Fukushima Daiichi Nuclear Accident and Fukushima Medical University Activities

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Evacuations and Sheltering due to NPP Accident

11 Mar  16:45  Article 15 event reported based on the Nuclear Disaster Law
          21:23  Instruction of Evacuation to the residents living within a radius
                  of 3km from the NPP and Instruction of stay-housing
                  (Sheltering) in 3-10km zone were issued.

12 Mar  5:44  Instruction of Evacuation to the residents of 10km zone from
               the NPP was issued.
          15:36  Hydrogen Explosion of NPP unit 1 was happened.
          18:25  Instruction of Evacuation to the residents of 20km zone from
                  the NPP was issued.

14 Mar  11:01  Hydrogen Explosion of NPP unit 3 was occurred.

15 Mar  6:10  Explosion of NPP unit 2,
            6:14  Explosion of NPP unit 4,
            11:00  Instruction of stay-in-housing (Sheltering) to the residents
                   living within 20-30km zone was issued.
1. Fukushima Daiichi Nuclear Accident & Disaster Medicine
Disaster Medical Activities
in Fukushima Medical University (FMU)

- 35 Disaster Medical Teams were organized by 180 medical staffs of FMU and all Japan at 2011.3.11. We accepted 168 emergency patients.
- We triaged the 175 patients and temporary accepted admission of 125 patients on the way to transfer from hospitals in the affected areas during the first week.
- More than 500 evacuees were tested for radiological screening during the first week.
- 12 patients from Fukushima Daiichi Nuclear Power Plant were treated during first month.
- Medical staffs have visited to the temporary housing for health support of evacuee one month after Disaster.

(Book: ‘Face up to radiation disaster’ Fukushima MUH Radiation Disaster Medical Center ed. lifescience publ. 2013.)
Medical Activities for Nuclear Disaster in Fukushima Medical University

- Emergency treatment
- Training
- TV meeting
- Decontamination Supports by the Self-Force
Radiation Exposure Pattern in Nuclear Accident

131I Inhalation
134Cs, 137Cs Intake of Contaminated Food

Stable iodine Evacuation

External Irradiation

Internal Irradiation Radioactive Materials

Radiation Plume

Nuclear Power Plant Accident

 Fallout

Environmental Contamination

Food monitoring & Regulation

People in Contaminated Area

External dose estimation & Monitoring & Decontamination

Food Chain
2. Radiation Dose Estimation in Residents

Initial 4 months Dose Estimation by Basic Survey

Questionnaire

Movement & behavior

Time-course of air dose rate map

The individual dose has been reported to each respondent by FMU

Estimation dose calculating combined above two information by NIRS

Distribution of External Exposure Dose (mSv)
(Estimated cumulative effective dose from March 11 to July 11)

Number of responses; 421,394 (70,319)

- ~1mSv 62.0% (77.5%)
- ~2mSv 94.0% (94.9%)
- ~5mSv 99.8% (98.6%)

- Maximum 25mSv (25mSv)
- Average 0.8mSv (0.8mSv)

(Distribution of External Exposure Dose (mSv)
(Evacuation Area, Soso district in parentheses)

http://www.cms.pref.fukushima.jp/)
Estimated annual exposure dose by personal dosimeter in Fukushima City

<table>
<thead>
<tr>
<th>Examination Period</th>
<th>Average estimation of Annual dose equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep-Nov 2011 (n=36,767)</td>
<td>1.04 mSv/y</td>
</tr>
<tr>
<td>Sep-Nov 2012</td>
<td>0.56 mSv/y</td>
</tr>
<tr>
<td>Sep-Nov 2013</td>
<td>0.44 mSv/y</td>
</tr>
</tbody>
</table>

(Source: http://www.city.fukushima.fukushima.jp/soshiki/71/hkenkou-kanri14022601.html)
Thyroid doses for evacuees from the Fukushima nuclear accident

Adults: Detected 74% (40/54)
ND-33 mSv, Median 3.6 mSv

Children: Detected 75% (6/8)
ND-23 mSv, Median 4.2 mSv

Estimation of internal exposure of the thyroid to $^{131}$I on the basis of $^{134}$Cs accumulated in the body among evacuees ~. (Hosoda M et.al. Environment Intern 61:73-76, 2013. (N=2393)

# Estimated Internal Dose from Diet Radioactive Cesium Levels

*Data From Mar to May 2012 by Ministry of Health, Labour and Welfare Food and Drug Safety Administration*

<table>
<thead>
<tr>
<th>Prefecture</th>
<th>radioactive Cs (mSv/year)</th>
<th>K-40 (mSv/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>average</td>
<td>90 percentile</td>
</tr>
<tr>
<td>Hokkaido</td>
<td>0.0013</td>
<td>0.0018</td>
</tr>
<tr>
<td>Iwate</td>
<td>0.0035</td>
<td>0.0075</td>
</tr>
<tr>
<td><strong>Fukushima</strong></td>
<td><strong>0.0022</strong></td>
<td><strong>0.0035</strong></td>
</tr>
<tr>
<td>Tochigi</td>
<td>0.0030</td>
<td>0.0078</td>
</tr>
<tr>
<td>Ibaraki</td>
<td>0.0039</td>
<td>0.0091</td>
</tr>
<tr>
<td>Saitama</td>
<td>0.0018</td>
<td>0.0043</td>
</tr>
<tr>
<td>Niigata</td>
<td>0.0015</td>
<td>0.0022</td>
</tr>
<tr>
<td>Osaka</td>
<td>0.0012</td>
<td>0.0016</td>
</tr>
<tr>
<td>Kochi</td>
<td>0.0012</td>
<td>0.0016</td>
</tr>
</tbody>
</table>

*(Committed effective dose coefficient by ICRP 72)*
3. Our Challenge for Post-Disaster Health Promotion

Fukushima Health Management Survey:

• To monitor long-term health condition of resident and to promote their health
• To investigate whether a long-term low-dose radiation exposure has an effect on their health

Contents:

1. Basic survey (subjects: 2 million all resident in Fukushima)
2. Detailed survey
   • Thyroid screening by ultrasonography (360,000; 0-18 y/o)
   • Comprehensive medical checkups (210,000 ; Evacuee) about 130,000 examinee during 2012 and 2013
   • Mental health and lifestyle survey (210,000 ; Evacuee) about 7,700 telephone consultation support during 2012 about 4,600 telephone consultation support during 2013
   • Survey on pregnant women and nursing mothers (30,000)
# Mental Health Survey

High Score were observed in PTSD symptoms or mental health questionnaires (related with physiological and mental conditions, life style changes, experiences of Tsunami or explosion, radiation fear etc.). (Yabe H et al. Fukushima J Med Sci 60:57-67, 2014.)

<table>
<thead>
<tr>
<th></th>
<th>Cut-off point</th>
<th>%Cut-off excess reference to preceding studies</th>
<th>%Cut-off excess about 1 year (*2 years) after disaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fukushima Residents, PTSD symptoms (PCL)</td>
<td>44</td>
<td>12.4% (World Trade Center Disaster Rescue &amp; Recovery Workers, 21.4% in volunteer)</td>
<td>21.3% (*18.3%)</td>
</tr>
<tr>
<td>Fukushima Residents, Adult general mental health (K6)</td>
<td>13</td>
<td>3.0% (Control) (^2) 6.9% (Iwate) (^3), 7.3% (Miyagi) (^3)</td>
<td>14.8% (*11.9%)</td>
</tr>
<tr>
<td>Fukushima Daiichi NPP Worker (K6)</td>
<td>13</td>
<td></td>
<td>46.6% (^4)</td>
</tr>
</tbody>
</table>

% Excess in BMI and HbA1c
Medical Checkups Data Compared to Past 3 Years

<table>
<thead>
<tr>
<th>Checkup year</th>
<th>% BMI&gt;25</th>
<th>% HbA1c(JDS)&gt;6.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>2008</td>
<td>30%</td>
<td>31%</td>
</tr>
<tr>
<td>2009</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>2010</td>
<td>30%</td>
<td>28%</td>
</tr>
<tr>
<td>2011</td>
<td>42%</td>
<td>34%</td>
</tr>
<tr>
<td>2012</td>
<td>38%</td>
<td>33%</td>
</tr>
</tbody>
</table>

(Target population is not completely identical due to evacuation.)
### Survey 2011 for pregnant women and nursing mothers

<table>
<thead>
<tr>
<th>district</th>
<th>Fetal death</th>
<th>Preterm birth</th>
<th>Low-weight baby</th>
<th>Cardiac anomaly</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Nakadori</td>
<td>0.19%</td>
<td>4.1%</td>
<td>7.6%</td>
<td>0.98%</td>
</tr>
<tr>
<td>Middle Nakadori</td>
<td>0.30%</td>
<td>4.2%</td>
<td>8.5%</td>
<td>0.83%</td>
</tr>
<tr>
<td>South Nakadori</td>
<td>0.17%</td>
<td>4.6%</td>
<td>8.1%</td>
<td>1.01%</td>
</tr>
<tr>
<td>Soso</td>
<td>0.44%</td>
<td>4.4%</td>
<td>8.1%</td>
<td>0.55%</td>
</tr>
<tr>
<td>Iwaki</td>
<td>0.36%</td>
<td>5.0%</td>
<td>10.6%</td>
<td>1.00%</td>
</tr>
<tr>
<td>Aizu</td>
<td>0%</td>
<td>5.0%</td>
<td>10.1%</td>
<td>0.91%</td>
</tr>
<tr>
<td>All Fukushima</td>
<td>0.25%</td>
<td>4.4%</td>
<td>8.7%</td>
<td>0.89%</td>
</tr>
<tr>
<td>Japan</td>
<td>0.33%</td>
<td>5.7%</td>
<td>9.6%</td>
<td>0.8-1.0%</td>
</tr>
</tbody>
</table>

Support flow on pregnant women/nursing mothers and mental health and lifestyle survey

Subject

① Send a questionnaire

② Return to the questionnaire

③ Telephone consultation and support

④ E-mail /Telephone consultation

⑤ Letter of thanks

Midwife, Psychotherapist, Doctors of FMU Staffs

FMU Health Management Office

③ Check it to evaluate high risk group

Confirm the answers, especially items of depression, and decide whether telephone consultation is needed or not

(http://www.fmu.ac.jp/radiationhealth/)
**Telephone Consultations for pregnant women and nursing mothers**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Concerns of Radiation Health Influences</td>
<td>409 (29.2%)</td>
<td>244 (23.5%)</td>
</tr>
<tr>
<td>Health problem for subject</td>
<td>283 (20.2%)</td>
<td>339 (32.7%)</td>
</tr>
<tr>
<td>Child-rearing</td>
<td>196 (14.0%)</td>
<td>273 (26.3%)</td>
</tr>
<tr>
<td>Health consultation for children</td>
<td>147 (10.5%)</td>
<td>137 (13.2%)</td>
</tr>
<tr>
<td>Evacuation life</td>
<td>130 (9.3%)</td>
<td>20 (1.9%)</td>
</tr>
<tr>
<td>Family life</td>
<td>69 (4.9%)</td>
<td>112 (10.8%)</td>
</tr>
<tr>
<td>Others</td>
<td>509 (36.3%)</td>
<td>327 (31.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>1401</td>
<td>1041</td>
</tr>
</tbody>
</table>
Thyroid Ultrasonography Screening Criteria

Diameter: 0 5 10 15 20 25 30 mm

Thyroid Cyst

A1: No finding for cyst or nodules

Thyroid Nodule

A2

(http://www.fmu.ac.jp/radiationhealth/)
Ultrasonographic thyroid nodular findings in Japanese child

Nobuyuki Taniguchi · Naomi Hayashida · Hiroki Shimura · Noriyuki Okubo · Yasushi Asari · Takeshi Nigawara · Sanae Midorikawa · Kazuhiko Kotani · Shigeyuki Nakaji · Misa Imaizumi · Akira Ohtsuru · Takashi Akamizu · Masafumi Kitaoka · Shinichi Suzuki · Shunichi Yamashita · Noboru Takamura · The Investigation Committee for the Proportion of Thyroid Ultrasound Findings
General Health Consultation in Reconstruction - Chronic Phase

• Consultation for radiation fear in daily life.
• Consultation for children and mothers’ health in kindergarten/school dialogue.
• Advice for primary and secondary prevention of hypertension, diabetes, cancer, and lifestyle diseases at medical checkup/screening venues.
• Mental health care for residents and their families.
• Explanation of thyroid screening and its meaning.
Summary

• Despite unexpected huge combined disaster, initial responses of disaster medicine and radiological screening have been successful through the efforts of people and public regional institutions.

• The evacuation and shipping restriction by pollution inspection of food and water were reduced additional internal and external in the most majority. However, big problem remains as for the collapse of community and local medical system.

• It is essential to prepare in the case of nuclear catastrophe including hospital evacuation.

• In the short to medium term after disaster, prevention of diseases caused by mental stress or lifestyle change is an urgent need.

• In the long term, psychosocial care and communication for radiation health risk are important for vulnerable people.

• We greatly appreciate the supports of International Red Cross as well as that of inside or outside Japan.
On-going Challenge in Fukushima

• Due to recent advances in US technology, diagnostic image quality has dramatically improved. Although increased incidence of thyroid cysts/nodules and cancers is worldwide tendency, the average detection rate of childhood thyroid cancer in Fukushima is high around 0.03% by US screening. It is required to achieve both minimizing overdiagnosis from thyroid screening and revealing whether radiation of nuclear disaster influences long-term health effect or not.

• To overcome many difficulties in Post-Fukushima, Fukushima Health Management Survey program has started. This challenge will contribute to the promotion of health and the solution of psychosocial consequences after the disaster. We are trying to establish a radiation protection science through medical education and a radiation safety culture to understand the various risk factors through face-to-face communication.