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Implementing ALARA in existing exposure situations - Post-accidental situation -

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Controllability of sources, pathways and exposures

	Sources	Pathways	Exposures
Planned exposure situations	Yes	Yes	Yes
Emergency exposure situations	No	Partially	Partially
Existing exposure situations (Post-accident)	No Partially	Partially	Yes

Optimisation of protection strategies

Implementation of the principle of optimisation of protection is a source-related process, which should ensure the selection of the best protection strategy under the prevailing circumsta nces, i.e. maximising the margin of good over harm.

ICRP Pub.111 §32

Maximising the margin of benefit from living a normal life over radiation risk in a post-accidental situation

Optimisation faces many specific challenges

The fact that population will stay in a contaminated area is, per se, a compromise for them .. (§35, Pub.111)

Recovery strategy in a contaminated area needs:

- Characterising exposure situations
  - ➡ Measurement and assessment
- How to improve the exposure situations, **How low ?**
  - ➡ Decontamination (Not a magic way)
- How to improve the community
  - ➡ Medical, school, supermarket, etc.
- How to mitigate the concern about radiation, **How to face?**
  - ➡ Education, communication, rumor risk

Social and ethical considerations will be taken into account

Social and ethical aspects

Non-radiation effects

- Evacuation was associated with 1.82 times higher mortality (Nomura,et al. Prev.Med. 2016)
- School restrictions on outdoor activities would increase obesity incidence in male children. (Nomura,et al. BMJ Open. 2016)
- The follow-up study for Kawauchi Village revealed an increase in lifestyle-related disease (Ebner,et al. BMJ Open. 2016)

Psychological effects

- The close association between psychological distress and the radiation levels shows that the nuclear accident seriously influenced the mental health of the residents (Kuni,et al. PLOS One 2016)
- The cross-sectional study suggests that there are severe mental health problems, such as depression and PTSD. (Yoshida, Peer J,2016)
- The risk perception about the health effects of radiation among residents could ha ve a major impact on social well-being... (Orita,et al. PLOS One 2015)
- Frequent relocation and dissatisfaction with the residence were associated with ps ychological distress among evacuees following the Fukushima nuclear disaster (Horikoshi, BMC Psychiatry 201 6)

How to face social and ethical aspects

No tools and numerical values for comparison

- Social and ethical factors depend on judgments of residents and authorities.
- Radiation risk based on measurement will be numerical

However, an implicit comparison will be conducted

- How to share the judgment and radiation risk
- Who compare multiple factors including radiation risk

Reasonableness is a fundamental questioning that depends on the prevailing circumstances

- Barriers against decision may be an ethical consideration and scientific understanding of radiation risk
- Difficult to independently treat science and ethics in case of a nuclear accident

Key issues on reasonableness

The Fukushima experience provided two major issues on radiological protection.

1: The system of radiological protection has not been easily understood by not only lay people but some radiation experts.

- Multiple reference levels and dose limits have confused the people.
- Why we can use different levels from planned exposure situations ?
- What is a reference level ?
- It is a key that risk-based approach should be disseminated
- Radiation cancer risk can be compared with cancer risk in a normal life

2: Understanding of low-dose risk varies widely depending on scientific experts who do not understand the system of radiolog ical protection

Implementing ALARA in existing exposure situations

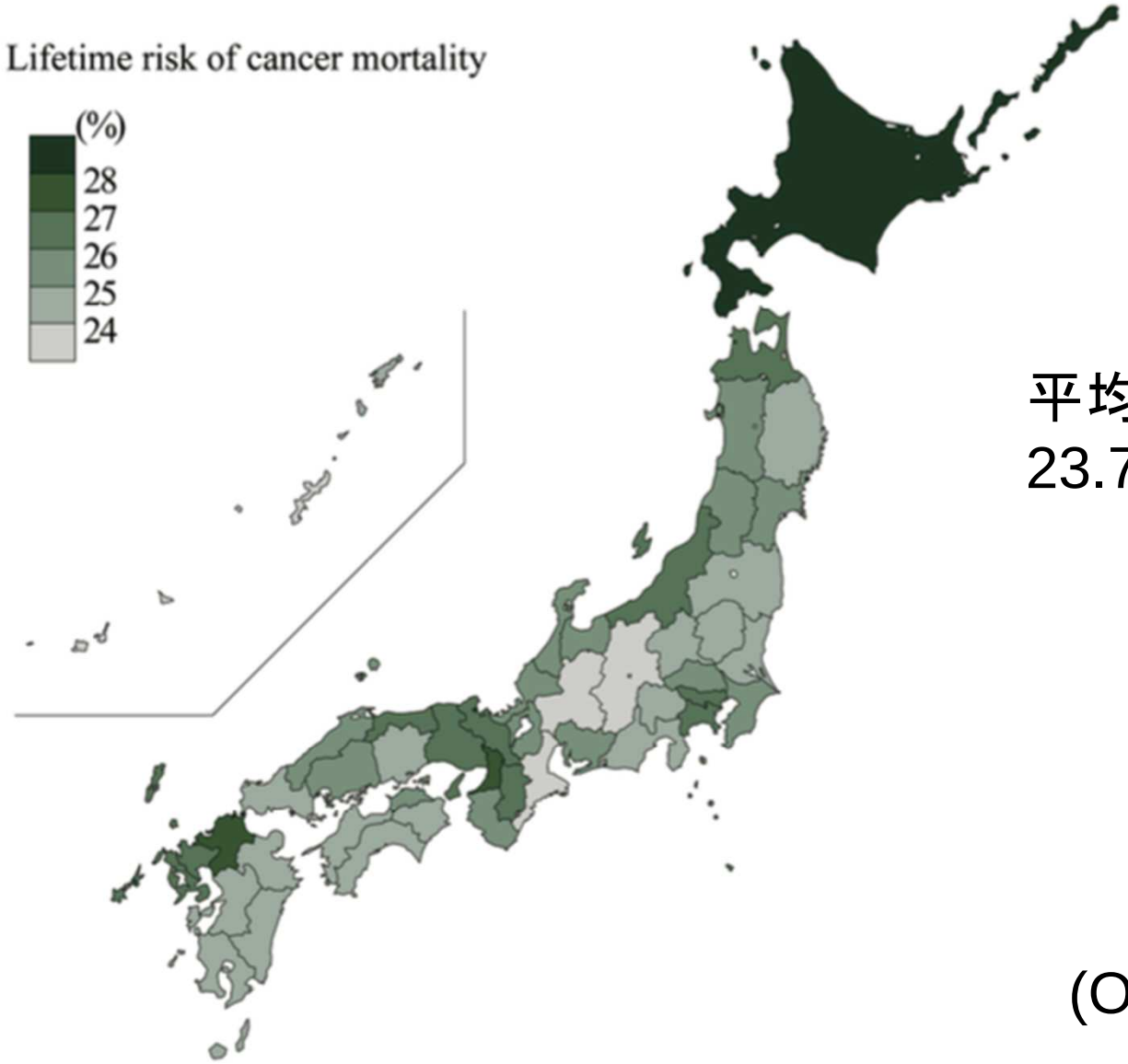
Scientific issues:

- Dose are a fundamental tool in RP decision.
- However, risk information rather than doses will be needed to understand the dose in communication with the public
- The same risk measures with general public health should be used.
- Further research will focus on how to understand the risk with public health professionals.

Ethical (Trust) issues:

- To improve the trust in the system of radiological protection, we should share and tell the philosophy behind radiological protection.
- ALARA will be able to be implemented on not only scientific but also ethical bases.
- ALARA needs transparency and direct involvement of stakeholders due to a judgment nature.

Calculation of Background Lifetime Risk of Cancer Mortality in Japan



平均25.4%
23.7% - 28.3%

(Ogino, 2014)

Fig. 1 Background lifetime risk of cancer mortality for each prefecture in Japan as of 2010.

Conclusions

- A key in implementing ALARA is understanding of the RP system and radiation risk by residents and authorities
- The RP system covers scientific and ethical aspects
- Difficult to independently treat science and ethics in case of a nuclear accident
- Risk measures rather than doses will be needed to understand how high radiation exposure

- ALARA will be able to be implemented on not only scientific but also ethical bases.
- ALARA needs transparency and direct involvement of stakeholders due to a judgment nature.