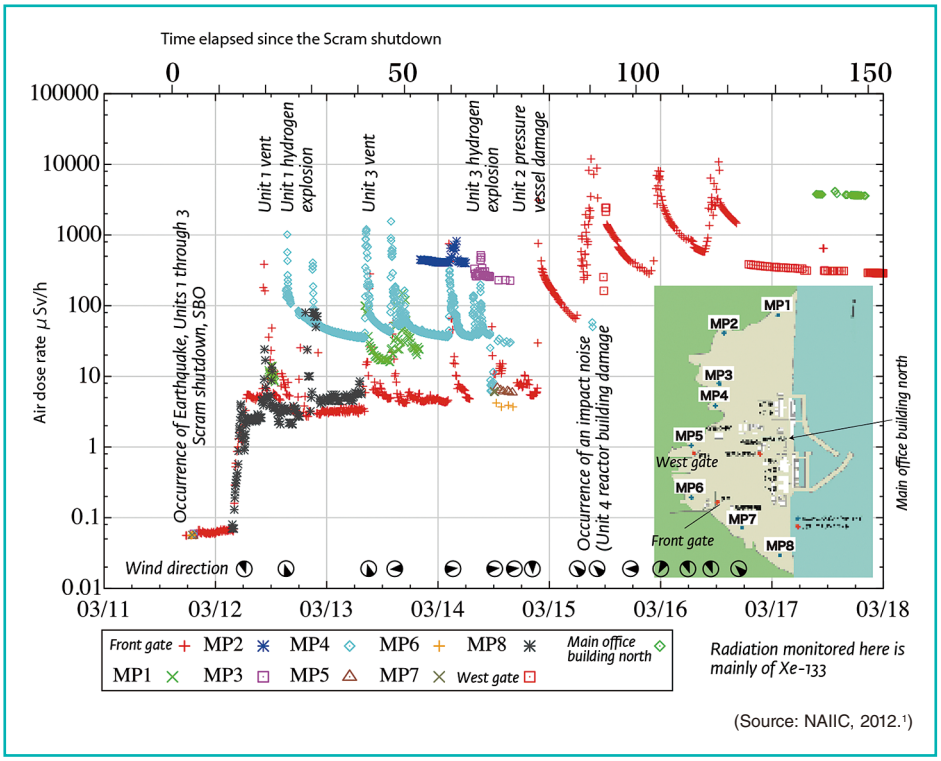

Fig. 1 Radiation dosage measured by a monitoring car in the Fukushima Daiichi plant

at 11:00 on March 15 (T + 3 days 20:14), an order was issued to "Shelter in place in the 20-30 km Zone." Here the problem was that only an evacuation order was issued, and there was no order of the direction of evacuation based on scientific data (**Fig. 1, Table 6**).

In other words, this time when the evacuation order was issued, the System for Prediction of Environmental Emergency Dose Information (SPEEDI) was not used.

At the time, the direction in which many residents of the villages of Namie and Futaba evacuated was in the direction of the Tsushima branch office of the Namie village office to the west-northwest to northwest (after noon on March 15, in east-southeast and southeast winds). As a result of this, they ended up evacuating in the direction that the radioactive substances were flowing.

This SPEEDI information, even though information about the emission source was not available, is able to obtain a calculation result for the direction of dispersion by estimating the unit volume emission (emission of 1 Bq/h of radioactive substances). The Ministry of Education, Culture, Sports, Science and Technology of the national government has a great responsibility for its operation and management.

Problem 12: Evacuation in a northwesterly direction from Fukushima Daiichi NPS

From March 11 to March 12 and March 15, evacuation was implemented when each local government issued evacuation orders for its residents from late in the night of March 12 through March 16 after receiving evacuation orders from the national government for each zone from 3 km to 30 km. Of the residents who evacuated, there were problems with the residents of the towns of Namie and Futaba having evacuated in east-southeast to southeast winds on March 15 when the explosion in the Unit 4 reactor building and the large-scale damage to the Unit 2 pressure suppression chamber occurred at 6:12 (T + 3 days 15:26) (**Table 6, Fig. 1**).

Due to the occurrence of these events, and readings of 400 mSv/h near Unit 3 as well as

readings of 100 mSv/h near Unit 4 at 10:22 (T + 3 days 19:36), the volume of radioactive emissions from near the main gate on March 15 increased sharply and reached nearly 12 mSv/h at one point (**Fig. 1**).

Because the wind direction after noon was the east-southeast or southeast (with wind blowing in the direction of the west-northwest and northwest), the possibility of radiation exposure was pointed out for the residents of the towns of Namie and Futaba who had already evacuated.

Problem 13: Residents in the surrounding area forced to evacuate from after noon on March 12 until March 18 at a time when high levels of radiation were anticipated

The radiation levels on site at the Fukushima Daiichi NPS from March 12 to March 18 exceed 500 μSv/h just after noon at MP4 (monitoring point name from **Fig. 1**, hereafter the same), reached 1,015 μSv/h at 15:29, and the radiation level continued to rise after that as well.[1,3,6] (**Fig. 1, Table 7**).

After this condition continued until March 13, on March 14 levels at the Main Gate monitoring point reached 3,130 μSv/h at 21:37, and at MP6 at 22:23 levels reached 3,200 μSv/h. Next, at 6:12 on March 15 (T + 3 days 15:26), after the Unit 4 reactor building explosion and the large-scale damage to the Unit 2 pressure suppression chamber occurred, at 9:00 the Main Gate recorded a peak of 11,930 μSv/h, and at MP6 at 10:15 a peak of 8,837 μSv/h was measured.

Furthermore, at 10:22, 400 mSv/h was measured near Unit 3,100 mSv/h near Unit 4. These radiation levels were values on site at Fukushima Daiichi NPS, but the fact that these radioactive substance were dispersed by the wind outside the site area to as far as the 30 km zone was anticipated sufficiently by such facts as the cumulative radiation level results from the Tsushima branch office of the Namie village.

The evacuation of residents in the surrounding areas was implemented after noon on March 12 and the time of stay at the evacuation centers was to be at least until March 16. It can be said that the evacuation of the residents of the surrounding areas was forced at a time when high radiation levels were anticipated. Since the average wind speed on March 15 was 1.6 m/s (meters/second), in the five hours from about 10:00 to 15:00 that the southeast wind was blowing, calculations show that radioactive substances were transported as far as 28.8 km.

1.6 m/s × 60 seconds × 60 minutes × 5 hours = 28.8 km

Residents' Availability of information about the accident and the evacuation orders as well as problems of the actions of residents in the evacuation

Problem 14: Only just over 30% of the residents were aware of the occurrence of the NPS accident at the stage of the evacuation order for residents in the 10 km zone on March 12.

The declaration of nuclear emergency was issued on March 11 at 19:30 (T + 4:17), but about ten hours later at the stage when the evacuation order for residents in the 10 km zone at 5:44 (T + 14:58), only just over 30% of the residents were in the broadest sense aware of the occurrence of the NPS accident (**Fig. 2**).

The reason that has been put forward for this is the fact that in the 10 km zone (the towns of Futaba, Okuma, Tomioka and Naraha), the local government was the information source about the accident for only about 30-40% of the residents, while TV, radio and the Internet were the information source for over 30% of the residents, and family and neighbors were the information source for most of the remainder. In addition, when the zone was expanded to 20 km, there was a tendency for the local government to be the information source for an even smaller number of residents, while TV, radio and the Internet became even more prevalent (**Fig. 3**).

In other words, accurate information about the accident should have been made known by the local government, but since they had not been informed by the local government, residents variously used TV, radio and the Internet or their families and neighbors for gathering information, and it was found that due to this there were few residents who had knowledge of the occurrence of the accident.

Problem 15: There was a large gap in awareness of the evacuation order among the residents in the 20 km zone on March 13.

The evacuation order from the national government for residents in the 20 km zone was issued on March 12 at 18:25 (T + 27:39), but one day later at the end of the day on March 13, there was a large gap in the percentage of residents in the 20 km zone with awareness of this evacuation order from over 10% to over 90%, depend-

Table 7 Status of leaks of radioactive substances at Fukushima Daiichi NPS site area[1,3,6]

Date	Time	Value measured at monitoring posts in NPS site area (μSv/h)			Elapsed time (hours:min)
		Main gate	MP4	MP6	
3.11	**14:46**	**Great East Japan Earthquake (SCRAM—Automatic shutdown of reactor)**			**0**
	15:12	**normal**	**normal**	**normal**	
	ca. 15:37	Largest tsunami hits			0:51
	19:03	**Government/Declaration of Nuclear Emergency**			4:17
	20:50	Evacuation Order related to Fukushima Daiichi NPS issued by Governor of Fukushima Prefecture Evacuation of residents within radius of 2 km from NPS			6:04
	21:23	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS			6:37
3.12	0:30	Okuma (2 km zone): Evacuation action for residents within 3 km zone			9:44
	0:30	Futaba (2 km zone): Evacuation action for residents within 3 km zone			9:44
	5:44	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 10 km from NPS			14:58
	6:00	Namie (5 km zone): Evacuation order on its own initiative for residents within 10 km zone			15:14
	ca. 6:21	Okuma (2 km zone): Evacuation order for all residents			15:35
	7:30	Futaba (2 km zone): Evacuation order for all residents			16:44
	7:45	Evacuation Order related to Fukushima Daini NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS			16:59
	8:30	Naraha (3 km zone): Evacuation order for all residents			17:44
	11:00	Namie (5 km zone): Evacuation order on its own initiative to outside the 20 km zone			20:14
	Morning	Tomioka (3 km zone): Evacuation order on its own initiative for all residents			—
	14:30	**Venting at Unit 1**			**23:44**
	15:29	—	**1,015**	—	24:43
	15:36	**Explosion of Unit 1 reactor building**			24:50
	18:25	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 20 km of NPS			1 day 3:39
	Night	Hirono (10 km zone): Appeal to residents to evacuate voluntarily outside of the town			—
	—	Tamura (20 km zone): Evacuation order on its own initiative for entire Miyakoji district			—
	—	Katsurao (20 km zone): Evacuation order for all residents within the 20 km zone			—
3.13	8:33	—	**1,204**	—	1 day 17:47
	9:20	**Venting at Unit 3**			**1 day 18:34**
	11:00	Hirono (10 km zone): Evacuation order for all residents			1 day 20:14
	13:52	—	**1,558**	—	1 day 23:06
	—	Kawauchi (20 km zone): Evacuation order for all residents within 20 km zone			
3.14	2:20	—	—	**751**	2 days 11:34
	3:30	**433**	—	—	2 days 12:44
	9:15	Katsurao (20 km zone): Evacuation order on its own initiative for all residents			2 days 18:29
	11:01	**Explosion of Unit 3 reactor building**			**2 days 20:15**
	18:06	**Venting at Unit 2**			**3 days 3:20**
	21:37	**3,130**	—	—	3 days 6:51
	22:23	—	—	**3,200**	3 days 7:37
3.15	**6:12**	**Explosion of Unit 4 reactor building**			**3 days 15:26**
	6:12	**Severe damage to Unit 2 pressure suppression chamber**			**3 days 15:26**
	8:31	**8,217**	—	—	3 days 17:45
	9:00	**11,930**	—	—	3 days 18:14
	10:15	—	—	**8,837**	3 days 19:29
	10:22	**400 mSv/h in area around Unit 3** **100 mSv/h in area around Unit 4**			3 days 19:36
	11:00	Residents within zone between 20 km radius and 30 km radius shelter in place			3 days 20:14
	23:30	**8,080**	—	—	4 days 8:44
	—	Kawauchi (20 km zone): Recommendation for voluntary evacuation			—
	—	Kawamata (50 km zone): Planned evacuation begins of residents in Yamakiya district			—
	—	Iitate (30 km zone): Planned evacuation begins			—
3.16	6:40	**400 mSv/h in the west area of Unit 3** **100 mSv/h in the west area of Unit 4**			3 days 19:36
	8:47	**150 mSv/h in area around Unit 2** **300 mSv/h in area between Units 2 and 3** **400 mSv/h in area around Unit 3**			3 days 19:36
	10:40	**10,000**	—	—	4 days 19:54
	12:30	**10,851**	—	—	4 days 21:44
	—	Kawauchi (20 km zone): Evacuation order on its own initiative for all residents			—

Note 1: Values for each monitoring post are displayed at the time when they exceeded 400 μSV/h and afterwards at the time when these values exceeded earlier values shown.
Note 2: Items shaded gray are related to the evacuation orders by the national government.
Note 3: Items in parentheses are evacuation order distances to whichever is closer, Fukushima Daiichi NPS or Fukushima Daini NPS.

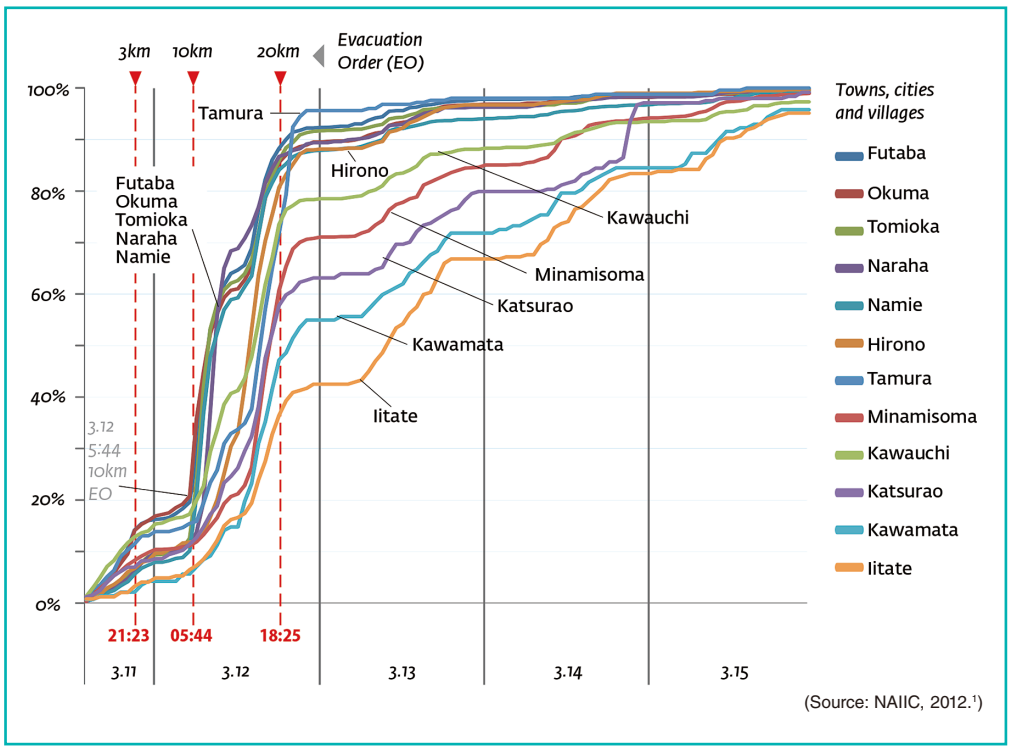

Fig. 2 Percentage of residents who were aware that the accident had occurred (100 percent: evacuated residents)

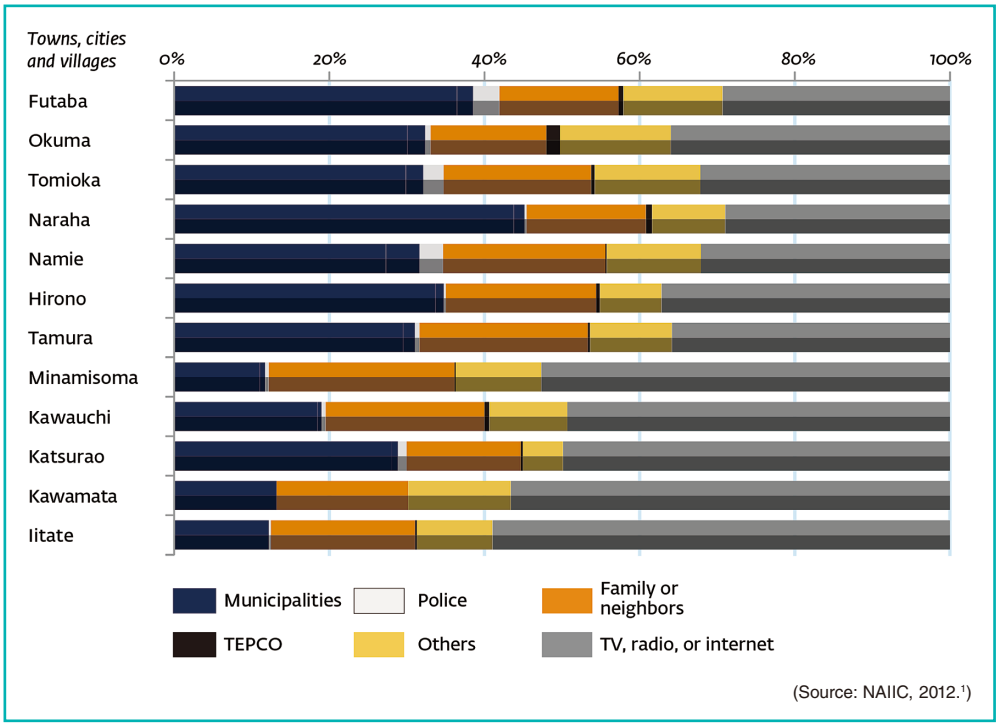

Fig. 3 Source(s) of information concerning the accident

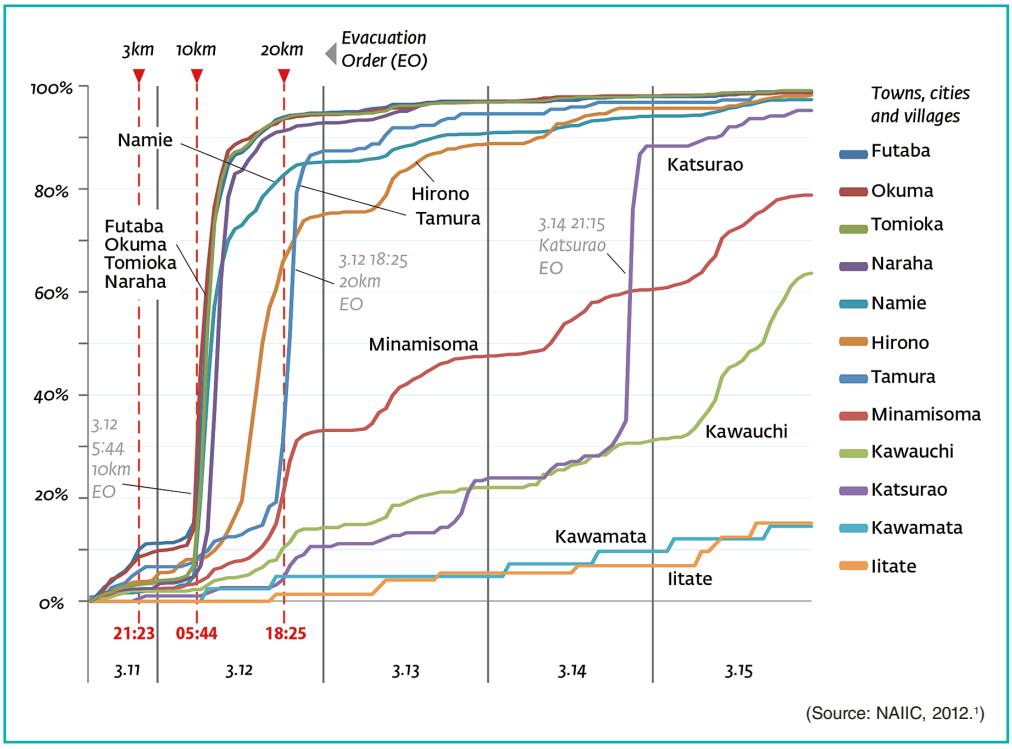

Fig. 4 Percentage of residents who had knowledge of the respective evacuation orders (100 percent: Residents who were evacuated)

ing on the municipality (**Fig. 4**).

The municipalities with a high percentage of evacuation of residents ordered to evacuate the 20 km zone were mostly at the site of Fukushima Daiichi and Daini NPS such as the towns of Futaba, Okuma, Tomioka and Naraha. The municipalities with the next highest percentage of evacuation were in the surrounding areas: the towns of Namie and Hirono and Tamura City. By contrast, the lowest were those further than 10 km from Fukushima Daiichi NPS: Minamisoma City and the villages of Kawauchi and Katsurao. The Katsurao village had the lowest percentage of evacuation, just over 10%.

Local governments as the source of information about the evacuation, with the exception of a few municipalities, rose to 50-60%, much higher than for awareness about the occurrence of the accident, but since in fact the share of residents who had knowledge of the evacuation order was low, how to inform residents as a whole was a problem. On the other hand, in most municipalities, TV, radio and the Internet was the information source about the evacuation order for only about 10-20% of the residents, which showed the limits of TV, radio and the Internet as an information source.

Problem 16: There was a large gap in the percentage of residents ordered to evacuate the 20 km zone who actually evacuated on March 13. The evacuation order from the national government ordering the evacuation of residents in the 20 km zone was issued on March 12 at 18:25 (T + 27:39), but one day later at the end of the day on March 13, there was a wide range in the proportion of residents in the 20 km zone who had actually evacuated, from over 20% to over 90%, depending on the locality (**Fig. 5**).

The municipalities with a high percentage of evacuation of residents ordered to evacuate the 20 km zone were mostly at the site of Fukushima Daiichi and Daini NPS such as the towns of Futaba, Okuma, Tomioka and Naraha with large numbers of residents. The municipalities with the next highest percentage of evacuation were in the surrounding areas: the towns of Namie and

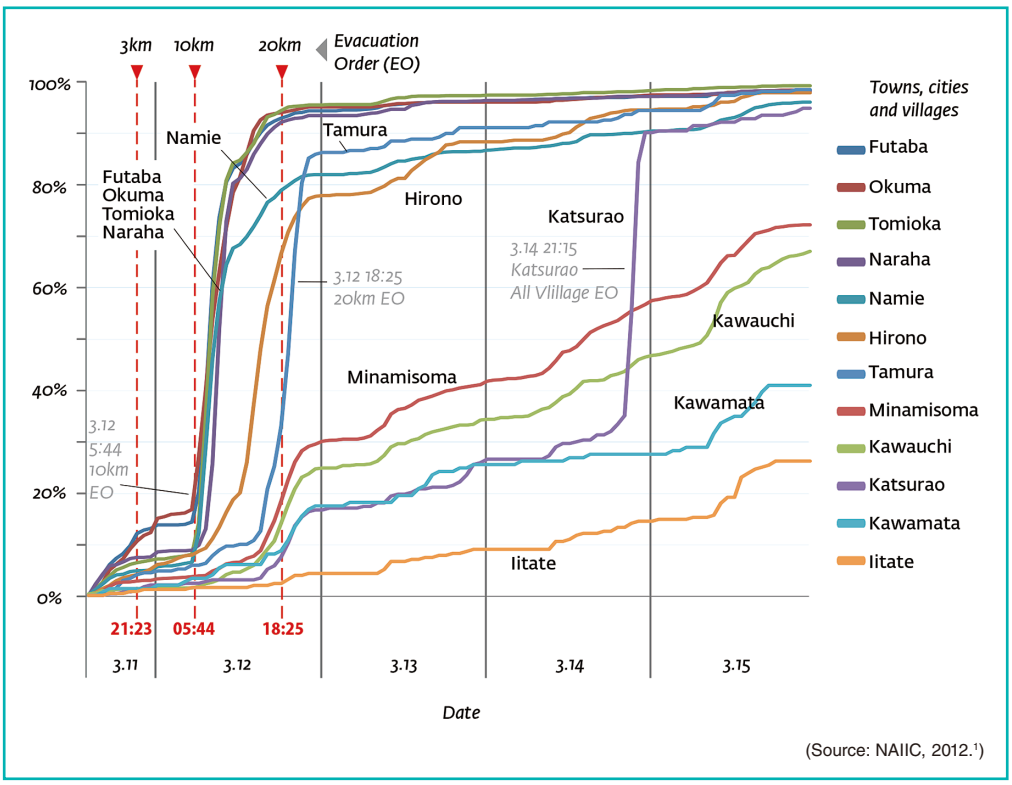

Fig. 5 Percentage of evacuated residents

Hirono and Tamura City. By contrast, the lowest were those further than 10 km from Fukushima Daiichi NPS: Minamisoma City, and the villages of Kawauchi and Katsurao.

It was found that as one of the reasons that the municipality had the highest evacuation percentages was the high degree of communication of information from the local governments and the high level of urgency of the residents themselves about suffering damage.

Problem 17: High numbers of residents evacuated voluntarily in areas further from the NPS.

Other than in the municipalities at the site, the percentage of residents evacuating based on their own judgment among the residents ordered to evacuate from the 20 km zone was relatively high in the region at some distance from the NPS, in Kawauchi village and Minamisoma City (there had also been an order for the planned evacuation of Kawauchi village), at over 40% to just under 60%. By contrast, the percentage was much lower, from over 10% to just under 20% in the municipalities at the site, the towns of Futaba, Okuma, Tomioka and Naraha.

This phenomenon should be considered sufficiently at the time of deliberations of the time required for evacuation and related matters in preparation for future nuclear accidents.

Problems with the evacuation of hospitals

Problem 18: Public hospitals with easy access to information evacuated at the same time as residents, while the evacuation of private sector hospitals could be later than that of the residents

Of the hospitals within the 20 km zone from Fukushima Daiichi and Daini NPS, two were public hospitals (Oono Prefectural Hospital, Minamisoma Odaka Municipal Hospital) and five were private hospitals. Of these, the two public hospitals evacuated at about the same time as the residents: Oono Prefectural Hospital on the morning of March 12, and Minamisoma Odaka Municipal Hospital evacuated on March 13. On the other hand, other than the JA-related Futaba Kosei Hospital, evacuation was later than for the residents, and they evacuated from the

evening of March 13 through March 15 (**Table 8**).

Of the five hospitals, Odaka Akasaka Hospital requested assistance from the Odaka ward office on March 12 and 13 but received none, and on March 14, police who visited the hospital provided a bus in the evening. Furthermore, Futaba Hospital did not receive any support for severely ill patients from the town, and from March 12, requests for assistance from firefighters, police and the Self Defense Forces (SDF), but the bus for the transport of severely ill patients and SDF vehicles arrived on March 14 and 15.

Problem 19: The main reason for the deaths of the severely ill patients was the long time for transportation.

Of the severely ill patients in Futaba Hospital, three patients died in the bus during transport, eleven more died after arrival the next day at their destination (Iwaki City) and by the end of March a total of 40 people had died. The number of patients who died was dramatically higher than at other hospitals (**Table 8**).

The length of the travel time was found to be one of the reasons for this.

The bus of severely ill patients from Futaba Hospital departed at 10:30 on March 14 (T+2 days 19:44), first went to Minamisoma Soso Health Center at 14:00, and after than stopped in Fukushima City, arriving finally at a high school in Iwaki City at 20:00. This travel time totaled nine and one half hours.

It was found that as a response for the future, planned designation in advance is necessary to secure nearer hospitals able to admit the severely ill patients from hospitals that must be evacuated on the occasion of a nuclear accident.

Problems in the Order for Distribution and Intake of Stable Iodine Tablets

Problem 20: Order for distribution and intake of stable iodine tablets after dispersion of radioactive substances from venting and reactor building explosion

When the intake of stable iodine tablets is done before internal exposure to radioactive substances, it has an effectiveness of 100%. But after this accident, four local governments (the towns of Tomioka, Futaba, Okuma and Miharu) issued intake orders, but all of these were issued after considerable period of time had passed since the aerial dispersion of radioactive substances as a result of venting operation at Unit 1 on March 12 at 14:30 (T+23:44) and the explosion of the reactor building at 15:36 (T+24:50) on the same day (**Table 9**).

More specifically, the intake order of Tomioka (21,000 tables distributed) lasted from the evening of the day of venting at Unit 1 until the next day (March 13), in Futaba (intake by at least 845 people) the order was on the day after venting at Unit 1, in Okuma (intake by 340 people who had evacuated to Miharu) the order was on the second day after venting at Unit 1 (March 15), and in Miharu (intake by 7,520 people) and Okuma the order was on the second day after venting at Unit 1.

All residents of Tomioka, Futaba, and Okuma had been ordered to evacuate no later than the morning of March 12 and had already moved away from the Daiichi NPS. However, because of the fact that the intake order was issued after a considerable time had passed after the dispersion of radioactive substances, the dispersion of the radioactive plume had reached 30 km in the five hours, as shown in the previous calculation, much doubts remained about its effectiveness.

Problem 21: Tablets were distributed but there was no intake order.

There were some local governments which had taken the positive step to distribute stable iodine tablets, which are highly effective as a protective measure against thyroid cancer due to radioactive substances, but did not issue an intake order (**Table 9**).

More specifically, tablets were distributed to individuals in Iwaki City (the morning of March 16, 152,500 people, 257,700 tablets) and in Naraha town (the morning of March 15, 3,000 people) but the intake order was not issued for reasons such as because there was no information about the level of airborne radiation, the timing of when to take them was not known, or they had waited for orders from the Fukushima Prefectural Government.

Furthermore, it was determined that residents who had evacuated to Tsushima district in Namie village had been exposed to the radioactive plume, but stable iodine tablets were distributed on March 13 and 14 in the evacuation center to the 8,000 people who had evacuated to Tsushima district. However, there was no order issued for the intake of these tablets.

Table 8 Timing of evacuation and means of transportation of seven hospitals within the 20 km zone around Fukushima Daiichi NPS[1]

Date	Time	Timing of evacuation and access to transportation of the seven hospitals within the 20 km zone	Elapsed time (hours:min)
3.11	**14:46**	**Great East Japan Earthquake (SCRAM—Automatic shutdown of reactor)**	**0**
	ca. 15:37	Largest tsunami hits	0:51
	19:03	**Government/Declaration of Nuclear Emergency**	**4:17**
	20:50	Evacuation Order related to Fukushima Daiichi NPS issued by Governor of Fukushima Prefecture Evacuation of residents within radius of 2 km from NPS	6:04
	21:23	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	6:37
3.12	5:44	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 10 km of NPS	14:58
	7:45	Evacuation Order related to Fukushima Daini NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	16:59
	Morning	Oono Prefectural Hospital: 35 inpatients in departments including Internal Medicine and Gastroenterology evacuated at about the same time as other residents. Seriously ill patients were evacuated by ambulance (no patients died by the end of March).	—
	14:30	**Venting at Unit 1**	**23:44**
	15:36	**Explosion of Unit 1 reactor building**	**24:50**
	18:25	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 20 km of NPS	1 day 3:39
	Evening until morning of 3.13	Futaba Kosei Hospital in the 5 km zone: 136 inpatients in departments including Internal Medicine, Obstetrics and Gynecology, and Pediatric Medicine evacuated at about the same time as the other residents. Seriously ill patients were evacuated by SDF helicopter (4 patients died by the end of March).	—
3.13	**9:20**	**Venting at Unit 3**	**1 day 18:34**
	—	Minamisoma Odaka Municipal Hospital in the 20 km zone: 68 inpatients in departments including Internal Medicine, Surgery, Ophthalmology and Radiology were evacuated at about the same time as the other residents. Seriously ill patients were evacuated by ambulance and microbus (no patients died by the end of March).	—
	Evening until morning of 3.14	Imamura Hospital, within 10 km zone: 96 inpatients in departments including Internal Medicine and Cardiovascular Medicine evacuated later than other residents. Seriously ill patients evacuated by SDF helicopter (3 patients died by the end of March).	—
	10:30	Futaba Hospital, within 5 km zone: 339 inpatients in departments including Psychiatric Medicine and Internal Medicine evacuated later than other residents. Seriously ill patients were evacuated by SDF vehicles and busses (40 patients died by the end of March).	—
3.14	**11:01**	**Explosion of Unit 3 reactor building**	**2 days 20:15**
	18:06	**Venting at Unit 2**	**3 days 3:20**
	Evening	Odaka Akasaka Hospital, within 20 km zone: 104 inpatients in departments including Psychiatric Medicine, Internal Medicine and Clinical Medicine evacuated later than other residents. Seriously ill patients were evacuated by and busses (no patients died by the end of March).	—
	Evening	Nishi Hospital, within 10 km zone: 75 inpatients in Internal Medicine and other departments, most of whom were undergoing dialysis treatment, were evacuated later than other residents. Seriously ill patients were evacuated by SDF helicopter and police vehicles (3 patients died by the end of March).	—
3.15	**6:12**	**Explosion of Unit 4 reactor building**	**3 days 15:26**
	6:12	**Serious damage to Unit 2 pressure suppression chamber**	**3 days 15:26**
	11:00	Residents between 20 km radius and 30 km radius from NPS shelter in place	3 days 20:14

Note: Items shaded gray are related to evacuation orders issued by the national government.

Table 9 Status of local governments that distributed and ordered intake of stable iodine tablets[1]

Date	Time	Status of local governments that distributed and ordered intake of stable iodine tablets	Elapsed time (hours:min)
3.11	**14:46**	**Great East Japan Earthquake (SCRAM—Automatic shutdown of reactor)**	**0**
	ca. 15:37	Largest tsunami hits	0:51
	19:03	**Government/Declaration of Nuclear Emergency**	**4:17**
	20:50	Evacuation Order related to Fukushima Daiichi NPS issued by Governor of Fukushima Prefecture Evacuation of residents within radius of 2 km from NPS	6:04
	21:23	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	6:37
3.12	0:30	Okuma (2 km zone): Evacuation action for residents within 3 km zone	9:44
	0:30	Futaba (2 km zone): Evacuation action for residents within 3 km zone	9:44
	5:44	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within radius of 10 km from NPS	14:58
	6:00	Namie (5 km zone): Evacuation order for residents within 10 km zone	15:14
	ca. 6:21	Okuma (2 km zone): Evacuation order for all residents	15:35
	7:30	Futaba (2 km zone): Evacuation order for all residents	16:44
	7:45	Evacuation Order related to Fukushima Daini NPS issued by NERHQ Chief Evacuation of residents within radius of 3 km from NPS Shelter in place for residents from radius of 3 km to radius of 10 km from NPS	16:59
	8:30	Naraha (3 km zone): Evacuation order for all residents	17:44
	11:00	Namie (5 km zone): Evacuation order on its own initiative to outside the 10 km zone	20:14
	Morning	Tomioka (3 km zone): Evacuation order on its own initiative for all residents	—
	14:30	**Venting at Unit 1**	**23:44**
	15:36	**Explosion of Unit 1 reactor building**	**24:50**
	18:25	Evacuation Order related to Fukushima Daiichi NPS issued by NERHQ Chief Evacuation of residents within 20 km of NPS	1 day 3:39
	Night	**● Tomioka: Iodine tablet intake order (21,000 tablets distributed)**	**—**
3.13	**9:20**	**Venting at Unit 3**	**1 day 18:34**
		● Futaba: Iodine tablet intake order for residents who had evacuated to Kawamata (intake by 845 people)	**—**
	3.13-14	**Namie: Distribution only of iodine tablets at Tsushima District evacuation center, intake waited for order from Prefectural Government (8,000 people)**	**—**
3.14	**11:01**	**Explosion of Unit 3 reactor building**	**2 days 20:15**
	18:06	**Unit 2 vent operation**	**3 days 3:20**
3.15	**6:12**	**Explosion of Unit 4 reactor building**	**3 days 15:26**
	6:12	**Severe damage to Unit 2 pressure suppression chamber**	**3 days 15:26**
	11:00	Residents within zone between 20 km radius and 30 km radius shelter in place	3 days 20:14
	13:00-18:00	**● Miharu: Intake order for iodine tablets (7,250 people)**	**—**
	Afternoon	**Naraha: Distribution only of iodine tablets to individuals who had evacuated to Iwaki City, intake waited for order from Prefectural Government (3,000 people)**	**—**
	—	**● Okuma: Intake order for iodine tablets for residents who had evacuated to Miharu (340 people)**	**—**
3.16	10:35	Order from NERHQ Chief to Fukushima Prefecture Governor Intake of stable iodine tablets to all residents remaining in the evacuation zone (20 km radius) at the time of the emergency. (At the point in time when the order was issued, evacuation had already been completed, so there were no residents who took stable iodine tablets based on this order)	4 days 19:49
	Afternoon	**Iwaki: Iodine tablets only distributed to individuals, intake waited for order from Prefectural Government (152,000 people, 257,000 tablets)**	**—**

Note 1: **● indicates that an intake order was issued, local governments without this mark only distributed.**
Note 2: Items shaded gray are related to the evacuation orders by the national government.
Note 3: Items in parentheses are evacuation order distances to whichever is closer, Fukushima Daiichi NPS or Fukushima Daini NPS.

As described above, the distribution without an intake order produced the problem that the valuable stable iodine tablets ended up being wasted.

Problem 22: The failure of the intake order for stable iodine tablets issued by the national government

The local governments which issued their own intake orders ended their intake orders from March 13 to March 15. But after these ended, on March 16 at 10:35 (T + 4 days 19:49), there was an order from the NERHQ of national government to the Governor of Fukushima Prefecture for the intake of stable iodine tablets at the time of evacuation to all people still in the evacuation zone (within a 20 km radius)[7] (**Table 9**).

There was a significant problem: at the time of this order, because the evacuation had already been completed, there were no residents who took stable iodine tablets on the basis of this order,[7] and the intake order for stable iodine tablets issued by the national government ended up as a failure.

Problem 23: The order of the Japan Society of Obstetrics and Gynecology to administer potassium iodine tablets to pregnant and nursing women was ignored.

The Japan Society of Obstetrics and Gynecology, a public interest corporation, published on its web site on March 15 the document, "The Administration of Potassium Iodide Tablets (for Prevention of Developing Thyroid Cancer) to Pregnant and Nursing Women at the Time of Radiation Exposure due to the Fukushima Nuclear Accident."[8]

The main points of the document are the two following points, but there is a problem that the national government and many scientific societies have ignored them.

1. Even when it is unclear whether there has been radiation exposure, if pregnant women and nursing mothers are under 40 years old, they should be instructed to take two 50 mg tablets of potassium iodide (100 mg).
2. Pregnant women should be preferentially evacuated from land where there is a risk.

Problems in the Nuclear Emergency Response Guidelines from the Perspective of the Actual Conditions and Problems Related to the Evacuation Orders and Iodine Tablet Intake Orders in the Fukushima Daiichi NPS Accident

The Basic concept of the Nuclear Emergency Response Guidelines

Problem 24: The guidelines lack constructive responses to the "closed-door" nature of nuclear emergencies that hinder the provision of information to residents

It is clearly stated that "Disaster preparedness plans shall be formulated from the perspective of the residents" as a basic concept of the Nuclear Emergency Response Guidelines[4] among its "Objectives and Purposes," and this perspective should be reflected in the specific details of the Guidelines. However, five special characteristics of nuclear emergencies are listed in the guidelines, and the most important "closed-door" nature of nuclear emergencies is overlooked.

Even in tsunami emergencies in which it is comparatively easier for residents to obtain information than in nuclear emergencies, drastic changes in policies are being considered because of the enormous damage that was caused this time. By contrast, on the occasion of the Fukushima Daiichi NPS accident, information about the accident at the NPS and evacuation was withheld to the extent that residents were almost entirely ignored, which produced a problem that can be called an 'information disaster'[9] (**Table 10**).

Because of this, even more than in tsunami emergencies, we need to stand in the position of citizens and residents affected by the disaster, and provide information about the NPS accident in real time, so that residents in each region can take immediate actions including evacuation and the intake of stable iodine tablets.

Problem 25: The responsibility of securing the safety of residents and citizens, specific divisions of roles and actions should be clearly stated as the responsibility of the nuclear power operator.

It is clearly stated in the Guidelines, Chapter 1 Nuclear Emergencies, (1) Nuclear Emergencies and the Responsibilities of the Nuclear Power Operator, that "the nuclear power operator must recognize the fact that it has the primary responsibility for the convergence of events such as an accident that are the cause of the emergency,

Table 10 Comparison of the special characteristics of the damage caused by the tsunami disaster and the nuclear accident in the Great East Japan Earthquake

Provision to residents of information	Occurrence of the Great East Japan Earthquake (Northeast Japan Pacific Ocean Earthquake)	
	Large scale tsunami disaster (visible disaster)	Nuclear accident such as core meltdown (invisible disaster in a black box)
Information about **the location** of the disaster	Location of epicenter of earthquake was **provided quickly** to residents by earthquake and tsunami information provision system.	Details of the accident at Fukushima Daiichi and Daini NPS were either announced by the government or, until the hydrogen explosion, **not clearly communicated for several days**.
Information about **the scale and details** of the disaster	The magnitude of the earthquake was **provided quickly** to residents.	Information was **provided only slowly** by the government. Accident was classified as Level 7 only **after about one month** after its occurrence.
	There were **almost no factors that blocked communication** in the process of information provision such as meetings.	There were **a high number of factors that blocked communication** in the process of information provision such as meetings.
Information **necessary for evacuation**	There were some minor errors concerning the scale of the tsunami but it was **provided quickly** to residents.	Accurate information about radiation level values were **basically not provided to residents** in the area surrounding the NPS.
	The direction of evacuation relative to the tsunami was generally away from the ocean, and this was **generally known** to the residents.	The volume of inhaled aerial radiation and direction of dispersion from SPEEDI were **basically not provided** to residents in the area surrounding the NPS.
	The methods of evacuation relative to the tsunami was generally going up to higher ground, and this was **generally known** to the residents.	**Almost none** of the residents in the area surrounding the NPS knew about the methods of evacuation from radioactive substances.

(Source: Hatanaka T. JMAJ, 2012.[9])

and also has a large responsibility for actions in a nuclear emergency," but it should also clearly state specifically how roles are divided in which response areas in practice, and how these responses are to be made.

Furthermore, the responsibility to secure the safety of residents of the surrounding areas or more expansively of all citizens is not clearly stated as the responsibility of the nuclear power operator, and the Guidelines should state this clearly.

Specifically, whether in the case of a site area emergency or a general emergency, the Guidelines should state clearly that along with communication with local governments, the preparation of preventive protective actions, and the implementation of evacuation within the Urgent Protective action planning Zone (UPZ) in which urgent protective actions had been prepared (within 30 km). The Guidelines should also state clearly specific responses such as a duty to notify local governments of Article 15 notifications, a duty to assist evacuation of evacuees from a site area emergency, and a duty to compensate receiving hospitals.

Staged responses to urgent situations in the Guidelines

Problem 26: For NPS accidents due to large-scale earthquakes, site area emergencies and general emergencies should be responded in an integrated manner.

In the Guidelines, protective actions for residents are listed in three categories as the basic concept for implementation of protective actions in an urgent situation. What is a problem is that the Guidelines try to separate the responses by dividing protective actions for residents and

Table 11 Basic concept for implementation of protective actions in emergencies[10]

Category	Alert	Site area emergency	General emergency
	At the time, there is no emergency that has or threatens to have an impact on the general public due to radiation. However, since there is an unusual incident at the NPS facility, at this stage it is necessary to begin information collection and protective actions such as preparation for emergency monitoring and preparation for evacuation of persons at the site area who require evacuation in an emergency*	Because an incident has occurred at the NPS facility which may possibly have an impact on the general public due to radiation, at this stage it is necessary to begin preparation for the main protective actions such as the evacuation of areas surrounding the NPS planned for emergencies.	Because an incident has occurred at the NPS facility which is highly likely to have an impact on the general public due to radiation, at this stage it is necessary to implement rapid protective actions in order to avoid a definite effect and to minimize the risk of stochastic effect.
Accident situation			
• Effect of radiation on the general public (listed in the Nuclear Emergency Response Guidelines)	None (not an emergency)	Almost none (possible)	Yes (high possibility)
Main countermeasures			
• Emergency monitoring	Preparations	Implementation	(Implementation)
• Prophylactic evacuation of persons requiring evacuation*	Preparations	Implementation	(Implementation)
• Protective actions for residents and others		Preparations	Implementation
Laws and statutes			
• Act on Special Measures Concerning Nuclear Emergency Preparedness	—	Article 10 (Notification event)	Article 15 (Nuclear emergency)

* Persons requiring evacuation: people who need more time than usual when evacuation is carried out, and people who require support during an emergency so that the health risk from carrying out evacuation is not increased (sick or injured people, inpatients, elderly, disabled, foreign citizens, infants and small children, pregnant women and other persons who require support during an emergency), people to whom stable iodine tablets were not distributed in advance, and among the people for whom intake of stable iodine tablets is contraindicated, those for whom it is necessary to implement protective actions such as early evacuation during a site area emergency.

others into the categories of site area emergency (Article 10 situations under the Nuclear Emergency Act) and general emergency (Article 15 situations under the Nuclear Emergency Act)[10] (**Table 11**).

For site area emergencies, the impact of radiation on the general public is stated to be nearly zero (although there is a possibility), and other than the implementation of preventive evacuation, the protective actions for citizens and others stop at the preparation stage. On the other hand, for general emergencies, it is stated that there is an impact of radiation on the general public, and protective actions for citizens and other are implemented.

But in the Fukushima Daiichi NPS accident, there was only one hour of time difference between the site area emergency and general emergency. In the event that another disaster similar to the Great East Japan Earthquake occurs, this kind of division only invites confusion, and if a site area emergency occurs, actions should also be taken to prepare for a general emergency (**Table 1**).

The flow of emergency information communication in the Guidelines

Problem 27: In any kind of emergency, local governments and the general public should be notified immediately of NPS accidents and the status of the emergency.

Figure 6 shows the degree of emergency, sequence of communication from the nuclear power operator to the national government, local governments and the general public and others about the occurrence of an emergency and the status of the facility accident for each type of emergency stated in the Guidelines. Here, it is a problem that the concept for protective actions for residents and others is divided into the categories of "alert," "site area emergency" and "general emergency." There are also problems in that the scope of local governments that are to be the targets of communication by the nuclear power operator and the national government is not clearly stated, and in that there is no need for the nuclear power operator to inform local governments and the general public and others immediately at the "alert" stage (**Fig. 6**).

There were many local governments which were not notified of the occurrence of the Fukushima Daiichi NPS accident by the national government or by the nuclear power operator, and as a result of this, residents were of course also not notified by local governments, and this caused many residents to be unaware of the occurrence of the accident. On the other hand, the national government ended up ordering residents between the 20 km radius and the 30 km radius to shelter in place (T + 3 days 20:14) and voluntary evacuation (T + 14 days).

In any kind of emergency, local governments, the general public, and others should be notified immediately of the status of the NPS.

Problem 28: In the event of a large-scale earthquake, in any kind of emergency, local governments, the general public, and others within a 30 km zone should be notified of the status of the NPS.

After the SCRAM occurred at the Fukushima Daiichi NPS, the notification of a site area emergency came 56 minutes later, and the notification of a general emergency came one hour and 56 minutes later from TEPCO to the national government. The towns of Okuma and Futaba were notified by TEPCO in a telephone communication, and the neighboring Hirono town became aware of the occurrence of the accident from media reports (**Table 5**).

Local governments within the 30 km zone including Namie town, the cities of Tamura and Minamisoma, and the villages of Katsurao and Iitate became aware of the accident from media reports, and Kawauchi village learned of the occurrence of the accident when requested the next morning to receive evacuees from the towns of Tomioka, Futaba and Namie (**Table 5**).

In the event of a large-scale earthquake, the flow of information communication for emergencies in the Guidelines should be modified. Specifically in the event of a large-scale earthquake, in the case of an alert, site area emergency, general emergency or any kind of emergency, the nuclear power operator should in principle notify immediately local governments, the general public and others within a zone of at least 30 km about the details of the emergency (**Fig. 7**).

Problem 29: Local governments should not limit distribution of stable iodine tablets to the PAZ but should also distribute them in the UPZ and PPA.

In the Guidelines, standards for intake and distribution of stable iodine tablets are established separately for each of the nuclear emergency response key zones. In the Precautionary Action Zone (PAZ, within 5 km), in peacetime it is clearly stated that advance distribution shall be carried out, but in the UPZ (within 30 km) and the Plume Protection planning Area (PPA, beyond 30 km), advance distribution is not clearly stated, and some abstract preparation of a distribution system and stockpiling is to take place (**Table 12**).

More specifically, for PAZ, at the point in time when it becomes a general emergency, because the NERHQ or local government immediately orders evacuation and the intake of stable iodine tablets, they are to be taken in principle by following this order. However, people who are unable to take stable iodine tablets, or people who are at a greater risk of health effects from exposure of the thyroid gland to radiation from radioactive iodine, such as infants and small children, and their guardians, are to evacuate preferentially during the site area emergency, a stage at which the intake of stable iodine tablets is not necessary.

On the other hand, the response in UPZ and PPA is to be that after it becomes a general emergency, depending on factors such as the sta-

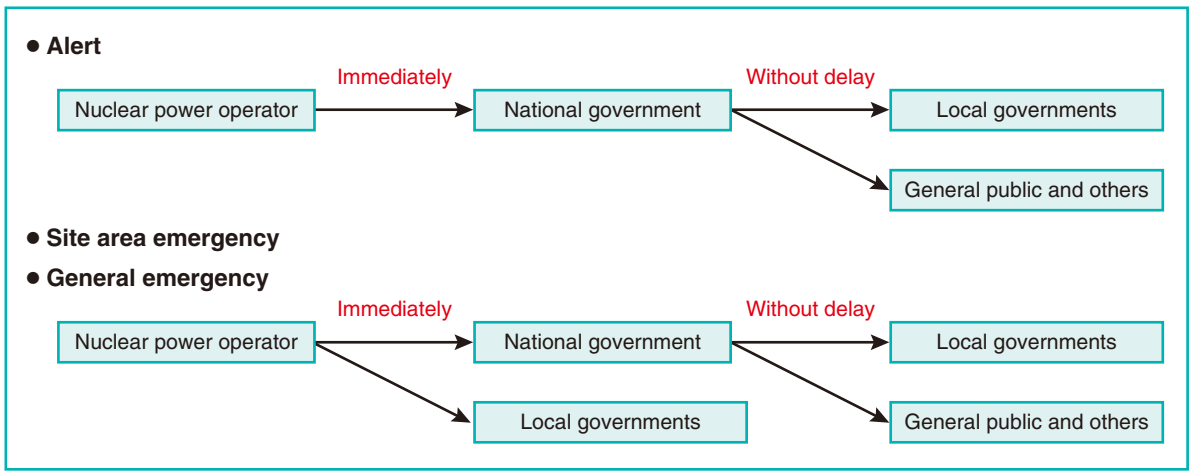

Fig. 6 Flow of emergency information communication in the Guidelines[4]

This figure is created based on the Guidelines' Section 2: Measures prior to nuclear emergencies, (2) Basic concept of implementation of protective actions in an emergency, 2) Concept for protective actions in initial response stage of an emergency.

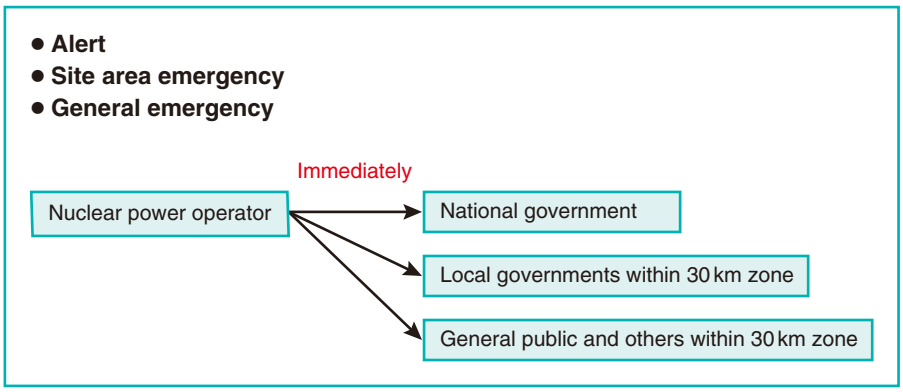

Fig. 7 Proposed modifications for the flow of emergency information communication in the event of large-scale earthquake

tus of the NPS and the level of airborne radiation, the Nuclear Regulation Authority (NRA) determines the necessity of the distribution and intake of stable iodine tablets, along with evacuation or sheltering in place, and because the NERHQ or local government orders it, they are to be taken in principle by following this order.

On the occasion of the Fukushima Daiichi NPS accident, orders for evacuation within 3 km and orders to shelter in place between 3 km and 10 km, zones in which there were municipalities at the site, were issued simultaneously six hours and 37 minutes after the SCRAM. Then, on the day after the SCRAM, fourteen hours and 58 minutes later, the evacuation order for the 10 km zone was issued, and there was only eight hours and 21 minutes between them (**Table 1**).

In this way, because the evacuation orders of municipalities belonging to PAZ and UPZ were issued without setting any time, there is a high possibility that the different standards set for distribution of stable iodine tablets in PAZ and UPZ will end up not matching the actual conditions of the accident. Because of this, local governments should not limit advance distribution of stable iodine tablets to PAZ but should also distribute them in UPZ and PPA.

Furthermore, the order for intake of stable

Table 12 Key zones for nuclear emergency response[4]

Category	PAZ Precautionary Action Zone (Zone for preparation of preventive protective actions)	UPZ Urgent Protective Action Planning Zone (Zone for preparation of protective actions for an emergency)	PPA Plume Protection Planning Area (Zone for implementation of protective actions for the purpose of avoiding radiation exposure from the plume)
Objective of establishment of zone	Zone for preparation of preventive protective actions at a stage prior to the release of radioactive substances into the environment, in order to prevent definite effects from radiation exposure even in the case of a rapidly developing accident, in support of Emergency Action Level (EAL) and for such purposes as implementation of immediate evacuation.	This is a zone that prepares protective actions in the time of an emergency based on EAL and Operational Intervention Level (OIL) in order to contain the risk of an effective impact at a minimal level.	Even outside the UPZ, it is anticipated that impacts such as radiation exposure of the thyroid gland due to the inhalation of radioactive iodine when the plume passes through. In other words, even though it is outside the 30 km boundary of the UPZ, there will be cases in which protective measures are necessary, primarily in the area surrounding the UPZ.
Boundary of zone	About 5 km radius from NPS facility	About a 30 km radius from NPS facility	Outside the boundary of the UPZ

iodine tablets in PAZ, UPZ and PPA is to be an order issued by the NERHQ or local government. However, on the occasion of the Fukushima Daiichi NPS accident, notification to local governments of the occurrence of the accident and the evacuation orders were not reliably communicated even to the local governments at the site of the NPS, and almost every other local government did not become aware of it from the national or prefectural government or the nuclear power operator (**Tables 5, 6**).

Because of this, strengthening the means of notifications and communication is a matter of course, the fail-safe concept should be introduced, and specific response methods should be listed, taking into consideration the condition that the orders from the NERHQ or local government do not arrive.

Recommendations: Revisions in the Investigation of the Fukushima Daiichi NPS Accident and Reflection in the Nuclear Emergency Response Guidelines

The Nuclear Emergency Response Guidelines

Constructive measures to avoid an 'information disaster'

On the occasion of the Fukushima Daiichi NPS accident, specific information about the accident at the NPS and information necessary for evacuation was withheld from residents to the extent that residents were almost entirely ignored, which produced a problem that can be called an 'information disaster.' Because of this, the Guidelines should stand in the position of citizens and residents affected by the disaster, and provide information about the NPS accident in real time, without fear of failure, so that residents in each region can immediately take evacuation actions including the intake of stable iodine tablets based on this information.

State clearly the specific roles and tasks of nuclear power operators in the 30 km zone

Damage to residents due to the release of radioactive substances on the occasion of an accident is the responsibility of the nuclear power operator. In the Guidelines the nuclear power operator should be responsible for communication with local governments, the preparation of preventive protective actions, and the implementation of evacuation at least within UPZ. The Guidelines should also state clearly specific responses such as a duty to notify local governments of Article 15 notifications, a duty to assist evacuation of evacuees from a site area emergency, and a duty to compensate receiving hospitals.

An integrated response to site area emergencies and general emergencies in NPS accidents due to events such as large-scale earthquakes

The Guidelines try to separate the responses by

dividing protective actions for residents and others into the categories of site area emergency (Article 10 situations) and general emergency (Article 15 situations). But in the Fukushima Daiichi NPS accident, there was only one hour of time difference between the site area emergency and general emergency. In the event that another disaster such as a large-scale earthquake similar to the Great East Japan Earthquake occurs, the actions to respond to a site area emergency should be the same as a general emergency.

In the event of a large-scale earthquake, information about the emergency should be provided to all local governments, the general public and others within the 30 km zone in any type of emergency.

When the large-scale earthquake occurred, the flow of communication to the national government, local governments and general public and others, and the degree of emergency stated in the Guidelines did not function and should be altered. More specifically, on the occasion of the large-scale earthquake, in the event of any type of emergency—alert, site area emergency, or general emergency—the nuclear power operator should provide information about the details of the emergency, in principle immediately, to all local governments, the general public, and others within at least the 30 km zone.

Advance distribution of stable iodine tablets should not be limited to PAZ but distribution should also be in UPZ and PPA.

Local governments should not limit distribution of stable iodine tablets to PAZ and should extend to UPZ and PPA.

Concerning the order for intake of stable iodine tablets as well, strengthening the means of notifications and communication is a matter of course, the fail-safe concept should be introduced, and specific response methods for intake orders should be listed, taking into consideration the condition that the orders from the NERHQ or local government do not arrive.

Revision of the system for information communication to medical care providers

Medical providers are in a position to play an important role in protecting the lives and health of residents by such actions as providing explanations of the protective actions and the effects on the health of residents who evacuated, medical treatment for emergency patients with contamination, evacuation of hospital inpatients, and decisions about sheltering in place. The paths of communication appropriate for each community should be deliberated from the perspective of an adequate system for collecting information about radiation, the expansion of the scope of communication, the distance from NPS, human networks in peacetime, and the continuity of communication of natural disaster information. In the future, an effective system of information communication should be constructed by conducting disaster drills.

Preparation by the national government of an infrastructure for the effective distribution and intake of stable iodine tablets

The national government should prepare an infrastructure for advance distribution to residents in UPZ and PPA.

In the future, it is anticipated that along with the establishment of an expanded evacuation planning area which includes not only PAZ, but also UPZ and PPA, methods will be considered for advance distribution of stable iodine tablets. If this is the case, smooth advance distribution by local governments will be difficult under the present system.

It is necessary that as quickly as possible, the national government should hold discussions about and make preparations for a system for advance distribution on a scale targeting tens or hundreds of thousands of residents.

The national government should establish a setting in which the opinions of medical professionals concerning the advance distribution and intake can be heard broadly.

Not only in the region where nuclear power stations are located, it is vital for physicians and medical associations to provide input to local governments with scientific medical knowledge about the timing of intake and distribution of stable iodine tablets, in order to minimize the risks of radiation exposure to residents based on understanding the accident situation and risk assessment. Therefore, it is necessary for the national government to establish a setting in which the opinions of medical professionals can be heard broadly concerning advance distribution and intake.

References

1. Report of the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC). 2012. http://warp.da.ndl.go.jp/info:ndljp/pid/3856371/naiic.go.jp/en/report/.
2. Nuclear Emergency Response Headquarters (NERHQ). 2011 Fukushima Daiichi and Daini Nuclear Power Station Incident (51st Report). http://dl.ndl.go.jp/view/download/digidepo_6011191_po_9_05_gensai.pdf?contentNo=6&alternativeNo=. (in Japanese)
3. Independent Investigation Commission on the Fukushima Nuclear Accident (Minkan Jikocho). The Fukushima Daiichi Nuclear Power Station Disaster: Investigating the Myth and Reality. UK: Routledge; 2014.
4. Nuclear Regulation Authority (NRA). Nuclear Emergency Response Guidelines (Revised September 5, 2013). https://www.nsr.go.jp/data/000024441.pdf. (in Japanese)
5. Asahi Shimbun, Morning Edition, August 21, 2014. (in Japanese)
6. Radiation dose measured in the Fukushima Daiichi Nuclear Power Station 2011 | Archives. Tokyo Electric Power Company (TEPCO). http://www.tepco.co.jp/en/nu/fukushima-np/f1/data/2011/index-e.html.
7. Secretariat of the Nuclear Emergency Response Headquarters (NERHQ). Response to the Nuclear Disaster at the Fukushima Daiichi and Daini NPS (Summary), August 12, 2011. http://www.nsr.go.jp/archive/nsc/senmon/shidai/bousin/bousin2011_02/siryo2-7-1.pdf. (in Japanese)
8. The Japan Society of Obstetrics and Gynecology. http://www.jsog.or.jp/news/pdf/announce_20110315.pdf. (in Japanese)
9. Hatanaka T. The Great East Japan Earthquake: Research and actions of JMARI. JMAJ. 2012;55(5):368-374. http://www.med.or.jp/english/journal/pdf/2012_05/368_374.pdf.
10. Japan Atomic Energy Agency. http://www.jaea.go.jp/04/shien/research/EP010.html. (in Japanese)

Japan Medical Association Junior Doctors Network Report on the WMA Council Session, Tokyo 2014

JMAJ 57(5·6): 320-323, 2014

Kazuhiro ABE,[1] Chiaki MISHIMA[2]

General Overview*1

The World Medical Association (WMA) Council Session was held at the Hotel Nikko Tokyo, Tokyo, Japan from April 24 to 26 of 2014. In concert with this meeting, the WMA Junior Doctors Network (WMA-JDN) also met on April 27.

The principal objectives of this WMA-JDN meeting were to enhance the organization's power, as was discussed in the preceding WMA General Assembly (Fortaleza, Brazil, in October 2013), a meeting attended by Drs. Mishima and me, and to share information on the actual conditions of various member countries.

The purpose of the Japan Medical Association Junior Doctors Network (JMA-JDN) in the WMA-JDN meeting was to facilitate the attendance of JMA-JDN members who are usually busy working and find it difficult to take a leave of absence to attend meetings held overseas, encouraging exchanges with junior doctors from around the world. The ultimate goal is always to enhance the interactive experience. To this end, the date of the WMA-JDN meeting that had been scheduled for prior to the Council Session was changed to Sunday. As a result, despite being very busy, a total of 7 doctors from the JMA-JDN participated, and one additional doctor participated in the hospital inspection tour. The WMA-JDN meeting was considered to be successful, according to impressions expressed by the members. Thanks to the warm and sensitive support of JMA members and staff and the admirable work of Dr. Mishima, Deputy Chair (External Affairs) of the JMA-JDN, we were successful in holding the WMA-JDN meeting, after adjustment of the date and venue of the meeting to allow reservation of the venue, facility, exchange events among junior doctors, and the Japanese hospital inspection tour. Participating junior doctors from other countries were delighted and profoundly grateful to have this opportunity.

It is particularly noteworthy that the content of the WMA-JDN meeting provided a valuable experience allowing junior doctors to directly receive messages sent from various viewpoints by WMA leaders. In addition, a lecture on disaster medicine in Japan was given by Dr. Masami Ishii from the JMA of the host country. Because the subject was timely, including earthquake, tsunami, and damage caused by radiation, junior doctors from various countries listened with interest, and asked many questions. In particular, the system of providing continuous care to disaster sites by interchanging Japan Medical Association Team (JMAT) crews in short intervals appeared to be a particularly worthwhile and exciting innovation for doctors from other parts of the world. Presentations, as a means of sharing information, focused on the actual status of junior doctors in various countries.

As a presentation from Japan, an overview was given of the organization of the JMA-JDN, and Dr. Shin-u Hayashi explained the results of reviewing reports on physician well-being in

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Japan. As expected, this elicited several questions, and we had the opportunity to share this information, which is not described in research articles or expressed in figures, on the actual work environment status of junior doctors in various countries. Discussions also extended to the topic of support systems for female doctors, in terms of pregnancy and delivery, which vary greatly among countries.

During this WMA Council Session, South Korea submitted a proposal to produce a short-term exchange (overseas study) program between South Korea and Japan, considering the promotion of the JDN in the Asia-Pacific region. A suggestion for an exchange program with Japan was also put forward by Brazil, and it was decided to pursue a course of discussing the details of this issue. These are good opportunities for exchange of junior doctors, although there are issues of doctors' qualifications, expenses, safety, and so on, to be considered. This program is the first attempt of its type for the JDN worldwide, and it would presumably be necessary for the exchange program to proceed with consideration of maintaining continuity while consulting with the JMA.

In my view, there was no progress in the actual status of the WMA-JDN as an organization from the previous WMA General Assembly held in Fortaleza, Brazil. Although there is a philosophy in place, the definitions of junior doctors and members, the organizational structure, and the method of officer election remain ambiguous. Although there is general consensus regarding the need for and the importance of addressing these issues, the lack of a working group start-up initiative, the absence of any one individual responsible for it, and as yet inadequate task management suggest that WMA-JDN officers are too busy with their day-to-day work to take on these responsibilities. It also seems that there is a problem with the structure of the organization because this has been an ongoing situation for more than 4 years. However, this time, the decision was made to set up a Working Group for Membership, and the JMA-JDN plans to send representative(s) to this working group. In the future, communication with WMA-JDN officers should be promoted, and Japanese junior doctors should become candidates for officer election.

Once this meeting has been fully concluded, the JMA-JDN intends to proceed with the following four activities in parallel. First, the realization of the exchange programs with South Korea and Brazil as a stepping stone will be implemented to establish and further strengthen good relationships within the WMA-JDN and Asia-Pacific region. It is preferable to send the same members to the meetings of the WMA-JDN, and to participate actively in working groups, thereby increasing the JMA-JDN's presence. Second, we must carry forward the Survey Project, which targets physician well-being, in small steps. In this meeting, a strong desire to promote physician well-being was heard from various countries. In cooperation with countries conducting the Survey, centering on Canada, preparation of an article as a product of the Survey is intended. Third, it is necessary to plan and implement events that provide seminars and workshops in which junior doctors have an interest, regardless of their specialties, in such a form as the general assembly of the JMA-JDN. Although it is common for existing organizations to participate in the WMA-JDN, Turkey and Nigeria are launching new organizations, like Japan. It is necessary to hold priming events to gain the recognition of the JMA-JDN in Japan and to provide opportunities to more junior doctors in this country. Fourth, for the JMA-JDN to establish itself with a solid footing, it is necessary to continue to address its organizational philosophy, structure, and articles of association.

In closing, an acknowledgement is made to Dr. Ishii, who has consistently provided us with valuable opportunities, staff in the International Affairs Division, and members of the Global Health Committee and Junior Doctor/Medical Student Subcommittees. Along with my JMA-JDN colleagues, my goal is to produce a platform for junior doctors across Japan to conduct activities involving public health and health policy.

Facility Tour to National Center for Global Health and Medicine and Launching of the International Exchange Program*2

As Deputy Chair, I had the opportunity to participate in the JDN meeting held in concert with

*2 This section was written by Dr. Chiaki Mishima.

Fig. 1 Visit to the special infectious disease ward in the Disease Control and Prevention Center

the WMA Council Session in Tokyo. This report describes my experience as a member of the executive committee on the Japan side for the JDN meeting in holding a facility tour to a Japanese medical institution and social activities during the period of this meeting. The plan of the international exchange program, from future perspectives, will also be referred to in this report.

On April 25, a total of 9 JDN members from Japan and overseas visited the Disease Control and Prevention Center (DCC) of the National Center for Global Health and Medicine. The DCC, which was set up on October 1 of 2004 in response to the SARS outbreak, is composed of 3 divisions, i.e., the Global Infectious Disease Prevention Division, Travel Clinic, and Infectious Disease Division. Through lectures given by doctors from the DCC, it was explained that the DCC is now functioning as a clinical referral center for clinical infectious diseases in Japan as well as being engaged in training of healthcare professionals in the field of infectious diseases, the provision of information on infectious disease control, and research. We also visited the special infectious disease ward attached to the DCC (**Fig. 1**).

After the lectures, we had time to exchange opinions among the attending JDN members about infectious disease control, vaccination systems, and reporting systems for emerging and reemerging infectious diseases in each country. Sharing information and having discussions about systems and social backgrounds which vary among countries provided us with a special and very interesting experience. During the WMA meeting, some volunteers planned a social gathering at a Japanese style pub and karaoke bar. Although online meetings are usually the main form of exchange, junior doctors from various parts of the world met for the first time, and enjoyed the music of various countries and having a meal together, in a very relaxing atmosphere. We were thereby able to foster closer relationships. This was an attractive opportunity provided by the JDN to have the uniquely pleasurable experience of singing songs in various languages together, without actually needing to know these languages. Some senior members of the WMA Secretariat also participated, and dialogue beyond national borders and generations was thus promoted. The JMA also hosted a Japan tour to Tokyo Tower, Asakusa, and Zojoji Temple. We believe that participants enjoyed the comfortable public transportation system in Japan, Japanese food, and the hospitality of Japanese people. These events held prior to the JDN meeting provided an opportunity to hear the views and understand the backgrounds of

each of the participants, and presumably facilitated discussion in the JDN meeting and produced new ideas from these off-line conversations.

An outcome of this meeting is that the ideas of overseas study programs between Japan and Brazil and between Japan and South Korea arose from dialogues in the JDN meeting, and these ideas are now moving into the phase of taking action to achieve their realization as projects. Although details of the contents and dates are under consideration, we intend to provide an opportunity for junior doctors in Japan, Brazil, and South Korea to train and study together at sites of clinical practice, research, public administration, etc. We hope that junior doctors will interact beyond their specialties and backgrounds, and use the program as the venue of an international network for junior doctors in Japan and the rest of the world. As a step toward achieving this goal, the organizational system of the JMA-JDN should first be prepared, and discussion further deepened. Participation of a wide spectrum of Japanese junior doctors is also necessary.

We anticipate that the friendship and bond strengthening that occurred at this meeting in Tokyo will contribute to further progression of our activities, and it is desirable that such social events be planned henceforth as part of all future JDN meetings. I am deeply grateful for the opportunity to participate in this event, and express my sincere gratitude to the WMA, JMA, and JDN members for their invaluable cooperation.

Japan Medical Association Junior Doctors Network Report on the WMA General Assembly, Durban 2014*1

JMAJ 57(5·6): 324-330, 2014

Kazuhiro ABE,[1] Chiaki MISHIMA[2]

Report of the JDN Meeting (Table 1)

The role of junior doctors in the Ebola outbreak

An invited guest from the Centers for Disease Control and Prevention (CDC) gave a lecture and then opened a question-and-answer session on the Ebola Virus Disease (EVD) prevalent in West African areas. Basic medical issues regarding EVD were explained, and the opinion was expressed that the Junior Doctors Network (JDN) should also attempt to make these issues known widely in order to protect junior doctors in various countries. In particular, the fact that wearing a mask, goggles, and a visor is recommended should be known by general healthcare professionals as well.

Because the World Medical Association (WMA) General Assembly was held in South Africa, many African junior doctors were present, and junior doctors from West African countries were able to hear the lecture directly. EVD often occurs in country villages in West Africa, and measures against Ebola do not appear to be working well due to the lack of medical resources available in these villages and deficits in the healthcare system. On occasion, people in a village where Western medicine is rejected reportedly will battle Ebola employing traditional medicine and will not ask for help from international organizations until a substantial number of people have become infected.

In areas with actual Ebola outbreaks, major problems include the following: how to address feverish patients in the waiting room, how the emergency crew should respond in the vehicle serving as an ambulance, and how to deal with Ebola by differentiating this infection from Lassa fever or other diseases. Reportedly, although experience with HIV infection control is extrapolated to Ebola control, the response is delayed because Ebola is a hemorrhagic fever which is characterized by acute onset and high mortality, unlike HIV infection. A representative of the JDN in Nigeria explained that it is difficult to put domestic systems in place under circumstances in which an Ebola outbreak already exists, reporting confusion in the field. Although questions were raised concerning vaccination, new drugs, and treatment using sera obtained from those patients who were in remission from EVD, the CDC responded that safety had not yet been established for any of these measures. In addition, the audience was informed that the CDC was preparing simpler and more practical materials.

Discussion with WMA Secretary General

The WMA Secretary General, Dr. Otmar Kloiber (Germany), was invited to discuss the optimal way for the JDN to operate. Currently, the WMA has 111 member nations. The International Federation of Medical Students' Associations (IFMSA) is an organization representing medical students. An opinion was expressed that the

*1 WMA General Assembly was held in the Durban International Convention Center, Durban, South Africa, October 8-11, 2014.

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Table 1 JDN meeting agenda at the WMA General Assembly, Durban 2014

Day 1 (Monday, Oct. 6)

1. Welcome & Introduction
2. Conference 1: "WMA—How it works and the role of JDN in its structure"
   Dr. Otmar KLOIBER, WMA Secretary General (Germany)
3. Health Response to Women Reproductive Health and Rights Abuses
   Dr. Margaret MUNGHERERA, WMA President (Uganda)
4. The Role of Junior Doctors in Ebola Outbreak: Interaction with the CDCs of Nigeria, South Africa, US, or Sierra Leone
5. JDN Africa Project: The journey so far—The JDN Africa exchanges, research, meetings, JDN Africa networks in African countries
6. JDN Physician Well-being Mini-Conference
   a. Welcome & Introduction
   b. Overview: Physician well-being for junior doctors
   c. Physician Stress & Distress Panel
   d. Fatigue, Sleep Deprivation & Medical Error
   e. Plenary Discussion: Next steps
   f. Closing Remarks

Day 2 (Tuesday, Oct. 7)

1. Welcome & Introductions
2. Confirmation of agenda, apologies, accept last minutes (Tokyo, April 2014)
3. JDN Update
   - Overview
   - WFME Global Standards for Quality Improvement of PGME
   - Review of WMA policies/submissions
4. Leadership Project
5. Introduction to represented junior doctor countries—including experience sharing
6. Elections
7. Introduction to represented junior doctor countries—continued
8. JDN Operations Discussion: Planning/goals, capacity building, funding/meeting planning, next meeting

JDN should endeavor to earn trust in small steps through participation in the general assembly, presentation of proposals, submission of articles, and so on, in order to establish its position as a representative of junior doctors. The WMA understands that its organization does not necessarily guarantee equality because the assigned number of votes is greater for more affluent countries, and it also seems that the WMA understands the presence of influences on healthcare from various factors outside the field of healthcare, such as the Trans-Pacific Partnership (TPP) and transportation systems. Dr. Kloiber noted that the WMA considers the opinions of junior doctors actually working in the healthcare setting to be very important, and suggested that the JDN send its opinions to the society, making good use of the WMA and other relevant organizations. He made three recommendations to the JDN regarding relevant activities: actually seeing patients; practicing campaigns; and conducting political activities in cooperation with various national medical associations and the WMA.

Discussion with the WMA President

Dr. Margaret Mungherera (Uganda), the WMA President, was invited to speak to us. She was supposed to deliver a lecture on women's reproductive health, but instead gave a short speech due to time constraints.

The launching of regional activities is expected from the JDN. The prolonged lack of leadership in African regions has brought about the deficiencies in current healthcare systems. Although it is often the case in many regions that junior doctors do not have good opportunities due to traditional paternalism, it is now considered to be necessary for the JDN to take a leadership role. Doctors in the 21st century have their own methods and practices of IT, communication, and

Mishima (front row, fourth from right) and Abe (back row, second from right) at the venue of the JDN meeting

handling information; these means should be used to achieve optimal outcomes. Dr. Mungherera gave an enthusiastic message: the JDN should be a communicator, politician, and engineer, and should be stronger; the leader needs to be a strong motivator.

JDN Africa Project

The JDN is conducting a project that has been dubbed the Africa Project, which was launched at the WMA Council Meeting held in Tokyo in April 2014, based upon the intention to form links among about 50 nations of the JDN on the African continent. However, the project is not currently proceeding with the desired progress because there are barriers involving language, race, people's fears regarding the new organization, etc. These challenges with the current status of the project were reported. The JDN still advocates promoting the project through mutual feedback not just among African nations but within the JDN overall.

Physician Well-being Mini-Conference

The background for the development of the Physician Well-being Policy Statement initially submitted by the JDN at the last WMA General Assembly in Fortaleza, Brazil was explained. At that time, the information on the current situations of each country was shared. In South Korea, resident neurosurgeons may labor under extreme conditions such as continuously working for 100 h while not returning home for 100 days. A Japanese representative presented the report that had been given at the meeting in Tokyo in April.

JDN update

There were ongoing discussions about the building of the organization. However, advancements have not yet been fully achieved because of the relationships within the WMA. For relationship-building with other parties, the JDN participates in activities with the WMA, World Health Assembly (WHA), and World Federation for Medical Education (WFME). In the future, along with changes in the organizational structure of the WFME, the JDN may acquire the right to vote in the WFME. In this case, an Education Officer from the JDN will participate, but this raises the issue of how to catch up with discussions already underway within the WFME. In addition, because the WMA also has the right to vote, there is the problem of one organization having two votes; these potential inequities and conflicts require further consideration.

IFMSA updates

The IFMSA is scheduled to alter the organizational structure, to achieve greater efficiency, in March, 2015. In particular, because the Alumni Director was not functioning well, the planned alteration includes its improvement. The strategic plan has also apparently been updated.

How to work with IFMSA is a challenge faced by the JDN. WMA membership is different from that of IFMSA. Therefore, it is currently unclear to IFMSA how to deal with the JDN and the WMA.

The JDN prominently requested that IFMSA members think about the day they become doctors. It should be considered that IFMSA strengthens the JDN, and that the JDN strengthens the WMA. Specifically, it was proposed that cooperation with IFMSA, in the forms of a newsletter and Facebook activities, might be worth exploring as means of enhancing these connections among the organizations.

Introduction to represented junior doctor countries

Several representative countries gave presentations. For us, among the most memorable was the report from South Korea that Korean residents went on strike demanding improvement of their work environment. It seems that no discernable changes in these circumstances resulted, however, and strong dissatisfaction thus persists in South Korea. Since many representatives from African countries were present, numerous reports were presented describing the very poor work environments of residents and frequent strikes in African countries.

Climate changes reported by the WMA Environment Caucus Meeting

Health hazards due to climate changes are a current topic for discussion in the WMA, and Dr. Peter Orris, associate member of the WMA, from the American Medical Association (AMA), and Dr. Dong Chun Shin, Chair of the WMA Environment Caucus Meeting, from the Korean Medical Association, lectured on this topic.

The actual situation of changes in diseases in relation to global warming was also explained. The energy and transit industries have the greatest influences on global warming, and CO_2 emission from China is attracting attention. Harm from PM2.5 is also serious. The USA is finally taking a positive attitude toward the issue of global warming. Therefore, there will probably be a major turning point in this issue in the future.

Scene from the JDN meeting

Comment—1[*2]

Looking back on the JDN meeting and the overall WMA General Assembly

The JDN meeting was held on the campus of a state university in Durban City for a period of 2 days prior to the WMA General Assembly. A total of 23 JDN members gathered for this meeting in South Africa. It was very impressive that there were many young doctors from various African countries including South Africa, Zambia, Mozambique, and Nigeria. On the occasion of presentations from the participating countries, a number of enthusiastic presenters delivered their lectures, almost exceeding the allotted time, concerning the work environments of junior doctors and differences in medical education among their countries. In this situation, networking provided a very valuable opportunity for the participants. As a whole, topics related to Ebola were at the center of these lively and fruitful discussions. A lecture on Ebola was also given at the JDN meeting. As the true problems of anti-Ebola measures, various issues such as differences among customs remaining in each region of Africa and Western culture,

[*2] This section was written by Dr. Chiaki Mishima.

Dr. Kloiber (back row, second from left), Dr. Mungherera (back row, third from left), and the JDN

specific ways of handling the dead which might deviate greatly from standard practices in the industrialized world, and poor access to health-care services were highlighted in this lecture, and the information was shared by attendees through reports by junior doctors from various African countries.

Based on these circumstances, we consider the two major issues—how each national medical association should function as a member of the WMA, and the role that Japan should play—to be very important.

Increasing JDN presence in the WMA

Activities in which the JDN is involved have gradually been increasing since the previous General Assembly in Fortaleza, e.g., the JDN meeting in Tokyo, empowerment of African regions, and policy recommendations focused on well-being, nuclear weapons, and the smallpox virus. In my view, these activities greatly increase the presence of the JDN.

During the General Assembly, expectations of the JDN in various scenarios were heard, suggesting that the presence of the JDN itself is exerting influences on the WMA. As noted in previous reports, the structure of the JDN is non-specialized, and there are mounting problems to be overcome before the progression of its activities, but we had the impression that the JDN is taking each step needed to reach this goal. Japan has very good communication with Dr. Ahmet Murt, the newly elected JDN chair (Turkey). We hope to continue close cooperation among core members of the JDN, Japan, and Asian regions.

Role of Japan and future perspectives

Four doctors from South Korea attended this event. They expressed deep concern about junior doctors' long working hours, violence, and other issues. We were able to share information on their activities with clearly defined objectives, including strikes, in South Korea.

On this occasion, we viewed interchanges and excitement among African countries, and based on this, we advocate that the Confederation of Medical Associations in Asia and Oceania (CMAAO) and the JDN function cooperatively. To look into what we should do as Asian junior doctors, the first step to be taken is to discuss what problems we have now. For this purpose, we should consider establishing a network that links junior doctors in Asian countries including Japan to the JDN and developing communication tools effective among JDN members. For Japan to contribute to the JDN while taking a leadership role, it is important to expand both domestic and overseas activities by engaging in steady and continuous efforts. Among the functions and duties of the Deputy Chair, dealing on a deeper level with outgoing JMA-JDN corre-

With a bronze statue of Nelson Mandela

spondence, such as JDN networking in South Korea and other parts of the world and planning of programs for studying abroad and seminars, would be highly worthwhile.

The JMA, doctors from the Global Health Committee, and other persons involved in providing this precious opportunity are gratefully acknowledged.

Comment—2*3

This General Assembly was held in the Republic of South Africa in the middle of the raging epidemic of EVD across West Africa. In a single phrase, the General Assembly could be characterized as "an assembly on EVD." In the Plenary Session of the Assembly, there was heated discussion about whether to quote Article 37 of the Declaration of Helsinki in the emergency resolution concerning EVD,*4 and keynote speeches were mostly related to the severe epidemic of this virulent infection. In the JDN meeting, a lecture on EVD was given by a representative from the CDC, and actual conditions in the field were reported by participants from various African countries. Conversely, discussions about the operation of the JDN and Policy Statement were far less prominent.

EVD may be an issue lacking reality for junior doctors in Japan, unless they are working for medical institutions actually dealing with class 1 infectious diseases. In this JDN meeting, however, we seriously discussed what we junior doctors should and can do to achieve control of EVD. Not a few healthcare providers including doctors who see Ebola patients at the scene flee in fear. From a practical perspective, ideas and opinions were exchanged concerning various issues ranging from how to transfer feverish patients and keep them waiting in the hospital to how to differentiate them from patients with other diseases. Treatments were also among the major topics addressed. In my view, these discussions reflected the actual situation of junior doctors. Employing this approach, a meaningful proposal was made to an expert from the CDC that a practical and easily understandable pocket-sized manual be developed.

On the other hand, in the Plenary Session of the Assembly, discussions were held from a higher perspective, concerning requests for national governments or international organizations about EVD, ethical issues regarding the administration of new drugs, etc. Discussions at the JDN meeting and the Plenary Session of the Assembly were in stark contrast to each other, but both were interesting as well as important.

Dr. Otmar stated in the JDN meeting that junior doctors should implement "actually seeing patients," "practicing campaigns," and "conducting political activities through national medical associations." In my view, discussions on what junior doctors should and can do for various issues occurring in the world and in Japan should also be held by the JMA-JDN. In October 2014, the JMA-JDN held a workshop for junior doctors to consider community healthcare in 2025. Provision of such a venue for discussion is an important role of the JMA-JDN. In the next stage, conducting campaign activities probably has to be brought into view in order to more widely disseminate the acquired knowledge. Junior doctors tend to be inundated with the work of seeing patients, but at the same time, it

*3 This section was written by Dr. Kazuhiro Abe.
*4 See page 290.

is necessary to directly face, learn, and discuss various issues surrounding patients. Through these activities, the JDN (junior doctors) becomes more vigorous, which in turn strengthens the WMA and the JMA as well as healthcare in general, worldwide, as Dr. Mungherera, President of the WMA, so impressively stated. Dr. Yokokura, President of the JMA, and I had the pleasure of talking to the current President of the AMA, and we were surprised and highly impressed to hear that the president-elect of the AMA is a new young leader only 42 years of age. In contrast, we wonder whether Japanese junior doctors may currently lack the backbone to be ready for such a responsibility, instead harboring vague feelings of resignation regarding this issue.

While accompanying Dr. Yokokura (President, JMA) throughout this General Assembly, and when listening to Dr. Yokokura, Dr. Matsubara (Vice-President, JMA), Dr. Ishii (Executive Board Member, JMA), and Dr. Kawashima (President, Tokushima Medical Association), I realized that they have in common the characteristic feature that they always bear in mind how to deliver optimal healthcare to people, and act altruistically on their convictions. The opportunities the JDN offers to junior doctors to aspire to these convictions and the self-sacrificing activities of more experienced senior doctors serve as invaluable guidance for the future of junior doctors. As the Chair of the JMA-JDN, my sincere gratitude goes to the JMA and senior doctors for giving us these opportunities.

The JMA-JDN intends to further provide junior doctors in Japan with venues for discussion and learning and to conduct enlightenment activities, as well as to play a coordinating role in the global JDN, particularly for the Asian and Oceanian regions.

Disaster Management at Soma General Hospital in Response to the Great East Japan Earthquake

JMAJ 57(5·6): 331-334, 2014

Hisanori FUKUNAGA,[1] Hiromi KUMAKAWA[2]

The great earthquake of March 11, 2011, the first of its magnitude to hit Japan in a thousand years, and the consequent tsunami led to unprecedented damage to various areas of the Pacific coast in northeast Japan. Added to these double disasters, residents in Fukushima Prefecture are tormented by the fear of nuclear meltdown at the Fukushima Daiichi nuclear power plant even now. Soma City, with a population of approximately 38,000 people, and Shinchi town, with approximately 8,000 residents, were both severely damaged by the triple disaster. Nevertheless, Soma General Hospital, which is in the service of these communities, and located only 40 km north of the nuclear power plant in question, has been able to fulfill its role as a key regional hospital, delivering medical services effectively with minimal confusion. We would like to review measures that could help deal with similar catastrophes in the future by looking back on this hospital's performance during the catastrophe.

The first thing we did was construct a system for triage so that we would be fully prepared to respond to emergency patients from the initial phase. Because of the temporary closure of the emergency room in the former hospital ward, the emergency room was relocated to the new hospital ward, which had sufficient structural strength to withstand the earthquake; waiting rooms, examination rooms, reception, medical consultation rooms, prescription issuance rooms, etc. were set up around the emergency room. Functions were integrated to achieve the aim of having a minimal flow of people coming in from outside through the temporary entrance, and there was also an efficient deployment of doctors, nurses, clerks, etc. We also arranged beds in the corridor in front of the waiting rooms so follow-up consultations could be carried out without hospitalization (**Fig. 1**). Once a disaster victim who had been forced to evacuate is hospitalized, it would often take a long time to safely discharge the victim. This desperate measure was therefore taken to avoid the hospital becoming full. As for emergencies, young doctors initially worked in pairs by dividing the day into three shifts, but we devised a role-sharing system that combined all of our forces irrespective of department or age.

On the second day after the disaster, we clarified the division of roles between medical association volunteer doctors, hospitals, and medical practitioners. Hospitals undertook the cases of emergency and hospitalization, and practitioners from private institutions were asked to visit evacuation shelters in various parts of Soma City. This division of roles was logical because the private medical practitioners' clinics were mostly closed due to shortages of nursing and office staff and/or damages from the earthquake. For this reason, we were able to maintain existing hospitalization functions and take on other functions, such as dealing with emergency outpatients and patients with prescription requests from other hospitals. Ambulances handled numerous patients with hypothermia and trauma patients from the initial tsunami damage, but patients with colds, pneumonia, cerebral infarctions, and so on increased after the third day. There were also many patients with acute gastric ulcers.

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Fig. 1 A hospital ward that provided outpatient care after the disaster

Fig. 2 A scene from the daily morning meeting (March 2011)

Every morning, a meeting was held to share information among the doctors, nurses, and pharmaceutical, examination, and radiology technicians, as well as managers, office staff, and representatives from nutrition departments (**Fig. 2**). We were able to grasp the situation and understand transitions in vital information that changed day by day and hour by hour regarding stocks for test drugs, X-ray films, medicinal and food supplies, radiation levels, and so on. By requesting the presence of prefectural health division representatives, we were able to coordinate with hospitals, dispensing pharmacies, and medical associations to deal with mentally ill patients at the hospital and to restrict the dispensation of psychiatric drugs to a single specialist location in the city, even while telephone communication had not been reestablished and cars could not be used because of a lack of gasoline. In this way, we were able to fulfill our role as a key hospital in the Soma region without making any compromises under the system of cooperation with people in various lines of work inside and outside the hospital.

Every doctor worked tirelessly and without taking leave. Many doctors stayed continuously in the hospital, and their high sense of professionalism and their strength of unity were shown very clearly. Our success was also achieved by the strong relationship built between the hospital and medical associations over several decades. In addition, we must not forget that the hospital workers were supported with three meals a day, which the nutrition department staff provided. Despite meager food supplies they did their best to sustain the activities of doctors, nurses, and other staff. As the famous saying goes, "an army marches on its stomach"—and, not even once did we feel hungry.

From March 11 to 31, 2011, 110 patients were taken to the Soma General Hospital by ambulance, and 87 were immediately admitted to intensive care. In total, 8,068 outpatients were treated. As shown in **Fig. 3**, during this period the number of outpatients by department were: internal medicine 4,257 (53%), urology 889 (11%), surgery 626 (8%), orthopedics 602 (7%), pediatrics 594 (7%), otorhinolaryngology 480 (6%), ophthalmology 213 (3%), dermatology 140 (2%), neurosurgery 114 (1%), obstetrics and gynecology 82 (1%), and cardiac surgery 71 (1%).

The difficulties the hospital faced at that time were comparable to those faced by other areas affected by the earthquake and tsunami. These difficulties included: (1) shortages of hospital stockpiles (pharmaceuticals, food, water, medical oxygen, and other medical consumables); (2) limitations in mobility due to gasoline shortages and limited telecommunication means; (3) increasing unavailability in prescription drugs such as psychiatric agents at the hospital due to the closure of clinics and influx of evacuees, exacerbated by the need for manual administration of hospital paperwork (i.e., computers were nonoperational) (note: our situation was further complicated by the fact that the hospital had no psychiatric ward); (4) difficulty interacting with the pharmacies in the city; (5) increase in the

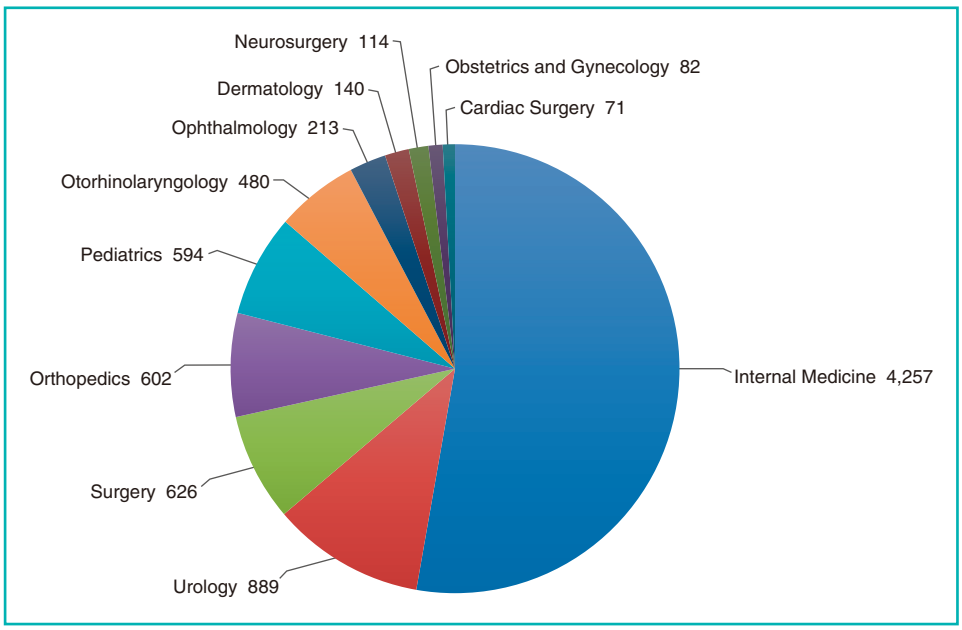

Fig. 3 Numbers of outpatients by department from March 11 to 31, 2011

number of people who needed medical treatment due to increasing number of evacuees and shelters; and (6) increase in emergency healthcare requests from other regions.

Members of the medical community observed the following regarding the delivery of healthcare services after the earthquake: (1) *okusuri-techo* (personal record books of prescription history, widely available in Japan) that many evacuee patients brought with them were extremely useful; (2) because cooperation with the medical associations was efficient, the hospital efforts could be devoted to emergency needs and inpatient services, and practitioners' roles in visiting the shelters were determined quickly and clearly; (3) people who helped hospitals, medical practitioners, the city hall, public health centers, and pharmacies by assisting the communication between the involved parties and coordinating our activities, were essential; (4) local residents provided excellent cooperation to recover food provisions and restore hospital equipment; and (5) hospital staff remained united in their dedicated efforts throughout the aftermath of the disaster.

This hospital was fortunate; there were no power outages, the loss of water supplies was temporary, there was an entire tank of oil for heating, and the damage to the wards was minor. Moreover, as the hospital did not fall within the evacuation area of the nuclear accident, we did not have to move the inpatients. Nevertheless, the hospital management is thankful for the commendable spirits of our hospital staff who, amid the considerable fear and anxiety associated with the nuclear accident, remained united all the way in their dedication to meeting the community's healthcare needs. We believe their dedication was a major factor in the hospital's success in responding to the earthquake. If staff members unite and work as one, they form a great force and can overcome any difficulty. The fact that everyone was essentially able to experience this sense of unity was the greatest lesson we learned from the healthcare practice from this earthquake.

From the above experience, we would like to suggest additional countermeasures to be considered in future disaster preparations as follows.

(1) Advance establishment of a medical coordinator for disaster relief, and the identification of a number of supporting staff who would assist the coordinator's work in a disaster situation.

(2) Means of verifying patients' medical information including, but not limited to, *okusuri-techo* (personal prescription history notebooks), for any emergency care such as contraindicated drugs or allergy history, at the least.
(3) Regular review of disaster stockpiles, such as pharmaceuticals, food, and water (both at the hospital and in nearby locations).
(4) Solid guarantee of efficient communication and transportation.
(5) Building good relationships with the local medical association and residents in normal times.

There are many issues that have not been covered in this brief summary, such as how to build a primary emergency system in the future that covers broad and urgently affected areas where telecommunications and transportation are hindered after a large-scale disaster. This large earthquake is said to have been the worst in a thousand years; hence, a similar serious disaster may not hit this area for a while. However, no one knows what type of disaster could occur in the future. Keeping in mind the Japanese proverb, "no need to worry if you are prepared," we would like to devise countermeasures for the future.

Acknowledgments

We express our sincere gratitude to everyone who extended their support to the people in Fukushima at that time. We are grateful to Dr. Ohtsura Niwa for helpful discussions and to Ms. Ikuko Inoue for providing us with some data.

Essay

Don't Drink Unboiled Water in Unfamiliar Places!—Taro Takemi's Success Story

JMAJ 57(5·6): 335-339, 2014

Tatsuo KUROYANAGI[1]

Prologue

Recent weather in the Japanese Archipelago is clearly abnormal. The influence of El Nino has produced localized torrential rains with hail, tornadoes, wind gusts, and lightning strikes, inflicting damage across the nation. Tokyo is no exception, and the Japan Meteorological Agency often issues warnings for heavy rains and lightning strikes. Have there ever been so many warnings issued for thunder and lightning in Tokyo?

As I was pondering this, the existence of a certain book came to my mind: *Kaminari* [Thunderbolt] (Iwanami Shinsho No.46), published in September 1939 by Dr. Ukichiro Nakaya (1900-1962), a physicist who succeeded in creating artificial snow for the first time and is renowned for his contribution to the study of snow crystals (**Fig. 1**). The inside cover of the book has a dedication that reads "Dedicated to Taro Takemi (**Fig. 2**)." This "Taro Takemi" is *the* Dr. Taro Takemi (1904-1983), the man who assumed the presidency of the Japan Medical Association in 1957, realized a universal health insurance system during his 25 years of term, and became known as the *Don* of the medical community of Japan. This paper aims to reveal why Dr. Nakaya dedicated his work to Dr. Takemi and illuminate the lesson contained in the background.

Before proceeding to the main topic, allow me to take a slight detour. In September 1944, I moved from metropolitan Tokyo to my grandmother's house in Takaoka village, which is located about 10 km north of the plateau where the lead factory of Toyota Motor Corporation is located. The area was completely rural back then, and people were drinking filtered artesian water that naturally flowed from underground. One thing that my grandmother repeatedly told me was "Don't drink unboiled water in unfamiliar places." At the time in Japan, water supply systems were still incomplete and there were hardly any sewage systems or water treatment facilities except in metropolitan Tokyo, and human excrement was used as the most vital agricultural fertilizer everywhere. Water bottles and thermoses were must-have items for school field trips and traveling, and teachers instructed students not to eat uncooked freshwater fish and salmon and sea trout from the Sea of Japan because they could carry parasites.

However, with Japan's high economic growth that started around 1965, movements to improve village living, and the nationwide spread of water supply and sewage systems, a myth was produced among Japanese people that tap water in Japan is safe, seemingly making the old saying of "Don't drink unboiled water in unfamiliar places" obsolete.

In July 1985, there was a symposium in Qingdao, in which dignitaries of the Chinese National People's Congress and the Academy of Social Sciences and Japanese legal experts gathered. During my train trip between Beijing and Qingdao for this event, the Chinese travelers I saw were all carrying large-size thermoses to enjoy jasmine tea using tea cups. The tables at the symposium venue also had thermoses, and tea cups with lids and jasmine tea bags were available as well.

When I was watching television at Taipei Airport in the fall of 1992, the telop repeatedly

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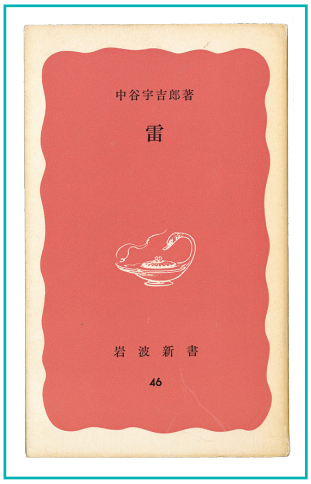

Fig. 1 *Kaminari* [Thunderbolt] written by Ukichiro Nakaya (Iwanami Shinsho No.46)

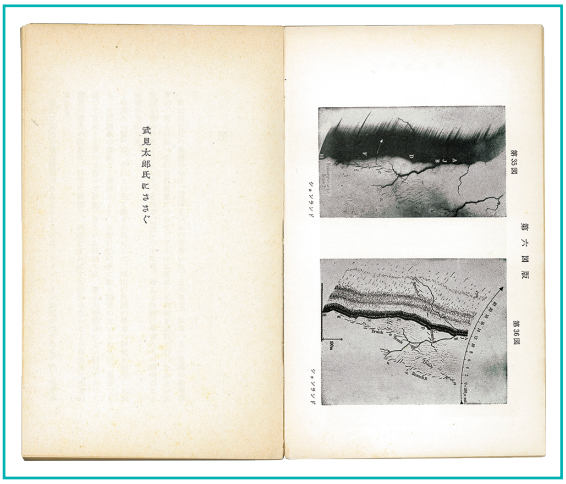

Fig. 2 A dedication on the inside cover of the book—"Dedicated to Taro Takemi"

flashed the message "Don't eat uncooked fish in foreign countries" on the screen. After some thinking, I realized that this telop is essentially warning against eating *sashimi* in Japan. Chinese cuisine basically consists of cooked dishes and is quite hygienic. In fact, older recipe books on typical Chinese dishes instruct to use heat in principle, and stir-fried, steamed, boiled, and baked dishes occupy the overwhelming majority of the recipes.

These facts prove that the teaching of "Don't drink unboiled water" and that the sense of alertness against eating uncooked seafood or animal meat was still alive until the end of 20th century.

Publication of *Kaminari* [Thunderbolt] by Ukichiro Nakaya, and Its Dedication

One of the publishers that represent Japan is the Iwanami Shoten founded in 1913. The founder is Shigeo Iwanami (1881-1946), who was enrolled in Department of Philosophy at Tokyo Imperial University. Iwanami started the publication of Iwanami Bunko (Iwanami paperback series) in July 1927. In the message to commemorate its launch, Iwanami wrote "Following the example of Reclams paperback series, I wish to publish books with true classical value that must be read universally in very simplistic style as needed, to provide documents that are absolutely necessary for everyday life for any person as well as the principles to evaluate life, in the areas of literatures, philosophy, social sciences, natural sciences, and any other subjects gathered from far east and west" (translated from Japanese). With the endorsement and support from celebrated writers, art and literature experts, and scholars within various fields, Japan's first paperback series of the Reclams size (105×148 mm) became a major success. In the meantime, Iwanami also published books on various subjects including art, literature, and a series of complete works on academic subjects. Then, in November 1938, he launched the Iwanami Shinsho [New Works] series (105×173 mm), after the example set by Penguin Books. In the prefix to commemorate its launch, Iwanami wrote "Together with the classical knowledge of the Iwanami Bunko series … this year the Iwanami Shinsho will start with the purpose of promoting modern education for modern men" (translated from Japanese). As Iwanami anticipated, the authors of the Shinsho series were all scholars who represented Japan in the areas of philosophy, literature, humanities, and natural and social sciences, and the public called them "the Men of Iwanami Culture."

The very first publication of the Iwanami Shinsho series was *Yuki* [Snow] written by the aforementioned Professor Ukichiro Nakaya of Hokkaido Imperial University. Dr. Nakaya's career first started at the Institute of Physical

and Chemical Research (RIKEN), working in the laboratory of his mentor, Dr. Torahiko Terada of Tokyo Imperial University, Faculty of Science. After a few years there, Nakaya assumed a post at Hokkaido Imperial University and immersed himself in the study of snow. He succeeded in creating the world's first artificial snow crystals in 1936. Dr. Nakaya was also a literary man, and he wrote many essays on natural sciences using laymen's terms that evoke his mentor, Terada. At the request of Iwanami, Nakaya's work *Kaminari* [Thunderbolt] was published in the Iwanami Shinsho series (No.46) as an awareness-raising work about thunder and lightning in September 1939. As previously mentioned, the inside cover of this book is inscribed with "Dedicated to Taro Takemi."

In the summer of 1938, a year before *Kaminari*'s publication, a young and energetic Dr. Nakaya was stricken by a disease of unknown cause. Internists at both Hokkaido Imperial University and Tokyo Imperial University diagnosed him with terminal intestinal tuberculosis, and he was spending bitter days alone in his hospital room. When Iwanami learned of this, he consulted Professor Makoto Koizumi of Keio University School of Medicine (a zoologist and parasitology expert who graduated Tokyo Imperial University) for they had been well acquainted through academic publishing, including *Shinka-gaku Joron* [Theory of Evolution: Introduction]. Koizumi recommended a consultation with Dr. Takemi, an internist under the tutelage of Koizumi. Under Professor Koizumi's direction, Dr. Takemi became Nakaya's attending doctor. Takemi denied the possibility of tuberculosis, and Professor Koizumi, a parasite expert, helped deliver a definitive diagnosis of distoma hepaticum. Nakaya received antimony treatment and made a complete recovery after a while.

During the course of this treatment, Koizumi found 5 other distoma hepaticum patients, including Iwanami, Isamu Kobayashi (Iwanami's brother-in-law who worked at Iwanami Shoten Publishers and later became the president of the company), Yoshio Fujioka of RIKEN (a graduate of Tokyo Imperial University and a nuclear physicist, who later became president of national universities), Sakuhei Fujiwhara of the Central Meteorological Observatory (a graduate of Tokyo Imperial University, who later became the director of the observatory), and Professor Yoshishige Abe of Keijo Imperial University (a graduate of Tokyo Imperial University who later became the minister of education, director of the national museum, and was appointed to other esteemed offices as well). Their treatment was also entrusted to Takemi.

Moreover, an investigation revealed that the flukeworm infestation originated from a dish that used uncooked freshwater fish (carp, crucian carp), which was served at the request of Iwanami at his favorite traditional Japanese cuisine restaurant in Nishi-Ginza, Tokyo. Iwanami was born in Nagano Prefecture, which has no access to an ocean, and in his mind freshwater fish dishes served in *sashimi* or uncooked style was a sign of utmost hospitality.

Through his success in treating distoma hepaticum, which was believed to be incurable, Takemi immediately won the trust of Iwanami. With support from Iwanami, Takemi joined RIKEN at the Komagome office (where the Japan Medical Association is currently located) and also opened his clinic in Ginza. At RIKEN, he was engaged in radiology research under Dr. Yoshio Nishina, a physicist who built the first cyclotron in Japan.

Nakaya, who was most severely ill among the 6 patients, thanked Takemi immensely for helping him fully regain his health under Takemi's dedicated care. After graduating from Keio University School of Medicine, Takemi had become a staff member under Professor Chujiro Nishino, an internist. According to Takemi, they had a disagreement about the paper to be published and their relationship fell apart, so Takemi began studying parasitology under Professor Koizumi—it was a gloomy time. If his words regarding his relationship with Nishino were true, we could say that the glimpse of his future self that people later called "*Kenka Taro* [Taro the hot-tempered]" was already there. If so, Nakaya, being a sensitive man, naturally would have perceived it.

The time that the manuscript of *Kaminari* was written is also the time that Nakaya, Iwanami, and others were under the care of Takemi and restored to their health from distoma hepaticum. We have expressions in Japan about thunder and lightning, such as *Kaminari-oyaji* [irascible old man] or "hitting with a lightning," to refer to someone who shouts at others. I had known Dr. Takemi for about 35 years during his career, but I had never witnessed a situation

where he raised his voice. Nevertheless, as I recall his polite yet dominating manner—such as when he decided that all doctors in Japan should entirely refuse to practice under the medical fee schedule of the government, or when his lecture was interrupted by a young doctor at a Japan Pediatric Society's meeting, —perhaps his nickname of *Kenka Taro* is aptly applied.

Nakaya's *Kaminari* simply states, "Dedicated to Taro Takemi," and there is no description that hints at any relationship between the title of the book and Takemi. It is only my imagination, but I would speculate that Nakaya wrote this irregular remark of dedication on his work *Kaminari* with gratitude and banter upon first consulting with Iwanami.

I would like to add one thing that I learned while writing this essay: *Hideyo Noguchi* (Iwanami Shinsho No.43), written by Makoto Koizumi, was also published on the same day as the Nakaya's *Kaminari*.

Washoku [Japanese Cuisine]— My Apprehension Toward Increasing Popularity of Eating Uncooked Seafood

In the fall of 2003, I went to New York after the World Medical Association General Assembly ended. I think it happened at lunch when I was invited to a Japanese restaurant near my hotel; they served me several pieces of sushi, and one of them looked unfamiliar. I asked the restaurant staff and learned that it used salmon *sashimi*. The president of the Ishikawa Medical Association,*1 who was also at the table, recommended that I not eat the salmon sushi. Then, a story about a lawyer of my neighbor came to mind. The lawyer born in Toyama City*2 who later became a Supreme Court judge, was diagnosed with tapeworms when he was appointed as a law officer and joined the navy. It was very difficult to treat, he said. I do not know if salmon and trout overseas carry parasites, but I followed the president's advice and stayed away from the salmon sushi.

Ten odd years have passed since. Nowadays, sushi restaurants in Japan frequently offer salmon and trout sushi, and fish stores carry imported salmon next to bluefin tuna, marlin, and yellowfin tuna in their displays. Japanese cuisine, *washoku*, is becoming increasingly popular across the world, especially *sashimi* and sushi that use uncooked seafood. What concerns me now is whether the possibility of food poisoning due to parasites ingested from eating uncooked seafood has been properly addressed overseas. In light of the experience accumulated in northern Hokkaido, super-low temperature freezing has been recently recommended in Japan in order to prevent tapeworm infestation; this has produced good results.

Lately, however, the problem of anisakiasis has surfaced. The National Institute of Infectious Disease (NIID) estimates that there were 7,147 cases of anisakiasis per year between 2005 and 2011 in Japan based on yearly-averaged 330,000 national health insurance claims during this period.[1] NIID reported that diagnostic techniques have been improved with widely available endoscopic examinations and that nationwide transportation systems for perishables have developed, which led to the geographical expansion and increase of anisakiasis cases. Comparatively, from 1960 to 2005, there were about 500 cases in total in Europe and about 70 cases in America. There are over 160 species of fish and shellfish consumed by humans that potentially carry the nematode *Anisakis* in the ocean surrounding Japan, such as mackerel, horse mackerel, squid, sardines, and Pacific saury. However, NIID also warns that many species of marine fish and shellfish across the globe are also known hosts of this parasite.

Be that as it may, NIID also states that "avoiding eating uncooked marine fish and shellfish" and "eating after cooking with heat at 60°C for 1 minute or longer" are secure preventative methods, and that eating previously frozen uncooked fish and shellfish is also effective because "*Anisakis* larvae lose their infectivity when frozen at −20°C for 24 hours or longer." In the Netherlands, a law enacted in 1968 stipulates that herring pickled with vinegar and served unheated must have been frozen at −20°C or below for 24 hours or longer before preparation. The US-FDA recommends freezing below −35°C for 15 hours or −20°C or below for 7 days in order for fish to be served uncooked. The EU's

*1 Ishikawa Prefecture is located in the central part of the Japanese Archipelago, facing the Sea of Japan.
*2 Toyama Prefecture neighbors Ishikawa Prefecture to the south, and its capital, Toyama City, also faces the Sea of Japan.

public health management standards require visual inspection of parasites from marine fish and require seafood to be frozen at −20°C or below for 24 hours or longer for it to be served uncooked.

* * * * *

Any civilized country would be fully capable of implementing all the measures described here. My hope, therefore, is that each nation carries out an outreach program to make the public aware that eating uncooked marine fish and shellfish can be a questionable practice. Governments are advised to take proper measures including deep freezing treatment at a super-low temperature.

The sources of infection in the modern age are very variable, from parasitic animals and plants to bacteria and viruses. In light of this, perhaps the old saying of "Don't drink unboiled water in unfamiliar places" should still be kept alive, even now.

Reference

1. National Institute of Infectious Diseases. http://www.nih.go.jp/niid/ja/kansennohanashi/314-anisakis-intro.html. (in Japanese)

From the Editor's Desk

Since the explosions occurred at the Tokyo Electric Power Company (TEPCO) Fukushima Daiichi Nuclear Power Station (NPS) in March, 2011, there continue to be persistent concerns regarding the stabilizing process in not only the regions surrounding the affected area but also around the globe. I am observing this process as a health professional responsible for disaster medicine in the Japan Medical Association, and as a physician operating local health facilities in Iwaki City, Fukushima, approx. 50 km away from the NPS. I believe that the safety level of my living environment is sufficient in terms of the environment, food, and water due to the daily efforts by TEPCO and the decontamination process in the surrounding area. The highway called Joban Expressway will be reopened soon, which passes from Tokyo to Sendai via Iwaki, through an area 10 km away from the NPS. Transportation convenience is gradually returning to the devastated area after four years. A report by the Japan Medical Association Research Institute on detailed government inspections concerning the nuclear disaster and its aftermath are included in this issue.

A report on the infectious threat of Ebola Virus Disease (EVD), which spread across borders from three African countries, is also included with the emergency resolutions of the World Medical Association (WMA). This was another kind of disaster that again terrified the global community, and the WMA immediately responded to this threat as an association of professional physicians of the world. A Japanese company has created a drug that could possibly be effective against EVD, drawing global attention. In the case of urgent demand from affected zones, we believe that access should be given to even unproven treatments as is stated in the WMA Resolution on Unproven Therapy and the Ebola Virus, and the Declaration of Helsinki; however, such drugs must undergo sufficient scientific evaluation.

Thus, with regard to global health issues, we are facing various difficulties and uncertainty. These difficulties will not be resolved without the creation of a common platform for physicians to share precise information and communication in order to make correct decisions and act with collective wisdom.

I believe that humankind can accomplish this, even if it seems to be the hardest task at present, through such processes in the upcoming year.

Masami ISHII, Editor-in-Chief, JMAJ; Executive Board Member, Japan Medical Association (jmaintl@po.med.or.jp); Treasurer, World Medical Association; Secretary General, Confederation of Medical Associations in Asia and Oceania (CMAAO).

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Special Feature: The 29th CMAAO General Assembly and 50th Council Meeting
Manila, the Philippines, September 24-26, 2014

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Principles of Medical Ethics

Japan Medical Association

The mission of medical science and health care is to cure diseases, to maintain and promote the health of the people; and based on an awareness of the importance of this mission, the physician should serve society with a basic love for humanity.

1. The physician should strive to achieve a lifelong dedication to continuing education, to keep abreast of medical knowledge and technology, and to support its progress and development.

2. The physician should be aware of the dignity and responsibility of his/her occupation and strive to enhance his/her cultural refinement, education, and integrity.

3. The physician should respect the individuality of his/her patients, treat them with compassion, provide full explanations of all medical treatment, and endeavor to earn the trust of the patient.

4. The physician should maintain respect for his/her fellow physician, cooperate with medical care personnel and serve the cause of medical care to the best of his/her abilities.

5. The physician should respect the spirit of public service that characterizes health care, contribute to the development of society while abiding by legal standards and establishing legal order.

6. The physician will not engage in medical activities for profit-making motives.

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