

Third International Expert Symposium in Fukushima:
Beyond Radiation and Health Risk- Toward Resilience and Recovery

The Basic survey: Estimation of external doses to residents in Fukushima Prefecture

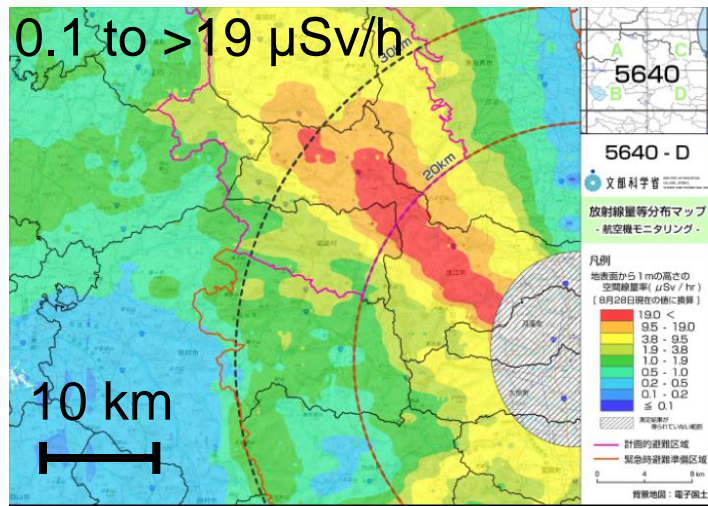
Tetsuo Ishikawa, Seiji Yasumura, Akira Ohtsuru,
Akira Sakai, Tetsuya Ohira, Kenji Kamiya, and Masafumi Abe

Radiation Medical Science Center for the
Fukushima Health Management Survey,
Fukushima Medical University



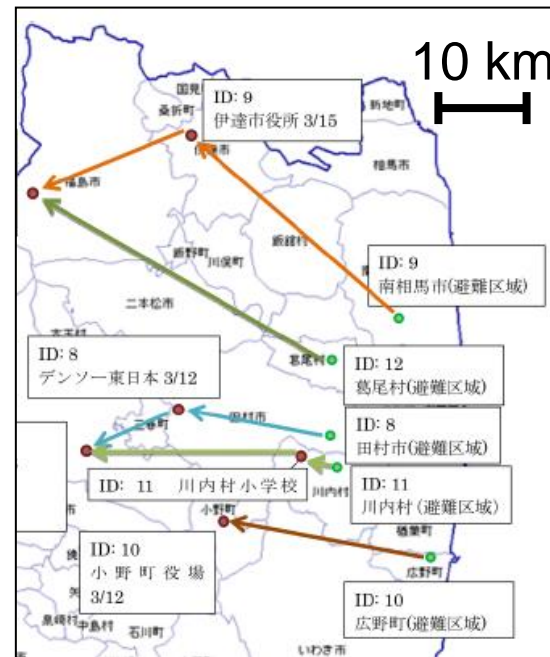
Background

- Gamma ray dose rate was considerably different from place to place
 - Evacuees moved from their original places
 - Various evacuation patterns
- “Record of movement” for each resident was necessary to estimate realistic external dose



Example of gamma ray dose rate map after the accident (MEXT website)

MEXT: Ministry of Education, Culture, Sports, Science and Technology



Eastern part of Fukushima Pref.



Five examples of evacuation patterns

Background

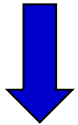
Many dose estimation studies have been done after the accident

In some cases, dose estimation was based on conservative assumptions to avoid underestimation

Assumptions used for external dose estimation:

- (1) People stayed outdoor all day long
- (2) People spent 16 h indoors and 8 h outdoors (MEXT)
- (3) Occupancy factor for indoor worker: outdoor: 0.9 and indoor 0.1 (UNSCEAR 2013 report)

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More realistic dose based on actual situations

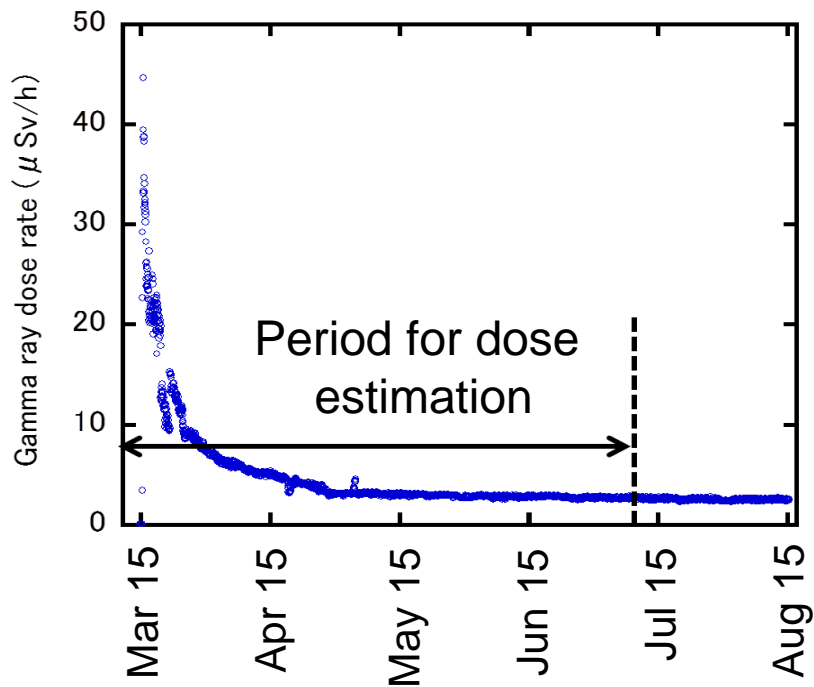


Basic Survey

Outline of Basic Survey

Fukushima Health Management Survey

- Basic Survey  Questionnaire targeting roughly 2,050,000 people who were living, or were present, in Fukushima Prefecture as of March 11, 2011.
- Four detailed Surveys



Items:

Whereabouts for each day in the period (locations and Indoor, outdoor, or moving)

Period: March 11, 2011 – July 11, 2011

Changes in gamma ray dose rate in Iitate Village:
After four months, gamma ray dose rate seems to be plateau

Questionnaire of Basic Survey

Sample of response sheet

※Please write for each day from March 11 to March 25

	Whereabouts	Time								Place / Facility			
		0	3	6	9	12	15	18	21		24		
March 11 (Fri)	Indoors	←		①	←		②	←	①	←	③	←	
	Moving												① Home
	Outdoors												② Place of employment ③ Evacuation center (District community center) (C)

※From March 26 onwards, please fill out the basic details of your area of residence (places where you spent time).

Children under 20y: signatures by their parents are necessary.
Simpler response sheets were also prepared mainly for non-evacuees.



Dose calculation (check of response sheets)

Checking response sheets returned from the residents



The response sheet is sufficient for dose calculation?

No



Contact each respondent by telephone or mail (**more than 70,000 respondents**)



Yes

Records of the movement of respondents are digitized



Sending the records to NIRS

NIRS: National Institute of Radiological Sciences,
Chiba, Japan



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NIRS dose calculation program

Monitoring data obtained
by MEXT



- Subtracting dose due to natural radiation
- Conversion to effective dose



Construction of daily
dose rate maps



Calculation of effective dose for adult



Body size (age) correction



Effective dose for each respondent

Records of the movement
(digitized questionnaire)

- Moving, outdoor, indoor
- Hours spent in the region
- Hours of moving
- Location of the region
- Dose reduction factor for each type of dwellings



Akahane et al: *Scientific Report*
3: 1670 (2013)



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How to report the results

Individual estimates of external dose

→ The individual doses have been statistically processed at FMU



The results have been discussed at Fukushima Prefectural Oversight Committee Meeting (once in about three months)
<http://www.fmu.ac.jp/radiationhealth/>

→ The individual dose has been reported to each respondent by FMU

Results (response rate)

The overall effective response rate to the Basic Survey was 26.4 % (541,653 / 2,055,533) as of 30 June, 2014.

However, the response rates for eight municipals (cities or villages with relatively high gamma dose rate) exceeded 50 %.

Doses have been estimated for 508,388 / 541,653 respondents (93.9 %) and the results have been returned to 491,093 respondents as of 30 June 2014.

In some cases, individual doses have been estimated for shorter periods than four months according to the obtained records of movement.



Results (whole prefecture)

External dose for the first four months

Effective dose (mSv)	Number of respondents (excluding radiation workers)	Ratio
< 1	261,140	62.0 %
1 - 2	134,848	32.0 %
2 - 3	22,600	5.4 %
3 - 4	1,382	0.3 %
4 - 5	494	0.1 %
> 5	930	0.2 %
Total	421,394	100 %

Maximum: 25 mSv

Average: 0.8 mSv (As of June 30, 2014)



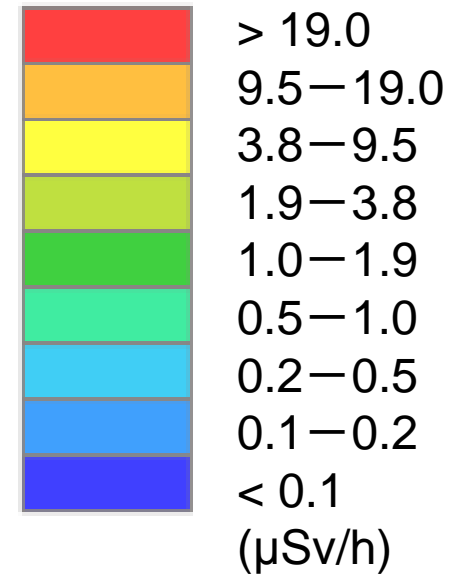
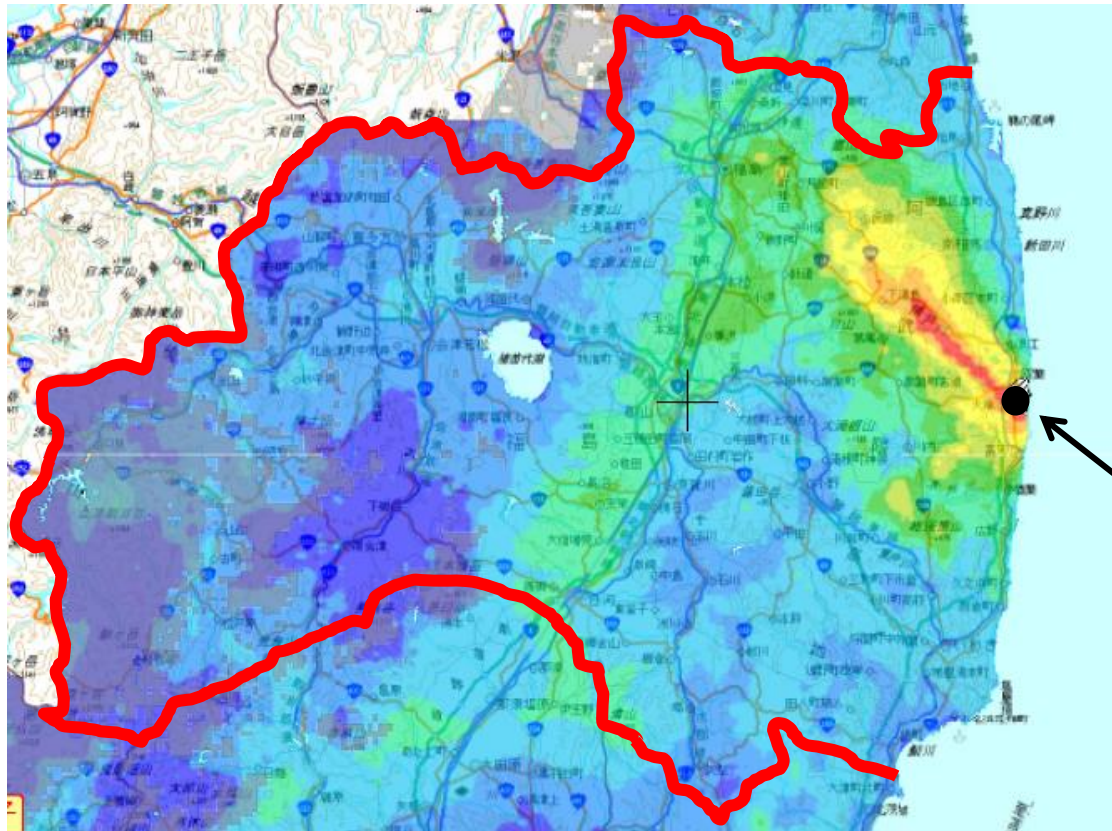
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Gamma ray dose rate level

Fifth airborne monitoring survey, as of June 28, 2012

Extension Site of Distribution Map of Radiation Dose, etc./Digital Japan

<http://ramap.jmc.or.jp/map/eng/>



Fukushima Dai-ichi
NPP

Results (dose distribution by regions)

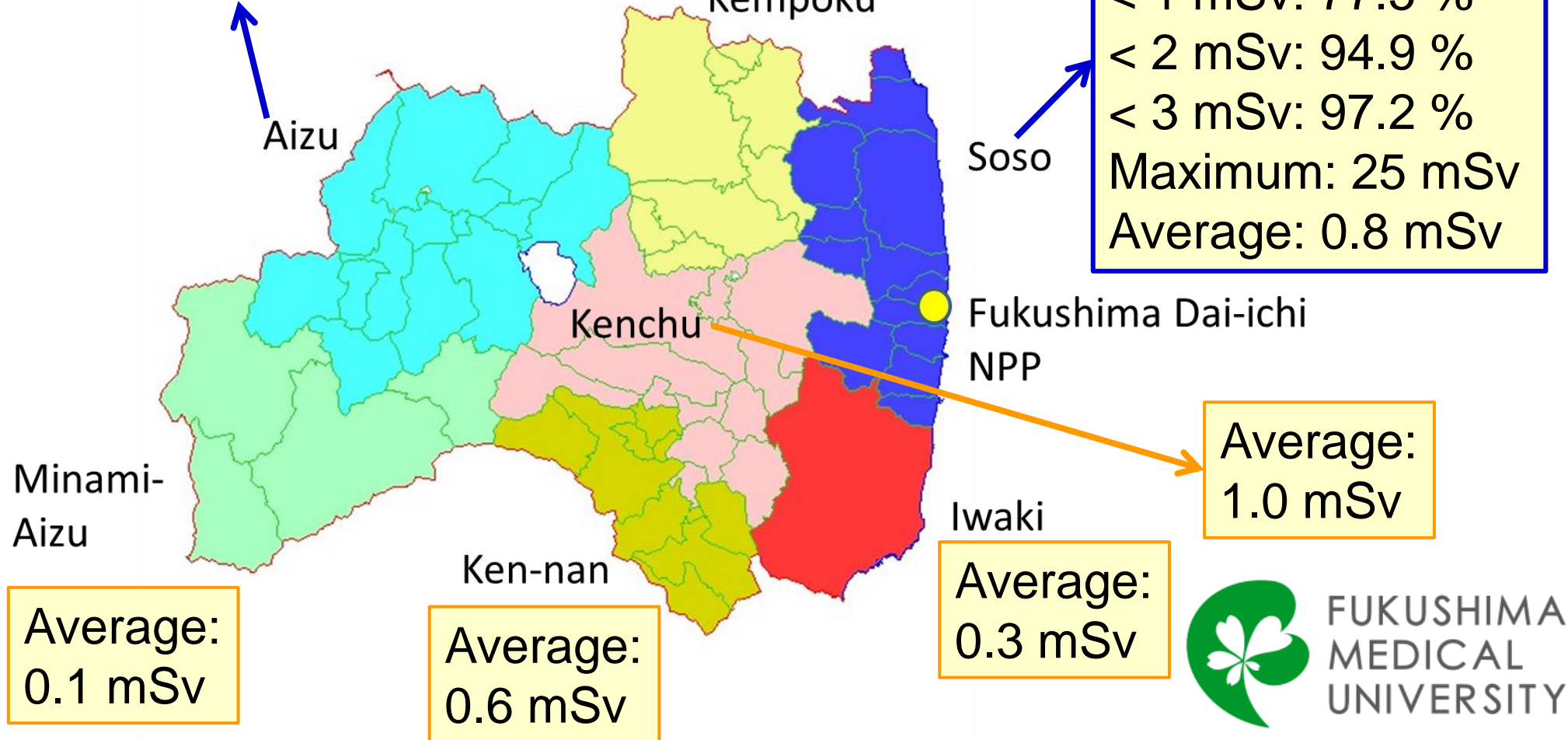
External dose for the first four months

< 1 mSv: 99.3 %
Maximum: 3.6 mSv
Average: 0.2 mSv

Average:
1.4 mSv

Kempoku

Most of residents evacuated
< 1 mSv: 77.5 %
< 2 mSv: 94.9 %
< 3 mSv: 97.2 %
Maximum: 25 mSv
Average: 0.8 mSv



Average:
0.1 mSv

Average:
0.6 mSv

Average:
0.3 mSv

Average:
1.0 mSv



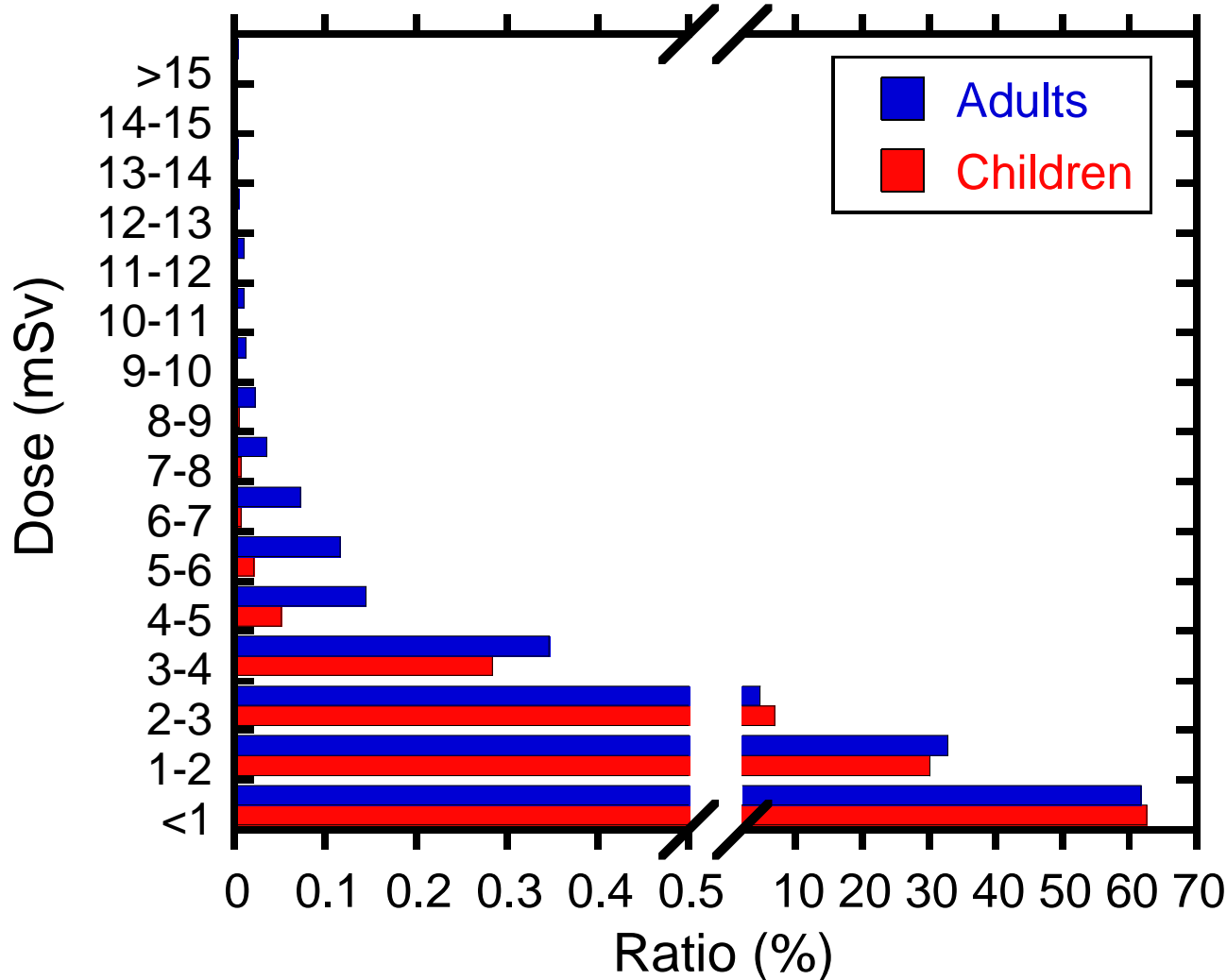
Results (dose distribution: adults vs. children)

External dose for the first four months

Dose distribution (adults versus children)

Children: $n = 124,314$

Adults: $n = 297,080$



Dose distribution was almost similar between adults ($\geq 20y$) and children ($< 20y$).

The ratio of doses of > 3 mSv was higher for adults.

Dose estimation in other frameworks than the Fukushima Health Management Survey

Fukushima Prefecture

Ministry of the Environment

- Organizations commissioned from Fukushima Pref.
- Local governments (cities, villages)

Fukushima Medical University

Collaboration

National Institute of Radiological Sciences

Fukushima Health Management Survey

Reconstruction of thyroid dose (area-by-area basis) (commissioned work from Ministry of the Environment)

Basic Survey

(external dose until July 11, 2011)

Whole-body counting

(internal dose due to cesium)

Personal dosimeter

(external dose)

Database at FMU



Summary

- Individual external doses after the accident have been estimated for more than 500,000 respondents by the Basic Survey.
- The individual dose has been reported to each respondent by FMU. In this respect, the Basic survey has an aspect of “health care service” as well as survey.
- Distribution of effective doses for the first four months (excluding radiation workers):
< 1 mSv, 62.0 %; <2 mSv, 94.0 %; <3 mSv, 99.4 %
Maximum: 25 mSv, Average: 0.8 mSv
- Dose distribution was almost similar between adults (≥ 20 y) and children (< 20y).