

Experiences of radiation emergency medicine

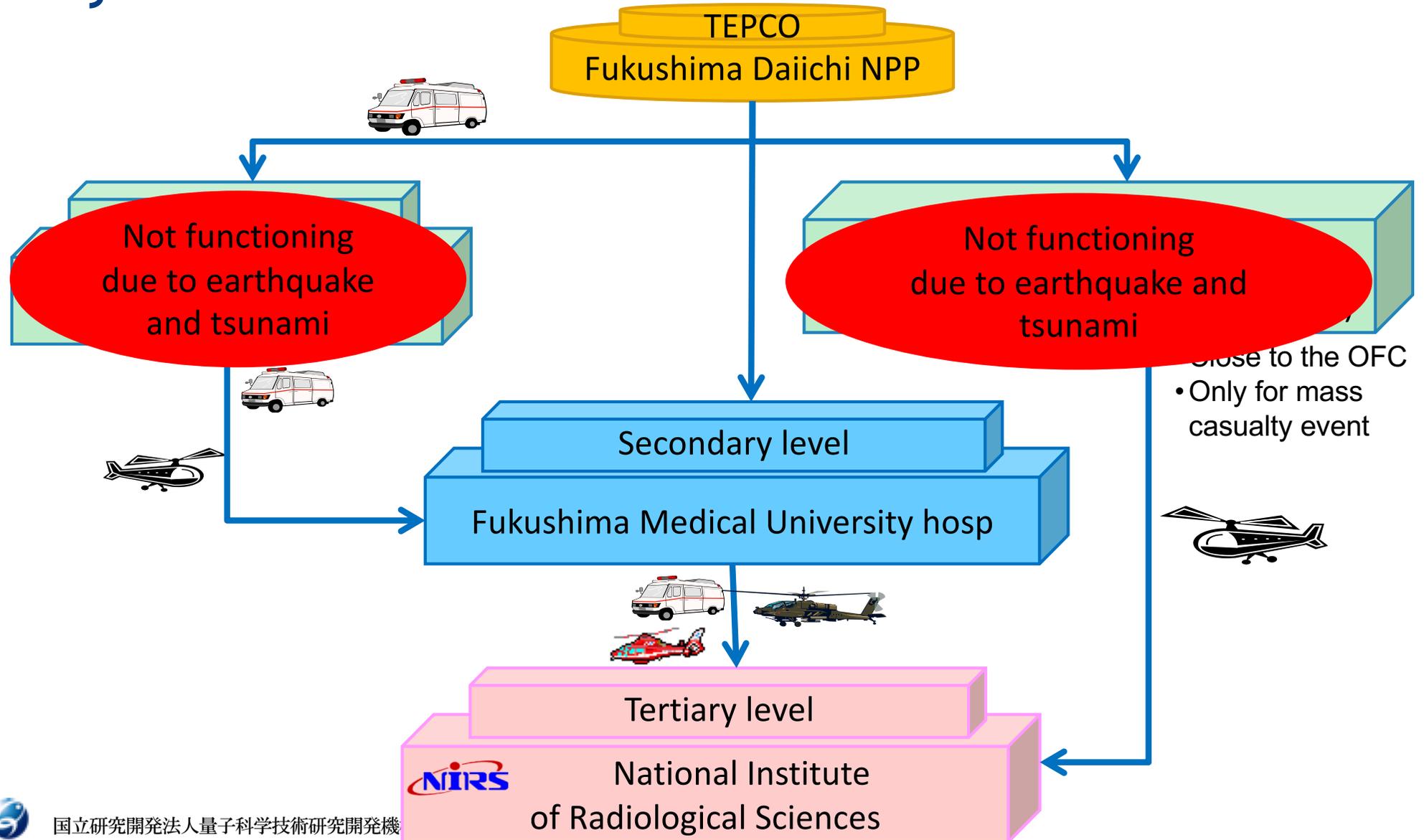
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TEPCO Fukushima NPP accident in 2011

- There were no patient highly exposed in this accident.
- QST has provided radiation emergency medicine for injured person with contaminated wounds, heavily contaminated workers, and internally exposed workers.

Radiation emergency medical response system in FUKUSHIMA



Sending REMAT to Fukushima



2011 March 12
Fukushima Daiichi NPS

- 2011 March 12 8:10am
(17 hours after the earthquake)
- First dispatching of REMAT from NIRS to Fukushima by a helicopter of Japan Self Defense Force



Case Report 1



The number of clinic or hospital visits

Number of people who visited a clinics or hospitals from the Fukushima Daiichi from 11 to 31 March, 2011

Date	Trauma	Internal disease	Total	Transport destination
March 11	1	1	2	Hospital
March 12	5	4	9	Hospital Kawauchi Clinic, Clinic in 2F OFC
March 13	0	3	3	Clinic in 2F
March 14	11	0	11	OFC Clinic in 2F Fukushima Med. Univ. NIRS
March 23	2	0	2	Clinic in 2F
March 24	3*	0	3	Fukushima Med. Univ. →NIRS

*Two were heavily contaminated and one was not contaminated on body surface.

Patients of hydrogen explosion

- At 11:01 March 14, 2011
- No.3 reactpr building
- 7 workers and 4 Japan Self-Defense Forces (JSDF) personnel were injured (Pieces of concrete hit the JSDF personnel)
 - 7 workers were transported to a clinic in TEPCO Fukushima Daini NPP (2F)
 - The 4 injured JSDF personnel were brought to OFC by track with other member

Protective equipment

- Took stable iodine before the mission in Fukushima Daiichi NPP
- Hydrogen explosion occurred an hour and 20 minutes after taking stable iodine
- Wore protective gear on his camouflaged uniform, and equipped a full face mask
- Personal dosimeter (PD)



Patients of hydrogen explosion

- Arrival of four JSDF personnel at OFC at 11:35
- Soon after arrival they were directed to move to the decontamination facility because the entrance of OFC was closed due to protection from radiation contamination after the explosion
- All of them showed heavy contamination on their protective gear
 - 1 mSv/h at 10 cm

 **Removing all clothes and taking shower**

Status of patients

- Contamination on face and wound were still observed after removal of their protective gear and shower
- Five minutes after removal of protective gear, their personal dosimeter alarmed due to over 20 mSv
- One of injured JSDF personnel had pain on neck and paralysis on arm
- One of the patients had a contaminated wound on the right thigh
- Other two had bruise or pain on shoulder

Diagnosis of patients

- One of injured JSDF personnel had pain on neck and paralysis on arm
 - Transferred to the Fukushima Medical University Hospital by ambulance and diagnosed with brachial plexus injury
- One of the other patients had a contaminated wound on the right thigh
 - Transferred to NIRS by JSDF helicopter
- Other two had bruise or pain on shoulder
 - Transferred to a clinic in Fukushima Daini NPP

Receiving a contaminated injured JSDF member at NIRS

- Arrival at NIRS by JSDF helicopter at 20:30
- Body surface was surveyed with GM counter and the level of external contamination was under 100 kcpm, whereas almost whole body was contaminated
- Level on right thigh wound was 2500 cpm
- Levels of abdominal part was the most prominent (31 kcpm)
- I-131, Te-132 and I-132 were detected from right nasal swab
- Admitted to NIRS hospital
- The exposed doses of experts who took care of patients with contamination were only a few tens of μSv



Clinical course

- Treatment
 - Cefcapene 100mg po administration for three times a day
 - Loxoprofen 60mg po administration for three times a day
 - Bed rest
 - Shower for decontamination every day
 - Dressing change
- Clinical course
 - Pain was reduced
 - Able to walk
 - Reduce subcutaneous induration on right thigh
 - Wound showed a tendency of epithelialization
 - Reduce surface contamination
 - Discharged on 17 March

Case Report 2



Heavy contamination

- On March 24, 3 workers accidentally put their feet in the water containing high concentrations of radioactive materials at the Unit 3 of NPS
- Two of them were contaminated on the feet since the water came into their boots
- They worked for 30 min soaking their feet in contaminated water and ignoring the alarm of personal dosimeters
- They were transported to Fukushima Medical University and then to NIRS

At Fukushima Medical University Hospital

- Experts from NIRS and Hiroshima University were dispatched to Fukushima Medical University Hospital
- At 18:40 workers arrived



Photo courtesy of Dr Hirohashi (Hiroshima University)



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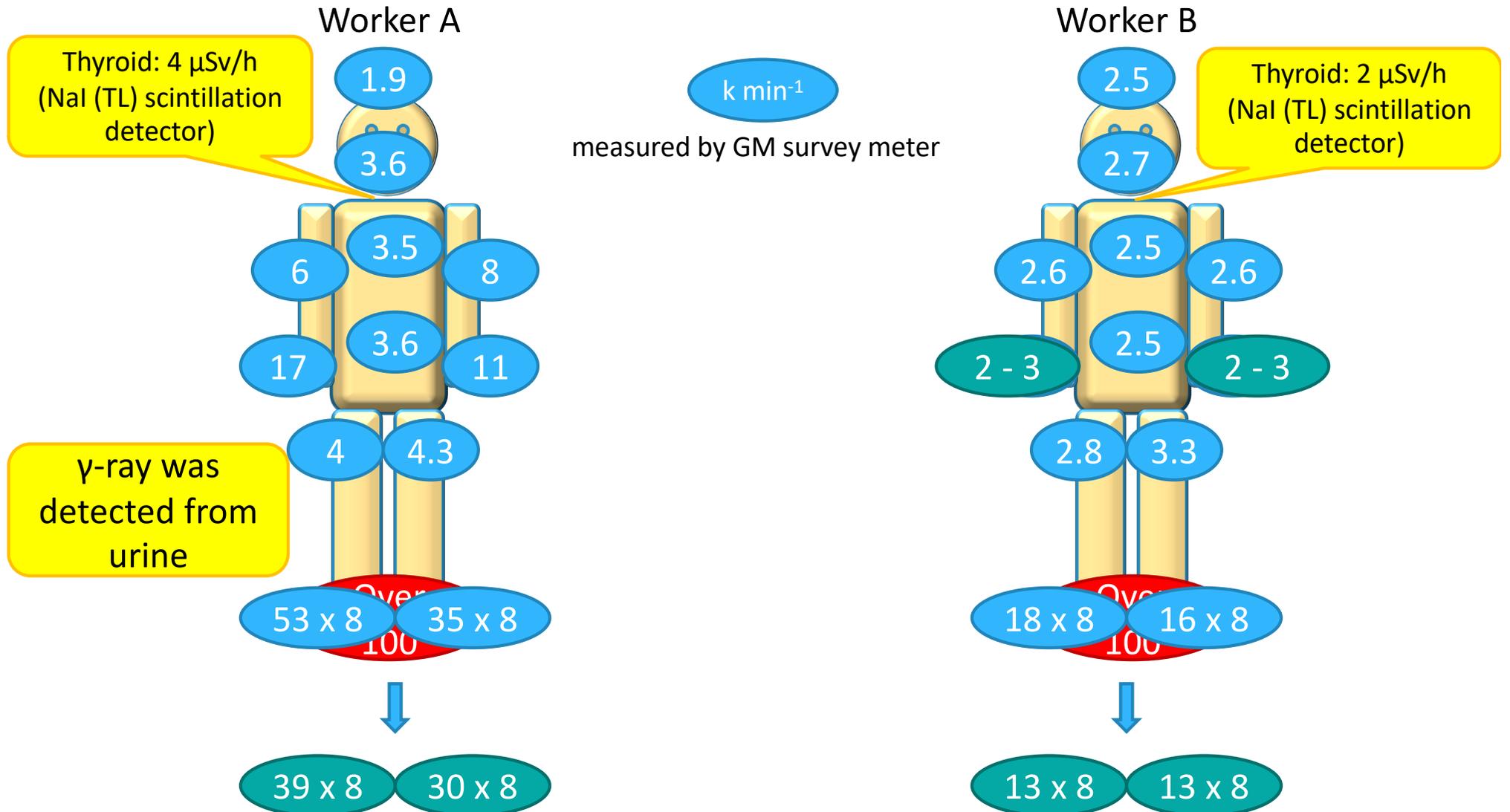


Photo credit: NIRS



Photo credit: NIRS

Skin contamination



Skin contamination

- survey at NIRS -

- The lower part of leg was soaked and heavily contaminated
- The proximal part was contaminated due to wet underwear
- Sole was most heavily contaminated exceeding 100 kcpm with the GM counter

Clinical laboratory findings

- Leukocyte, neutrophil, and lymphocyte count were normal range
- No other physical symptoms

Clinical course

- No cutaneous radiation injury
 - No erythema on their feet
- No specific treatment
- Shower for decontamination every day
- Contamination of sole was decontaminated and reduced to under 100 kcpm with GM
- Discharged on March 28
- Observation for 2 weeks showed no erythema

Dose estimation

- External exposure dose: Reading of PD
- Skin equivalent dose: Calculation from concentration of contaminated water and working time
- Committed effective dose: Based on measurements by WBC and radionuclide intake scenario of each person
- Thyroid equivalent dose: Based on measurements by thyroid monitor by intake scenario of each person (Only for I-131)

Exposure doses of workers

Radiation exposure of workers

- Regulation on **the dose limit for emergency workers** was revised from 100 mSv to **250 mSv** on March 14th 2011.
- This new regulation is applied only for the emergency workers of this accident.

Doses of internal and external exposure

Classification (mSv)	March 2011-December 2012			March 2011-January 2013			Fluctuation		
	TEPCO	Contractor	Total	TEPCO	Contractor	Total	TEPCO	Contractor	Total
Over 250	6	0	6	6	0	6	0	0	0
200-250	1	2	3	1	2	3	0	0	0
150-200	22	2	24	22	2	24	0	0	0
100-150	117	17	134	117	17	134	0	0	0
75-100	225	66	291	227	66	293	2	0	2
50-75	303	437	740	302	455	757	-1	18	17
20-50	598	3,032	3,630	602	3,079	3,681	4	47	51
10-20	484	3,250	3,734	483	3,316	3,799	-1	66	65
5-10	392	2,978	3,370	393	3,054	3,447	1	76	77
1-5	601	5,754	6,355	604	5,812	6,416	3	58	61
1 or less	882	6,229	7,111	884	6,393	7,277	2	164	166
Total	3,631	21,767	25,398	3,641	22,196	25,837	10	429	439
Max. (mSv)	678.80	238.42	678.80	678.80	238.42	678.80	-	-	-
Ave. (mSv)	24.79	9.74	11.89	24.81	9.76	11.88	-	-	-

Estimation of internal exposure dose for workers

- The committed effective dose of internal contamination was estimated at NIRS for 7 workers who had worked at TEPCO Fukushima Dai-ichi NPS after 11th March.
- The function of thyroid of all workers was normal.
- No clinical symptoms and no radiation injury up to now.

Summary

- In this accident, the response system for radiation emergency medicine was not functional since community lifelines such as water supply and electricity were severely damaged
- Workers, operational staff and emergency response personnel were exposed to radiation and/or contaminated but there were no workers or responders requiring treatment for ARS
- Basic education on radiation and radiation emergency medicine is essential for all health care providers, staff of hospital and first responders