

## Chapter 2

# From Hiroshima to Fukushima



Based on its many years of engagement in medical care for atomic bomb survivors and research into radiation disaster medicine, Hiroshima University today functions as the only tertiary radiation emergency medical institution in western Japan. Immediately after the recent disaster, in the face of so much conflicting and confusing information, Hiroshima University wasted no time in reaching the disaster

*From Hiroshima to Fukushima*

## **Medical Activities in Response to the Fukushima No. 1 Nuclear Power Plant Accident**

Koichi Tanigawa

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As a member of the Hiroshima University Radiation Emergency Medical Assistance Team (REMAT), I started working in Fukushima shortly after the occurrence of the disaster. Reflecting the role we were expected to play in each phase of the disaster, REMAT activities were classified into four parts: (1) acute-phase activities immediately after the occurrence of the disaster; (2) establishment of a radiation emergency medical system at J-Village; (3) assistance with evacuated residents' temporary entry into restricted areas; and (4) activities at an emergency medical care facility on the grounds of Fukushima No. 1 Nuclear Power Plant.



### (1) Acute-phase activities immediately after the occurrence of the disaster

After the accident of March 11, 2011, three REMAT members, namely Koichi Tanigawa and registered nurses Naoko Takeoka and Natsuko Kimoto, headed for the National Institute of Radiological Sciences (NIRS) in Chiba City on March 12. On March 13, together with Dr. Yoshio Hosoi and members from NIRS, we arrived at the headquarters in Fukushima Prefecture in a Japan Self-Defense Force (SDF) helicopter. At the headquarters, we worked with officials from the Fukushima prefectural government and experts from Fukushima Medical University to draw up a plan for on-site activities.

Early in the morning of March 14, at the Soso Public Health and Welfare Office in Minamisoma City, we conducted a radiation survey on patients waiting to be evacuated, who were still in hospitals and care facilities inside the 20-km area.

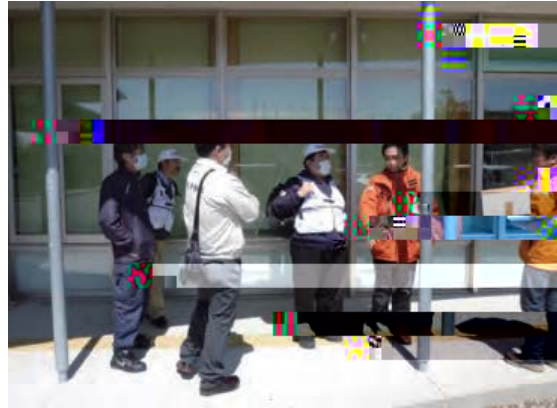
We also helped establish a system for admitting radiation-exposed patients to Fukushima Medical University. Meanwhile on March 16, we flew to the grounds of the crippled nuclear power plant by SDF plane in order to transport a patient who had suffered a chest injury to Fukushima Medical University, where we performed decontamination and treatment.

After that, as members of the medical team at the Offsite Center established in the Fukushima Prefectural Government Office, we engaged in activities such as coordination of activities among medical institutions admitting radiation-exposed patients, formulation of a flow chart for patient transportation, and preparation for the temporary entry of residents into the restricted area.



(2) Establishment of a radiation emergency medical system at J-Village

Following the shutdown of radiation emergency hospitals inside the 20-km area, it was urgently necessary to develop a system for providing medical care for workers who may be exposed to radiation while engaging in the crippled power plant's recovery operations. By the end of March, we decided to use J-Village, located 20 km south from Fukushima No. 1 Nuclear Power Plant, as a triage center and undertook work to prepare J-Village to function as a facility substituting for the closed radiation emergency hospitals.



(3) Assistance with evacuated residents' temporary entry into the restricted area

During the evacuated residents' temporary entry into the 20-km area that started from May, we assisted in providing emergency medical care and radiation surveys for those who temporarily returned home.



(4) Activities at an emergency medical care facility on the grounds of Fukushima No. 1 Nuclear Power Plant

In Fukushima No. 1 Nuclear Power Plant, every day thousands of workers were engaged in around the clock recovery operations. In order to quickly respond to serious emergency cases or radiation exposure that might arise during the process of recovery operations, No. 5/6 Emergency Room (5/6 ER) was established in July inside the No. 5/6 Reactor Service Building within the grounds of Fukushima No. 1 Nuclear Power Plant. Because the 5/6 ER had to operate on a 24/7 basis, we gathered doctors specializing in emergency and critical care and radiation emergency medicine, as well as nurses and radiological technologists from all over the country to work in rotation. To manage this system, a Fukushima

No. 1 Nuclear Power Plant Emergency Medical Service System Network was established. As an institution representing this Network, we engaged in the coordination and dispatch of medical staff, the development and preparation of relevant facilities, and the establishment of an emergency medical service system at Fukushima No. 1 Nuclear Power Plant.



*(1) DMAT mobilization*

**From DMAT (Disaster Medical Assistance Team) to REMAT (Radiation Emergency Medical Assistance Team)**

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On the afternoon of March 11, 2011, the TV screens were all showing the scenes of the tsunami breaching the seawalls and rushing farther and farther inland, submerging everything in its path. On the night of the same day, as members of the DMAT (Disaster Medical Assistance Team) were mobilized effectively for the first time, we were driving eastward on the Sanyo Expressway, when we received instructions from the prefectural government to board the Kunisaki, Maritime Self-Defense Force's tank landing ship which was about to depart from Kure. In the early morning of March 13, we arrived at the Port of Yokosuka and drove northward along an undulating and cracked road. As our final destination, DMAT headquarters ordered us via EMIS (Emergency Medical Information System) to head for Fukushima Medical University. Once in Fukushima City, in the face of the scenes of landslides in residential areas, crumbled roof tiles, and people waiting in long lines in front of supermarkets, we fully braced ourselves for DMAT operations.

In the afternoon of March 13, we reached Fukushima Medical University, where we were then ordered to head for Fukushima Gender Equality Center in Nihonmatsu City with the team dispatched from the National Hospital Organization Kure Medical Center. As soon as we arrived at the Gender Equality Center, we saw a long line of people, beyond which we found DMAT members in yellow protective suits, carrying radiation survey meters. We put on protective suits ourselves and joined the other members. In that process, we realized that, although we were initially dispatched as DMAT, we must in actuality function as REMAT. After the hydrogen-air chemical explosions, our primary responsibility was conducting radiation surveys on evacuated residents, as well as firefighters, paramedics, police officers, emergency relief team members, and other individuals coming in and out of the Gender Equality Center. The center accommodated 120 patients, as well as nurses and doctors evacuated from hospitals within the 10 km area around Fukushima No. 1 Nuclear Power Plant, and other people associated with the situation. Reportedly (sources of reports unknown), these individuals were contaminated with radioactive substances. I conducted radiation surveys with nurse Sasa on individuals stepping in and out of the Gender Equality Center. In that process, I found eight serious cases of radiation contamination from among the patients staying in the Center. I decided to give them treatment and transport them to other hospitals in cooperation with other staff members. We repeatedly made phone calls to all the hospitals in the surrounding areas that the paramedics had told us about. It was just after 12:00 midnight that we finished transporting all eight patients to other hospitals. We finally reached our accommodations on March 14, at 4:00 a.m. That afternoon we helped coordinate our final task, the operation of helicopter ambulance services at Fukushima Medical University. With this, we had completed our Fukushima mission as DMAT and on March 15, we returned to Hiroshima.

As Hiroshima University is a tertiary radiation emergency medical institution I have had the opportunity to receive relevant training for radiation exposure. Still, despite this training, I felt somewhat at a loss when our team had to

switch our mode of operation from DMAT to REMAT with virtually no information available regarding what was going on, nor how to deal with the circumstances. At the end of the day however, it turned out to be a unique and valuable experience for me to respond to the adversity in a creative and flexible way. Particularly when considering the close cooperation with my fellow team members who were also my colleagues at the university hospital's emergency and critical care center, as well as with staff members from the National Hospital Organization Kure Medical Center with whom we were sent to the Gender Equality Center.

After this mission, I have continued serving as a member of REMAT at Fukushima Medical University, OFC (Offsite Center), J-Village, and currently, at the Emergency Room of Fukushima No. 1 Nuclear Power Plant. As the cleanup operations for the Fukushima nuclear accident are expected to take several decades before their completion, I hope to continue playing an active role in both disaster medicine and radiation emergency medicine.



March 13. Hirohashi (left) and nurse Sasa in front of the Gender Equality Center

*(1) DMAT mobilization*

**Need for Sharing Accurate Information and Providing Mental Care**

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On the day on which the Great East Japan Earthquake struck, Hiroshima University Hospital DMAT immediately headed out for Miyagi Prefecture. From safety and health considerations, we decided to travel by car and Japan Maritime Self-Defense Force tank landing ship. However, while on our way to Miyagi Prefecture the news of the accident at Fukushima No. 1 Nuclear Power Plant came in and, at that moment, our destination was changed to Fukushima Prefecture. Facing a lack of information about the local situation and being poorly equipped for providing radiation emergency medicine, we were very worried and concerned about what awaited us ahead. Despite these challenges, we committed to our mission within our group and then committed to doing our utmost to develop a relationship of trust with the other DMAT teams.

On arrival at the Fukushima Prefecture DMAT headquarters, we were assigned to conduct radiation exposure tests at Fukushima Gender Equality Center in Nihonmatsu City. In the Center, there were about 290 people, including patients and medical professionals who had been evacuated from hospitals that lay within the 10-km radius of the nuclear power plant and staff members of the Gender Equality Center and public health centers.

We quickly performed triage and provided treatment to eight patients who were in the most serious condition and in need of immediate hospitalization. Before leaving the Center, the eight patients were tested for their individual radiation dose, which revealed that their exposed doses exceeded the specified dose limits. In cooperation with SDF personnel, we carried out decontamination procedures for all eight patients and transported them to hospitals by ambulance. Outside the Center, we performed radiation dose measurement and decontamination procedures for residents evacuated from within the 20-km radius, residents of elderly care nursing facilities who were evacuated from within the 20-km area in an SDF plane, as well as firefighters, paramedics, police officers, and emergency relief workers who had participated in rescue operations. Additionally, we helped coordinate the operation of helicopter ambulance services at Fukushima Medical University, and assisted in office procedures at the DMAT headquarters.

What I felt was the most difficult challenge from our recent mission was the overwhelming lack of information and extensive disruption of information networks in the face of the devastation caused by the massive earthquake, coupled with the damage done by the ensuing nuclear accident resulting in radiation exposure. To establish a chain of command necessary for conducting medical relief activities and to ensure our own safety, it is vitally important to share accurate information and keep track of the current situation. However, because the recent disaster occurred far from where we usually operate, we had no means of grasping not only the status of the disaster-hit areas, but also our own situation. Information was snarled and unreliable, sometimes hindering our activities and making it difficult for us to find a means of available transportation at any given moment.



Another challenge was that while DMAT team members had participated in a number of drills designed to deal with various disaster situations, it was frustrating to find that it was difficult to properly utilize what we had learned through such drills. We found disaster victims horrified by the unexpectedly enormous devastation caused by the earthquake and tsunami, scared of the invisible damage from radiation exposure, suffering from a sense of isolation owing to the lack of information, and despairing at the gloomy outlook for their future lives. Their sufferings brought home to us the importance of providing not only medical assistance but also accurate information from an early stage of relief operations, thereby helping to relieve the disaster survivors' mental stress and emotional anxiety.

I visited Fukushima Prefecture a total of three times to participate in REMAT activities. While engaging in my mission, I saw many catastrophic scenes and experienced numerous strong aftershocks. And yet, I also felt the strength and warmth of the people there. During each visit, I was encouraged to see the landscape and people of Fukushima recovering from the devastation—gradually but steadily—and promised myself to continue working harder for them in the years to come.



In front of the *Kunisaki*, a Japan Maritime Self-Defense Force tank landing ship

(1) DMAT mobilization

**Having a Very Hard Time Securing Accommodation**

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After the earthquake struck at 14:46 on March 11, 2011, Japan's Ministry of Health, Labour and Welfare requested all DMATs, through the EMIS (Emergency Medical Information System), to stand ready for mobilization. At 17:17, in response to the issuance of the mobilization order, we formed our DMAT. Dispatched as a coordinator, I engaged in keeping an activity log, managing money by recording expenses, securing food for team members, and securing accommodation, thereby facilitating our team's medical assistance activities.

At 19:00, we left Hiroshima University Hospital in one of the hospital's cars. While driving along the Sanyo Expressway, we were informed that the *Kunisaki*, a Japan Maritime Self-Defense Force tank landing ship, was to depart from the Port of Kure at 22:00 and that the ship could also transport cars. Therefore, we changed our plans and headed to Kure Port, where we boarded the ship at 21:40 to travel to the disaster areas. Members of DMATs from Kure Medical Center, Hiroshima Prefectural Hospital, and JA Hiroshima General Hospital were also aboard the ship. Because it was our first DMAT mission, all members from the various DMATs were very anxious. The time we spent together, sharing each other's feelings, both during the voyage and following disembarkation greatly encouraged us when carrying out our actual activities in Fukushima.

We entered the Port of Yokosuka in the early morning of March 13 and disembarked at 7:30a.m. When driving northward along the Tohoku Expressway, led by an SDF vehicle, we received news about the nuclear accident involving radiation exposure at Fukushima No. 1 Nuclear Power Plant. We changed our destination to the Fukushima Prefecture DMAT headquarters set up in Fukushima Medical Hospital. At 14:00, we arrived at the Fukushima Prefecture DMAT headquarters, where we were ordered to go to the Fukushima Gender Equality Center in Nihonmatsu city with members of Kure Medical Center DMAT.

In sub-zero temperatures, we conducted radioactive contamination screening until one o'clock in the morning, of March 14. Patients included about 100 evacuated residents, as well as 200 other individuals, such as elderly care nursing facility residents, fire fighters, paramedics, police officers, and emergency relief workers, who were suspected of having been exposed to radiation. We also performed screening on about 120 patients and medical experts who were also suspected of having been exposed while working at hospitals in Namie-machi and Futaba-machi.

On March 14, we arrived at the Fukushima Prefecture DMAT headquarters at 14:45 and helped with the coordination of the operation of helicopter ambulance services until 18:00. After that, we assisted in office procedures at the DMAT headquarters until 21:00. That night, we stayed in Utsunomiya. On March 15, after our return to Hiroshima University Hospital at 17:10, we reported on our activities to the hospital director.

Because it was our first-ever DMAT operation and we had to work in very cold weather, I could see that our team members were stressed and exhausted. Adding to the anxiety, on the night of March 13, it was extremely difficult to

find a place for us to stay. We finally secured our accommodations after I called the Division of Pharmaceutical Services by mobile phone designed for use during disasters and one of our colleagues was able to arrange for our accommodation.

Securing food is also vital. The SDF provided us with information concerning the inventory status of gasoline and other supplies at each convenience store or service area near the locations of our activities, so that we could replenish our food and gas while moving from one place to another. On the night of March 13, we bought rice balls from a nearby *izakaya* (Japanese-style pub). But on the 14th, we found almost all food and supplies had disappeared from the shelves of service areas, and so we subsisted on bread and whatever else was available.

What the recent mission taught us, among other things, is the importance of conducting drills and training in normal times. Although we were fortunate enough to be able to secure both food and accommodation, we also realized how important it is to secure sufficient food, supplies, and the money necessary for activities before departing for disaster areas. During missions of this kind, coordinators must carry out a range of activities that are not required when providing medical services at normal times, such as ensuring communications, keeping activity logs, and securing food and accommodation. For the smooth implementation of DMAT activities in the years ahead, I believe at least two coordinators are necessary for each team.

Finally, let me express my sincere respect for those who are making dedicated efforts in the disaster areas and my deep appreciation to SDF personnel and many, many others for their warm and helping hands.



Radioactive contamination screening using GM survey meter

*(2) Establishing the Radiation Emergency M*

help the dispatched personnel to travel and work freely and independently in disaster-hit areas. Hiroshima University's team was lucky to have two cars that ensured its members' free movement. Tertiary radiation emergency medical institutions also need to be fully equipped with facilities and personnel for admitting radiation-exposed patients.



Attending a meeting at the NIRS Nuclear Disaster Response Headquarters

*(2) Establishing the Radiation Emergency Medicine Coordination Conference*

**Soul-Searching Experience as a Radiation Biology Researcher**

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On March 12–17, 2011, I was in Fukushima as a member of the first group of Hiroshima University REMAT. At the National Institute of Radiological Sciences (NIRS), the Fukushima Prefecture Government Hall, and Fukushima Medical University, we provided support for the transportation of patients who were suspected of radiation exposure, we gathered situational information and communicated with Hiroshima University. At the Fukushima Prefecture Government Hall, we also extended support for radiation contamination screening conducted at evacuation centers in Fukushima Prefecture.

It was on March 12, the day after the Great East Japan Earthquake struck, that the first REMAT group was sent to Fukushima. We engaged in activities in a situation where the status of the reactors was changing by the minute. With virtually no information about what was going on, we carried out our mission, anxious about what we were going to do if the condition of the reactors became critical. The situation at NIRS and the Prefecture Government Hall was so chaotic that I often felt at a loss regarding what needed to be done. Because public transportation was disrupted between the NIRS (Chiba City) and Fukushima, we had to travel in an SDF helicopter. Just one of a series of extraordinary experiences associated with this operation. I still remember vividly how nervous I was throughout our mission.

There are many things that I could have done better. Most importantly, I should have asked myself questions such as “What can someone who is not allowed to provide medical treatment do?” and “What kind of knowledge would be necessary?” in the event of a nuclear disaster.

As the government expanded the size of the restricted area, more and more residents were obliged to evacuate from their communities. While engaging in my activities, I learned that evacuation procedures did not work for some of the more vulnerable individuals such as those who were already sick or in need of constant nursing care. This situation resulted in the loss of lives. The fact that the off-site center of Fukushima No. 1 Nuclear Power Plant hardly functioned and was moved to Fukushima City is another unfortunate outcome of the lack of preparedness and imagination for an actual nuclear disaster. I suspect that inadequate crisis management was a major contributing factor to the worsening circumstances surrounding this incident.

This kind of accident should never happen again. Despite this, it would be impossible to immediately stop using nuclear power. Through my REMAT activities, I came to have a strong conviction that the most important step to take at this moment is to improve the government’s crisis management system. As a radiation biologist, I am determined to continue doing whatever I can to better understand the biological effects of long-term radiation exposure, which has become a major concern for the Japanese people in the aftermath of the Fukushima nuclear accident.



Checking the contamination status of a patient in the contamination test room of Fukushima Medical University Hospital (Iizuka left front)

*(2) Establishing the Radiation Emergency Medicine Coordination Conference*

**A Sense of Helplessness in the Face of Dying Elderly People**

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On the morning of March 12, 2011, the day after the massive earthquake struck off the Pacific coast of Tohoku, Hiroshima University was requested to send its medical assistance team to the disaster area. In the afternoon of the same day, we headed for the National Institute of Radiological Sciences (NIRS) in Chiba Prefecture. At NIRS, we had an initial debriefing and discussed the situation in the disaster areas and the best ways to respond. On March 13, I traveled in a helicopter to Fukushima City, located 63 km from Fukushima No. 1 Nuclear Power Plant.

Under the leadership of Dr. Koichi Tanigawa and in cooperation with NIRS, Hiroshima University, a tertiary radiation emergency medical institution, established a Radiation Emergency Medicine Coordination Conference in Fukushima City. We began our activities by rebuilding disrupted systems for radiation emergency medicine and contamination screening for evacuated patients. We also confirmed wide-area transportation routes, established a medical care system at Fukushima Medical University, and helped in the transportation of persons who had been injured at the Fukushima No.1 Nuclear Power Plant.

With DMATs gathered from all over the country, there were more than enough experts capable of conducting screenings. However, as no chain of command had yet been established someone needed to step forward. Dr. Tanigawa was the person who took the initiative in coordinating the screening for evacuees in a safe and orderly manner.

Meanwhile, elderly residents of nursing care facilities who were not able to walk by themselves or eat via their mouth could not be admitted to the regular evacuation centers or be properly fed at the facilities. Unfortunately, while waiting in minibuses for their destinations to be decided, many of these people lost their lives. I felt helpless when I heard about their deaths, because I could not do anything useful for them.

Where there were no facilities to accommodate such elderly persons or medical equipment and supplies to treat them, I felt quite useless. Since information and communication was snarled at the Fukushima Prefectural Government where our activities were based and the streets of Fukushima were also in a chaotic state, it was extremely difficult to find accurate information, making our mission even more challenging.

As it turned out, I just helped out here and there under the instruction of Dr. Tanigawa, without being able to play a substantial role as a doctor. During my five-day stay in Fukushima, aftershocks struck continuously and explosions at the nuclear reactors continued. I spent my days there anxious about how the catastrophe following the earthquake and tsunami would turn out and how the invisible radioactive substances would affect us. It was my first experience working in an actual disaster-hit area. The experience brought home to me that, before being a gastroenterologist, first and foremost I am a doctor, and I must act like one.





Meeting of the Radiation Emergency Medicine Coordination Conference

*(2) Establishing the Radiation Emergency Medicine Coordination Conference*

**Conducting Screening at the Public Health Center on Patients in Need of Nursing Care**

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In response to the Great East Japan Earthquake and the accident at TEPCO's Fukushima No. 1 Nuclear Power Plant that occurred on March 11, 2011, I departed for the disaster areas as a member of the first group of the Radiation Emergency Medical Assistance Team (REMAT) on March 12.

At the National Institute of Radiological Sciences (NIRS) in Chiba, which was our first destination, a disaster response headquarters had already been established to collect information and undertake necessary measures. However, it was almost impossible to communicate with the Nuclear Emergency Response Headquarters (Offsite Center) near Fukushima No. 1 Nuclear Power Plant, making it extremely difficult to grasp the changing situation. NIRS and Hiroshima University REMAT had tense talks until late at night on what to do where.

The next day, March 13, we headed for the disaster response headquarters set up at the Fukushima Prefecture Government Hall. At dawn on March 14, in response to the information that patients at facilities and hospitals as well as residents in the 20 km evacuation radius from Fukushima No. 1 Nuclear Power Plant were still stranded, we sped to the Soso Public Health and Welfare Office in Minamisoma City to offer our services. We conducted radiation contamination screening in cooperation with the staff members of the public health and welfare office. Many of the patients brought in by buses one after another in order to find shelter and undergo screening procedures were either elderly or bedridden and in need of nursing care. Yet, few of them were attended to by medical experts. There were several patients who had been injured during evacuation and we needed to take care of them. Although we were dispatched as a radiation emergency response team, as it turned out, what we actually did, was to provide medical care. Screening continued from the early morning to midnight. Staff members of the public health and welfare office, who were disaster victims themselves, continued attending to the patients and residents.

From March 15, we started attending meetings at the radiation emergency response headquarters set up in the Prefectural Government Hall in Fukushima City. At the headquarters, medical teams from across the country gathered and had daily meetings and regular briefings on the current status of the screening process and ways to respond to the anxieties and other problems facing residents. During the meetings, these medical teams also drew up a radiation exposure response manual. With regard to patients exposed to high-dose radiation at Fukushima No. 1 Nuclear Power Plant, Fukushima Medical University readied itself to admit them. We then went to the medical university and confirmed the preparation status of its decontamination room and confirmed the operational procedures concerning patient transportation and admittance.

What I found most difficult in performing our REMAT activities was the lack of information concerning the nuclear accident. During our mission, we had no opportunity to deal with high-dose radiation exposure cases. However,

when we saw many elderly and/or bed-ridden patients who were not provided with adequate medical care at the public health center in Minamisoma, we recognized the devastating consequences of the massive disaster and nuclear accident.

In those days, people in Fukushima worked together to overcome the tremendous difficulties, in spite of all the anxieties and mental and physical stress they suffered. In retrospect, there were things that we could have done better to support them. We need to continue sharing updates about the nuclear accident and discussing what needs to be done in the field of radiation medicine in the years to come.



Elderly patients and facility residents evacuating in microbuses

## *(2) Establishing the Radiation Emergency Medicine Coordination Conference*

### **Feeling Our Way through the Mission with No Operation Standards**

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When I first saw the news of the earthquake on the TV, I just said to myself, “Oh, what an awful disaster!” as if I did not have much to do with it. So when I was asked to go to the disaster-hit areas as a member of the Radiation Emergency Medical Assistance Team (REMAT) and said “Yes,” it still didn’t seem real to me. I departed for the REMAT mission before giving enough thought to what I should do or could do.

Our operations started on March 12, 2011. Because it was only a day or so after the occurrence of the earthquake/tsunami and ensuing nuclear accident, things were in utter chaos wherever we went—NIRS in Chiba, the disaster response headquarters in Fukushima City, the public health center: Everywhere. Communication infrastructure was disrupted, making it impossible for our phone calls to get through. Thus, we made our way to the disaster areas without any concrete information concerning the status of the nuclear power plant or the evacuated residents.

Upon arriving in Fukushima, we found that a radiation emergency response headquarters had been set up. As the chaotic situation continued, I was assigned to collect information from online news sources via mobile phone. During our operation, I also met evacuees when I accompanied team members who were engaged in screening procedures. I was very impressed by the disaster victims who, though not knowing what was going on, were desperately trying to understand the scope of the situation. After Fukushima Medical University completed preparations for admitting patients exposed to high-dose radiation, we were ready to go into action at any given moment. Unfortunately, despite our preparedness, we did not have the chance to help admit radiation-exposed patients while in Fukushima.

During our mission, 24 hours a day we stood ready to respond immediately to the changing situation of the nuclear power plant. There were many stressful days waiting without being able to take time off. Furthermore, no operation manuals and an undecided operation length added significantly to our psychological stress.

In downtown Fukushima, not many buildings were destroyed and there were no obvious signs of devastation. However, as we drove closer to the nuclear power plant, we saw more and more collapsed buildings and impassable roads. In fact, these roads prevented access by car within a 5-km radius around the power plant. Everything I saw as we drove through Fukushima both frightened me and made me realize the massive damage caused by the earthquake. Up to that point in my life, I had never experienced such a real, major disaster. My experience in Fukushima made me feel a direct sense of immediacy that I think will remain a valuable lesson for the rest of my life.

Until the recent disaster, the major responsibilities of nurses in radiation emergency situations were the reception of exposed patients, preparation of decontamination procedures, and other steps necessary for admitting patients. All these activities assumed the hospitalization of exposed patients. In the recent mission, however, it was the first time we had been dispatched to such a disaster area. With little knowledge about what was to be done, we had to feel

our way through our mission, adapting our activities to an ever-changing situation. In the future, it is a necessity to establish a radiation emergency medical assistance system that also covers the activities which need to be carried out on site by the dispatched medical teams.



A scene before receiving evacuated residents for a radiation survey

### *(3) Screening Residents for Radioactive Contamination*

#### **Examining the Level of Radiation Accumulated in Children's Thyroid Glands**

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On March 25–30, 2011, as a member of the fifth group of the Radiation Emergency Medical Assistance Team (REMAT), we carried out activities primarily at the Fukushima Prefecture Government Hall and Offsite Center (OFC). SPEEDI data which predicts the dispersion of radioactive iodine in the air, was made available just before our arrival. This data revealed the risk for residents, and more importantly their thyroid glands, of being exposed to radioactive iodine in municipalities outside the evacuation zones such as Iwaki City, Iitate-mura, and parts of Kawamata-machi. In view of the high incidence of thyroid cancer among the children who survived the Chernobyl accident, it was important to examine the level of radiation in the thyroid glands of children in these municipalities.

With the advice of the Nuclear Safety Commission of Japan and in cooperation with Fukushima Prefecture, the nuclear emergency response headquarters conducted examinations on the region's children to measure the levels radiation contamination in their thyroid glands. The first examinations were carried out in Iwaki City on March 25, followed by Kawamata-machi on March 28 and Iitate-mura on March 29. Through the concerted efforts of the response headquarters, experts gathered in Fukushima Prefecture from all over the country, as well as personnel from the affected municipalities, it took only three days to examine more than 1,000 children for their level of radiation exposure.

To accurately detect weak radiation in children's thyroid glands, we needed to secure a place where the background dose was no more than  $0.2 \mu\text{ Sv/hr}$ . In Iwaki City, the radiation level in the air had already fallen below this level and so we were able to safely use an examination room in the Iwaki City Public Health Center.

However, in Kawamata-machi and Iitate-mura, where the radiation level in the air remained as high as  $1 \mu\text{ Sv/hr}$  or more, we had a more challenging time finding a suitable place for testing. In Iitate-mura, in particular, where there were few large concrete buildings that could function as an effective shield against radiation, I spent a whole day with the Deputy Executive Manager of Medical Treatment Support, Hiroomi Sumida, going around the village and measuring doses in all prospective buildings. Unfortunately, we could not find a suitable location where the background dose was low enough. We even discussed the possibility of taking children to Kawamata-machi for examination. However, after further consideration we decided to do a more comprehensive check within the assembly house at the village government office, (which had already been checked for radiation dose and found unsuitable for our purpose) and we were able to identify a small space behind the chairperson's seat that met our radiation level's criteria.

During our thyroid dose examination of these local children, we were relieved to find that no children who we were able to examine exceeded the target screening level. However, of important note, not all children in Fukushima were checked for the level of radiation in their thyroid glands. This, coupled with the limited accuracy of the screening, requires that follow-up examinations be carried out on the health effects of radiation on children.

Examining children's thyroid dose in the Iitate-mura Village Assembly House

*(3) Screening Residents for Radioactive Contamination*

**Reality of Radiation Survey of Children's Thyroid Glands in Kawamata-Machi**

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I was in the disaster areas from March 29 to April 5, 2011. On March 29, I exchanged information with the Emergency Medicine Division of Fukushima Medical University Hospital. On March 30, we conducted children's thyroid radiation dose survey in Kawamata-machi. On the 31st, I was at the Offsite Center, discussing how best to transport radiation-exposed patients with the Self-Defense Forces, the Emergency Medicine Division of Fukushima Medical University Hospital and Hiroshima University. On April 1-5, I participated in the establishment of a medical team at J-Village.

From March 28 to 30, the children's thyroid radiation dose examinations were conducted in Kawamata-machi and Iitate-mura where radiation doses were relatively high. I acted as leading physician in the examination conducted in Kawamata-machi on March 30.

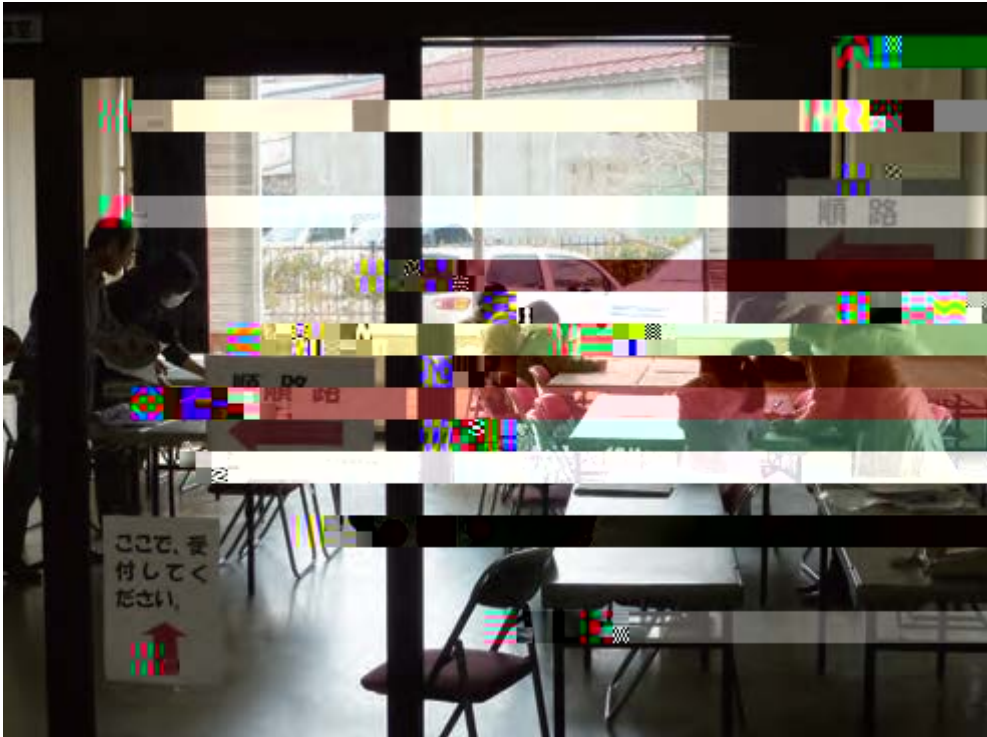
On that day, we went to Kawamata-machi with a team of radiological measurement technicians, measured the air radiation dose where the examinations were to be conducted, and then following a measurement that showed the radiation dose was within the acceptable parameters we checked and prepared the location for the examinations. Until the evening we then examined local children for thyroid gland radiation exposure using a NaI (TI) scintillation survey meter.

The previous day, Prof. Satoshi Tashiro and Dr. Hisayoshi Kondo, Vice Director of the DMAT Secretariat of Japan's Ministry of Health, Labour and Welfare had secured a location with a low background radiation exposure dose which was suitable for the survey. The staff of the Kawamata-machi Municipal Government were also very cooperative, in helping us to smoothly carry out the examination. Although the clothes of some of the evacuated residents were contaminated and these individuals needed to undergo decontamination procedures, none of them exceeded the radiation dose screening standard.

Examinations took place in a community hall where all people were asked to change from shoes to slippers. Furthermore, everyone was asked to not open the main entrance to the community hall and the door of the entrance hall simultaneously. Many children to be examined were accompanied by their parents, and they all looked relieved to hear the examination results which indicated that none of the children were contaminated.

Since it was expected that many residents might be moving to a new community in the future, we asked them to write down their cell phone numbers, rather than their home phone numbers, as their contact information. As for the children who were accompanied by their school teachers, we failed to obtain their conta





Reception of children for thyroid dose examination



To keep the indoor air dose low, all people were asked to change from shoes to slippers at the entrance and not to leave the two doors open simultaneously

### *(3) Screening Residents for Radioactive Contamination*

#### **Building an Examination System from Scratch**

Hiroomi Sumida

Deputy Executive Manager of Medical Treatment Support

Division of Medical Treatment Support

Hiroshima University Hospital

I was dispatched to Fukushima for the first time on March 25, 2011. Roughly two weeks after the disaster, activities to help disaster victims remained disorganized. Our initial mission was to organize the data obtained from screening conducted at every evacuation center and give advice to those engaging in radiation measurement and report on problems.

One of the most serious problems was children's thyroid gland exposure to Iodine-131. On March 24, 66 children were tested for their levels of thyroid exposure in Kawamata-machi and they were reported to have "no problems" in this regard. However, because the background dose (BG) was very high in the place where measurement was carried out, some experts pointed out the low reliability of measurement accuracy.

To address this problem, NIRS reviewed examination conditions. Based on the review results, the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Ministry of Economy and Industry (METI), and Hiroshima University were to work together to establish a thyroid gland exposure survey system. From Hiroshima University, Prof. Satoshi Tashiro and Senior Specialist Toshio Fujimoto and I were assigned to carry out that task. Based on the SPEEDI data concerning the distribution of radioactive substances, we decided to examine children aged 0–15 who resided in Iitate-mura (in which the air dose was then 10  $\mu$  Sv/h), Kawamata-machi (an air dose of 6  $\mu$  Sv/h), and Iwaki City (an air dose of 1.5  $\mu$  Sv/h).

The examination requirements presented to us were very strict. The air dose measurements at all locations on those days were very high, with even Fukushima City measuring as high as 3.5  $\mu$  Sv/h, making it extremely difficult to find an environment that met the examination requirement of BG of 0.2  $\mu$  Sv/h or less.

On March 26, we went to Iwaki City. When setting up (assessing) the environment, in consideration of the possible effects of fallout, we made it a point to choose a location close to the center of a reinforced concrete facility. Fortunately, we were able to find a suitable place for examination inside the Iwaki City Public Health Center where regular screening was being conducted for residents. We explained the procedures and other important points (including conditions set for measuring devices) to the radiological measurement technicians. After overseeing the radiation measurement of the first several children, we left the public health center. In Iwaki City, 137 children were examined.

On March 27, we looked for a facility for examinations in Kawamata-machi. Initially, we intended to use the community hall for that purpose. As it turned out, however, the community hall had been closed and was being used for storing relief supplies. Therefore we had to ask the relevant offices for permission to use the hall for our purpose. Although we were allowed use the community hall, there were few spots inside the facility that met our criteria. Finally, we found an adequate location in the hallway on the second floor. Since we needed to examine many disaster victims (631 individuals), we set up our examination site in a way that would best ensure efficient procedures and carefully

clarified each staff member's responsibilities. On March 28, examinations were conducted with the cooperation of the Nuclear Physics Group.

On March 29, we were to begin our environmental assessments in Iitate-mura. We had a briefing session in the village council office and gained approval to undertake the environmental assessments. The village council, however, asked us to conduct the assessments in public facilities. As a result of the preliminary assessment of the inside of the offices, the only site that met our examination conditions was the back of the village meeting hall. We looked for other facilities in the village that would meet our examination requirements, but air radiation doses were high everywhere and there was no other place that met our requirements. Ultimately we set up an examination system inside the assembly hall.

As an examination run-through we asked the village council officials to bring in several children. Though the situation in the village was very severe, we departed after communicating the examination procedures to Yuji Akiyama, a radiological technologist. In Iitate-mura, 315 children were examined.

From this mission, I learned that it requires a concerted effort among the many different affected parties to build an effective examination system from scratch.



Demonstrating how to examine children for thyroid gland exposure (at the Iitate-mura village council office)

### *(3) Screening Residents for Radioactive Contamination*

#### **My Heart Ached to See Children in Contaminated Clothes**

Nobukazu Abe

Radiological Technologist

Division of Medical Treatment Support

Hiroshima University Hospital

It was on March 16, 2011, five days after the earthquake, that I, a radiological technologist, was dispatched to Fukushima as a member of the second group of Hiroshima University's Radiation Emergency Medical Assistance Team (REMAT). It was the day after the news came out that a massive amount of radioactive substances had been released into the environment from Fukushima No. 1 Nuclear Power Plant. Understandably, information coming in from the affected areas was mixed and confusing. Not knowing exactly what I was to do, I departed for the disaster area with a great sense of anxiety. Yet at the same time, I felt a strong sense of mission purpose because I was the first radiological technologist to be appointed as a REMAT member.

That evening, while snow was falling we arrived at the Fukushima Prefecture Government Hall in which the Radiation Emergency Medicine Coordination Conference, our headquarters, had been set up. As soon as we stepped into the headquarters, I remember being overwhelmed by the tense feeling shared by the experts and workers gathered from around the country. At that time, the outdoor air dose in Fukushima City was as high as 10  $\mu$  Sv/h, despite being about 50 km away from the nuclear power plant.

Our team's mission was to conduct radiation contamination screening and provide first aid for evacuated residents and local residents. For three days from March 17 to 19, we screened about 1,100 individuals at screening sites set up in the municipalities of Fukushima City, Koriyama City, and Kawamata-machi. At evacuation centers, there were many people who had been evacuated from coastal areas without bringing any personal belongings. Fortunately, we found no person who exceeded the screening level and needed to undergo decontamination procedures. However, there were several people who had suffered mild contamination, mainly on their clothing.

What still stands out in my memory is when we screened two elementary school age sisters. Both were contaminated specifically in the buttock area of their clothing. When I had them take off their pants and underpants and reexamined them, the reading dropped substantially. What presumably happened to them was that the radioactive substances fell on the ground with snow and the two sisters sat on the wet ground side by side. My heart ached when I imagined the sight of the two little girls sitting together innocently.

During the screening procedures, on the orders of the headquarters, we wore Tyvec coveralls, masks, gloves, and other protective gear. Frightened at the invisible risk of radiation, residents would anxiously ask us "Are we all right?" We answered them, "Of course. You are all right." However, I wonder if they really believed our words when we were fully dressed in protective garments and they were not.

I had engaged in radiation emergency medicine for about one year before the recent major disaster struck and had been working seriously in that field. And yet, I cannot deny that even I was thinking somewhere in my mind that a radiation disaster of this kind "was unlikely to happen." As a radiological technologist from Hiroshima University, the

only tertiary radiation emergency medical institution in western Japan, I believe that there are many more things I can do. While it is unpleasant to imagine the possibility of a reoccurrence of this kind of accident, we must take every possible precautionary step based on the assumption that “it will happen.”



Screening at an evacuation center

### *(3) Screening Residents for Radioactive Contamination*

#### **Always Keeping Radiation Exposure Control in Mind**

Yuji Akiyama

Radiological Technologist

Division of Medical Treatment Support

Hiroshima University Hospital



I engaged in activities as a member of the Hiroshima University Radiation Emergency Medical Assistance Team (REMAT) from still snowy March to sizzling hot July, 2011. The activities we conducted at the Fukushima Prefecture Government Hall changed over time following the initial chaos of the nuclear power plant accident.

When we started our activities on March 29, scars of the earthquake devastation were apparent everywhere: Cracked road surfaces, long lines of cars waiting in front of gas stations, and collapsed houses among them. While in Fukushima, I placed particular emphasis on controlling the radiation dose to which our team members were exposed. Every morning, I telephoned Dr. Tanigawa's group at J-Village to check the readings of their pocket dosimeters.

Although our group's activities were centered at the Fukushima Prefecture Government Hall, Hiromi Sumida, a radiological technologist who was a member of the REMAT group dispatched immediately before ours, participated in thyroid gland screening away from the headquarters, so I was unsure about what my responsibilities should be at the prefectural government hall. I collected information and thought of what we, the radiological technologists dispatched as REMAT members, should focus on in our activities. As it turned out, I engaged myself primarily in continuing the thyroid gland screening of children in the evacuation centers, collecting and reporting radiation exposure screening data each day to the experts and officials concerned, and coordinating screening group dispatch, as well the group's preparations for the morning and evening meetings.

During thyroid radiation exposure screening for children in Iitate-mura, I conducted surveys on infants and young children. Wearing masks, these children were prohibited from playing outside their houses. My heart ached to hear their mothers speak so worriedly about their children.

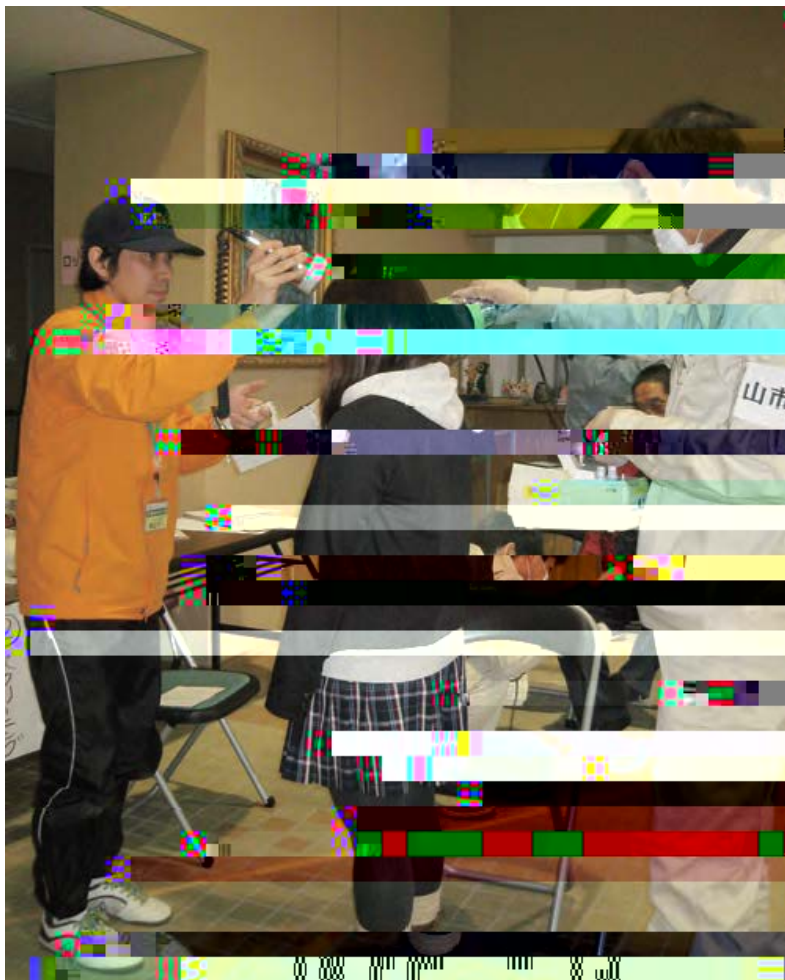
I also had the opportunity during my mission to participate in radiation exposure screening in Kawamata-machi. Many of the residents I met had been evacuated without taking anything with them and later returned home by car to collect their personal belongings before returning to the evacuation centers. As a result, these "repeat-evacuees" added significantly to the number of evacuees who need to be tested for radiation contamination.

By the time I began my second round of activities, the national government had prohibited entry into a designated "20-km radius restricted area" around Fukushima No. 1 Nuclear Power Plant. At the Fukushima Prefecture Government Hall, although the number of people that needed screening was decreasing, the need to screen cars and other belongings that residents had brought out of the 20-km restricted zone was increasing.

I attended meetings to coordinate a plan that allowed residents to enter the restricted zone during a specific, pre-determined time and the follow-up screening procedures needed following their exit from the restricted zone. I also took part in drawing up questionnaires for the residents concerning radiation exposure. Our activities at the prefecture government hall changed as the post-disaster situations changed. One of the challenges involved in our mission was how

to appropriately adapt our activities to these ever-changing situations.

During my REMAT operations, I learned how important it is for workers in this kind of mission to quickly understand their roles and the ever-changing environment. I also strongly felt the importance of ensuring communication and reporting. As a radiological technologist engaging in radiation emergency medical assistance in Fukushima in the aftermath of the nuclear accident, I always kept in mind that radiation exposure control was my major responsibility.



Screening residents for exposure

*(3) Screening Residents for Radioactive Contamination*

**Ready for Action Even While in Bed**

Toshio Fujimoto

Senior Specialist

Patient Support Center

Division of Management Support

(Then: Chief of Medical Affairs Group)

Hiroshima University Hospital

On March 25–29, 2011, I participated in REMAT activities mainly at the Fukushima Prefecture Government Hall and the Offsite Center (OFC). I asked members dispatched from the head office of the university corporation, together with nurses, to collect information at OFC and send data to the Radiation Emergency Medicine Committee. I myself was engaged in gathering information at the Fukushima Prefecture Government Hall, keeping track of our team's activities, reporting current situations to the headquarters of the Radiation Emergency Medicine Committee, preparing activity reports, and driving official university cars whenever needed, particularly during emergencies.

Although we were initially briefed on our operations, situations changed so rapidly that we were constantly gathering up-to-date information and adjusting in response to what was actually happening. Following our initial briefings, things changed the next morning: The doctors on our team were suddenly asked to head for J-Village. rwd(1)12-5304(m



cars in an emergency, I realized how vital it is to keep track of road situations, refueling locations, the status of supplies loaded in the vehicles, stay prepared to respond to emergencies, and to ensure communication among team members.



Medical Activities at J-Village

*(4) Medical Activities at J-Village*

**Importance of Sharing Feelings Associated with the Mission**

Masafumi Mizooka

Associate Professor

Department of General Medicine

Department of General Internal Medicine

Hiroshima University Hospital

On April 8–12, 2011, I participated in the establishment of a medical assistance team at J-Village (JV) as a member of the eighth group of REMAT. Located about 20 km away from Fukushima No. 1 Nuclear Power Plant (1F) and bordering on the restricted zone, JV was being used as a frontline base for “on-site coordination” of post-nuclear-accident responses carried out by TEPCO and the SDF. At JV, workers changed clothes before going to 1F and, on their return from 1F, underwent radioactive contamination screening and decontamination procedures. As a medical base, JV was

One of the problems identified during this mission was my lack of preparedness. I was lacking in basic knowledge about disaster medicine and radiation emergency medicine. In my first mission to a disaster-hit area, I found myself bewildered by the actual disaster situation, which was so completely different from that inside a hospital. I also realized the importance of sharing and communicating information. In particular, I renewed my understanding about the importance of communicating not only the situations we faced but also the feelings associated with our activities among team members. Particularly when different members who are coming and going on a daily basis are to function as an effective team under the same leader throughout.

In closing, I would like to offer my sincerest prayers for those who lost their lives in the earthquake and tsunami. It is my strong hope that the disaster areas will recover from the devastation and the nuclear disaster will end as soon as possible.



April 10. Patient transportation drill in an SDF helicopter CH47 (author with Chief Doctor Koriyama)



April 12. In front of the medical center attached to J-Village

*(4) Medical Activities at J-Village*



Meeting of medical teams at J-Village

#### *(4) Medical Activities at J-Village*

##### **Sharing Knowledge across Job Boundaries**

Keiichi Hara

Chief

Medical Affairs Group

Division of Management Support

(Then: Chief of Dental Satellite Group)

Hiroshima University Hospital



On April 8–12, 2011, our team worked at J-Village, the facility being used as a frontline base for workers engaged in operations at Fukushima No. 1 Nuclear Power Plant (1F) and Fukushima No. 2 Nuclear Power Plant (2F), and within the 20-km zone from 1F. The aim of our activities was to provide these workers with medical care. Specifically, we worked to improve the environment of the medical center attached to J-Village, thereby enabling it to function as a headquarters (medical facility) for our radiation emergency medical assistance teams to provide medical services to emergency patients (including radiation-exposed patients who underwent decontamination procedures).

My responsibilities as a member of the clerical staff were to make the necessary arrangements for moving our emergency medical team from dispatch location to the medical center and to subsequently collect on site information.

On the first day of our mission, we arrived at J-Village by way of Fukushima Airport. Dr. Nobuyuki Hirohashi, who led the previous team, guided us through the facility and updated us on the current progress.

J-Village was crowded with staff in protective overalls waiting to depart for their respective missions and noisy with the sound of workers carrying out their activities, as well as broadcast information about buses bound for 1F and 2F. This hectic atmosphere made me realize that we were still in a state of emergency (only a month after the nuclear accident). At this time, roughly 2000 people were working at 1F and 2F every day.

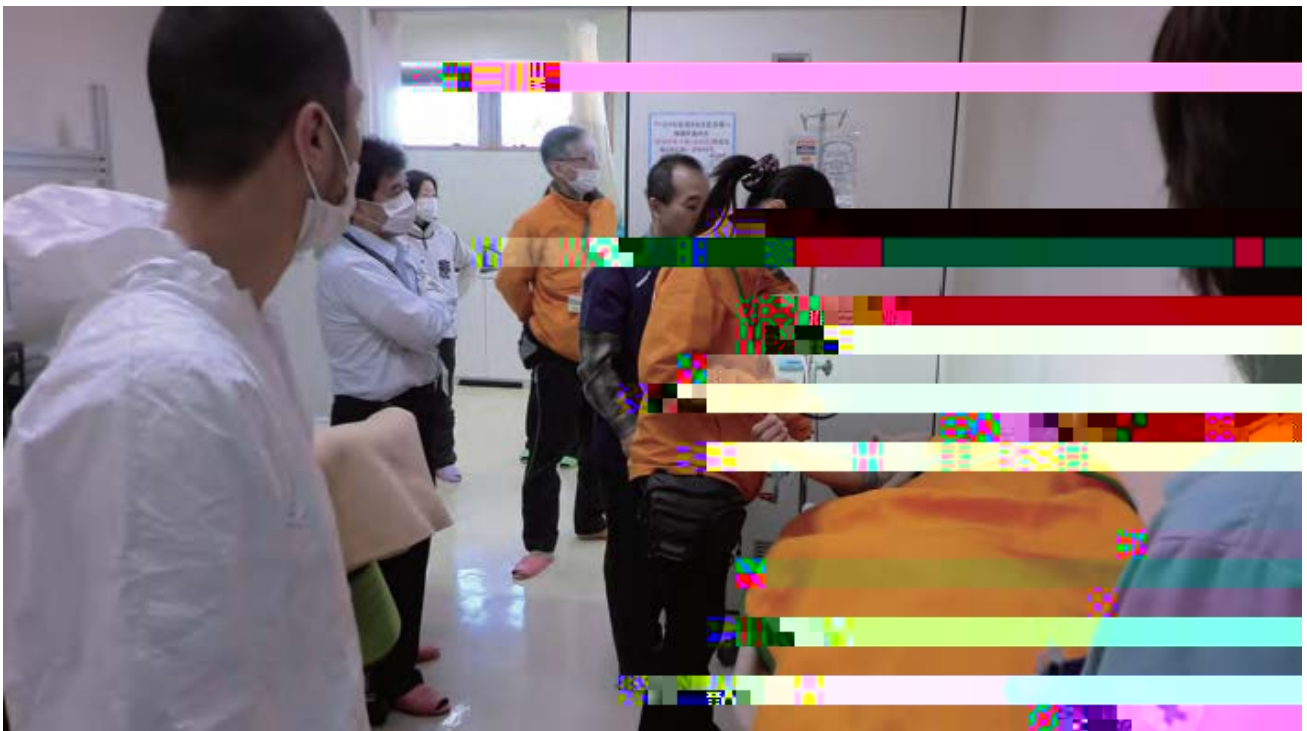
The headquarters managed by TEPCO were furnished with communications and office equipment (fax machines and photocopy machines). Piled up around these communications and office machines were cardboard boxes containing protective overalls for power plant workers and the food that they would need to bring to 1F and 2F. Although TEPCO was harshly criticized by the media for the insincere behavior of its top management, I was strongly impressed to see TEPCO employees work tirelessly on the front lines. In those days, this kind of reality was not fully reported to the public, most likely due to press restrictions.

While electricity was available, water supplies remained disrupted and so we did not have water to wash our hands. Fortunately, we had no problem with drinking water or food because we commuted from a hotel in Iwaki City. However, the TEPCO medical team who stayed at J-Village were not so lucky and found themselves unable to take a bath. I felt a strong sense of respect for the TEPCO employees who, in such a severe environment, selflessly devoted themselves to their work. The dispatched REMAT teams worked in shifts of 4–7 days for each mission, with the name's list of staffers working on site (including our team's members) being updated daily to keep everybody aware of the current staff. This demonstrates one example of just how exacting the mission was.

While we were there, the communication infrastructure and utility services gradually returned to normal.

Internet connections were established and a TV conference system was made available. Despite these positive developments, challenges such as the disrupted water supply remained.

What struck me most during my mission was that, in a situation where we could not see the prospect of resolving the nuclear disaster (due to lack of information) and where medical supplies and various other things were in short supply, workers from different teams gathered knowledge and combined strengths across job boundaries in order to overcome difficulties and accomplish their missions together. For this kind of teamwork to be most effective, we must learn to help and support each other not only in emergency situations but also during our regular daily work activities (although this may be a difficult task in reality).



Looking after an emergency patient carried in from 1F