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**Public health aspects of
preparedness and response
for a nuclear or radiological
emergency**

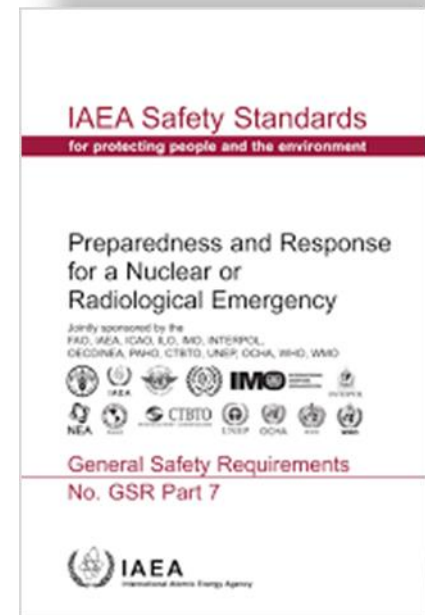
**Dr Zhanat CARR
Joint IAEA-WHO Webinar**

24 Feb 2017

GSR Part 7 requirements

“4.29. Each protective action, in the context of the protection strategy, ...shall be demonstrated to be justified (i.e. to do more good than harm), with an account taken not only of radiation exposure detriments but also of those associated with impacts of the actions taken on public health, the economy, society and the environment.”

When planning and implementing the protective actions, decision makers should always keep in mind the impact of these actions and interventions on human health.



GSR Part 7 requirements addressing health risks

4.31. The government shall ensure that the protection strategy is implemented safely and effectively in an emergency response through the implementation of emergency arrangements, including but not limited to:

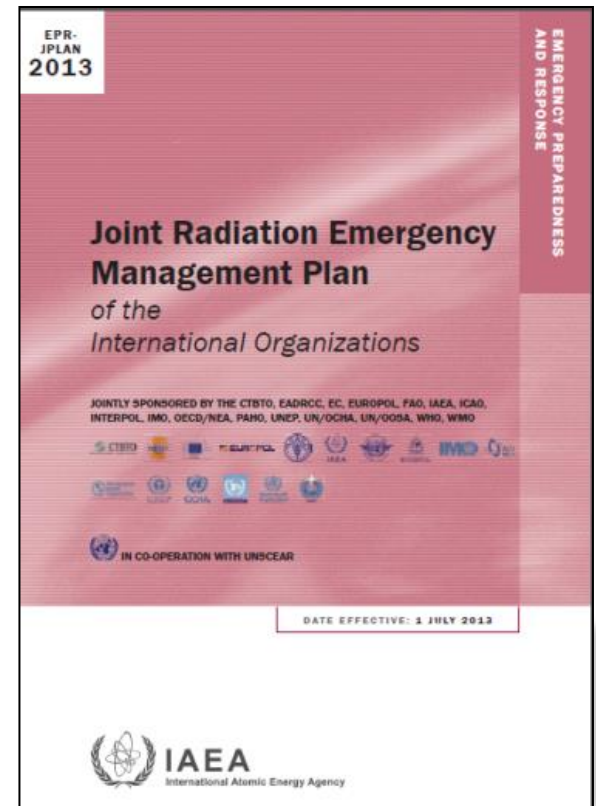
- (a) Promptly taking urgent protective actions and other response actions ... to avoid or to **minimize severe deterministic effects** (Appendix II), on the basis of observed conditions and before any exposure occurs;
- (b) Taking early protective actions and other response actions to **reduce the risk of stochastic effects** (Appendix I);
- (c) Providing for registration, health screening and **longer term medical follow-up**, as appropriate (Appendix I);
- (d) Taking actions to protect emergency workers (Appendix I)



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WHO functions in radiation emergency response

- **Public health risk assessment and response**
- Emergency medical response (diagnosis and treatment)
- Biological and clinical dosimetry
- **Long term follow-up of exposed populations**
- Control of food, drinking water safety
- Advise on trade and travel
- **Mitigation of mental health impact**
- Risk communication



Fukushima: public health impact of protective actions (1)

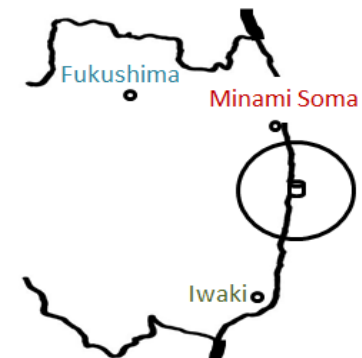
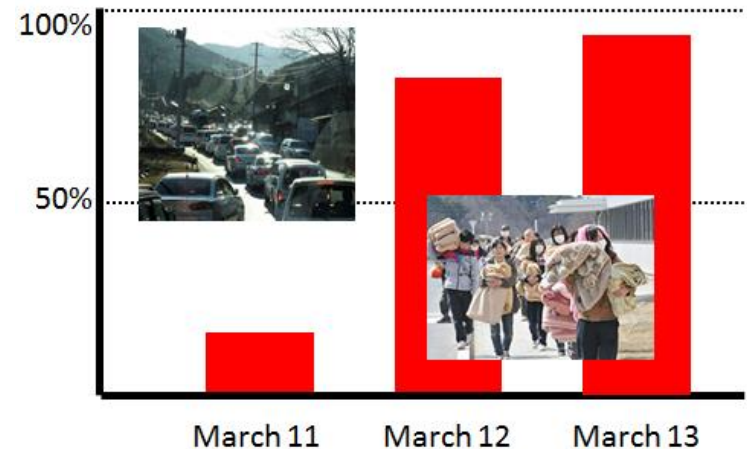
● Evacuation:

- Residents of the 20 km radius zone
- 1240 patients from eight hospitals
- 983 patients from 17 nursing facilities

● More than 60 deaths during the evacuation process due to:

- Lack of medical care for underlying medical conditions
- Hypothermia
- Dehydration

Evacuation of residents from 20km zone



Tanigawa K, et al. Loss of life after evacuation: lessons learned from the Fukushima accident. Lancet 2012;379(10):889-891.

Government of Japan. Final report of the Investigation Committee on the Accident at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company. Tokyo, 2012



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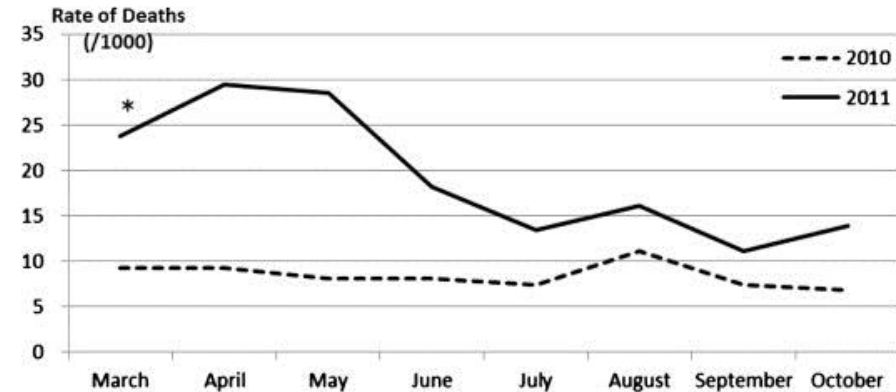
Evacuation, sheltering and relocation after Fukushima accident

- As an immediate response, about 78,000 people were evacuated from a 20-km radius of the power plant and about 62,000 other people living between 20 and 30 km from the plant were ordered to shelter in their own homes). Later, in April 2011, the Government recommended the evacuation of about 10,000 more people living farther from the plant (“deliberate evacuation area), because of the radioactive contamination on the ground. (UNSCEAR, 2013)
- As of March 2014, 136,000 relocated people were still living in temporary housing, among whom higher incidence of stress, anxiety, depression were reported, as well as more than 1,600 death related to post-disaster illnesses with the majority of these within the first year after the accident.
- Mental health impact for people who lost households, jobs and families is immense. National studies report the PTSD indicators in the affected people as high as those reported for rescue workers after 09/11

Yabe H, Suzuki Y, Mashiko H, et al. Psychological distress after the Great East Japan Earthquake and Fukushima Daiichi Nuclear Power Plant accident: results of a mental health and lifestyle survey through the Fukushima Health Management Survey in FY2011 and FY2012. Fukushima J Med Sci 2014;60:57–67.

Fukushima: public health impact of protective actions (2)

- Planning and executing urgent protective actions, as well as longer-term recovery operations, protection of most vulnerable populations should be considered a priority when possible (i.e. for children, pregnant and breast-feeding women, handicapped and elderly, chronically ill, and institutionalized patients),
- Evacuation and sheltering plans should make special provisions for the needs of critically ill and elderly patients for whom emergency interventions can do more harm than good;
- Carefully tailored, efficient risk communication campaigns targeting specific groups of population could alleviate the psychological and mental health of radiation emergencies



*Thirty-two deaths due to the tsunami were excluded in this data.

Yasumura S, et al. Excess mortality among relocated institutionalized elderly after the Fukushima nuclear disaster. Public Health, 2013, 127:2:186 – 188.



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Mental health and psychological support in emergencies

- The WHO Department of Mental Health emphasizes that the number of persons exposed to extreme stressors is large and that exposure to extreme stressors is a risk factor for mental health and social problems. The WHO's work on mental health in emergencies focuses mostly on resource-poor countries, where most populations exposed to natural disasters, disease outbreaks, and military conflict. E.g.
 - Ebola outbreak response
 - Syrian refugees crisis

- Dedicated website:

http://www.who.int/mental_health/emergencies/en/

The screenshot shows the WHO website page for 'Mental Health and Psychosocial Support in Emergencies'. The page features the WHO logo at the top, a navigation menu with 'Programmes' highlighted, and a search icon. The main content area is titled 'Mental Health and Psychosocial Support in Emergencies' and includes a sub-section 'General information related to most emergencies'. This section contains a photo of a young girl, Zara Molloo/IRIN, and text explaining that the WHO Department of Mental Health and Substance Abuse emphasizes that exposure to extreme stressors is a risk factor for mental health and social problems. The page also lists 'Latest news' (mhGAP Newsletter - November 2016), 'Latest publications' (Group Interpersonal Therapy (IPT) for Depression and Problem Management Plus (PM+)), and 'News' (Learning to heal minds in the eastern Mediterranean, Natural disasters and political conflict across the Eastern Mediterranean Region, Supporting people with severe mental disorders in war and other disaster settings, mhGAP Programme expands to include scalable psychological interventions, and Mental health services in Liberia: building back better).



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Social dimensions of emergencies

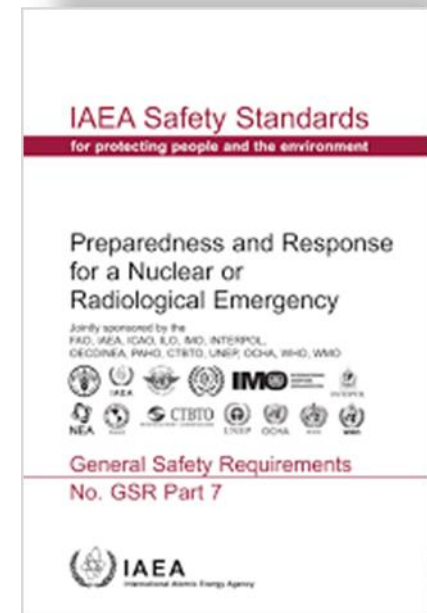
- **United Nations system-wide study on the implications of the accident at the Fukushima Daiichi NPP** addressed the need to integrate the experience from humanitarian disasters with lessons learnt from nuclear accidents (Chernobyl and Fukushima) and to bridge the gap between the humanitarian and nuclear emergencies sectors
- The common denominators for both settings include social determinants of health, psycho-social impact, ethical and cultural aspects of managing the response and recover, risk communication strategies, etc.
- National preparedness plans should be taking into consideration the social aspects and management of the social consequences of emergencies.
- Key stakeholders involved in EPR from both sides have to coordinate and cooperate at the preparedness stage
 - health care providers, radiation protection experts, sociologists, psychologists, anthropologists, NGOs, affected communities, etc.



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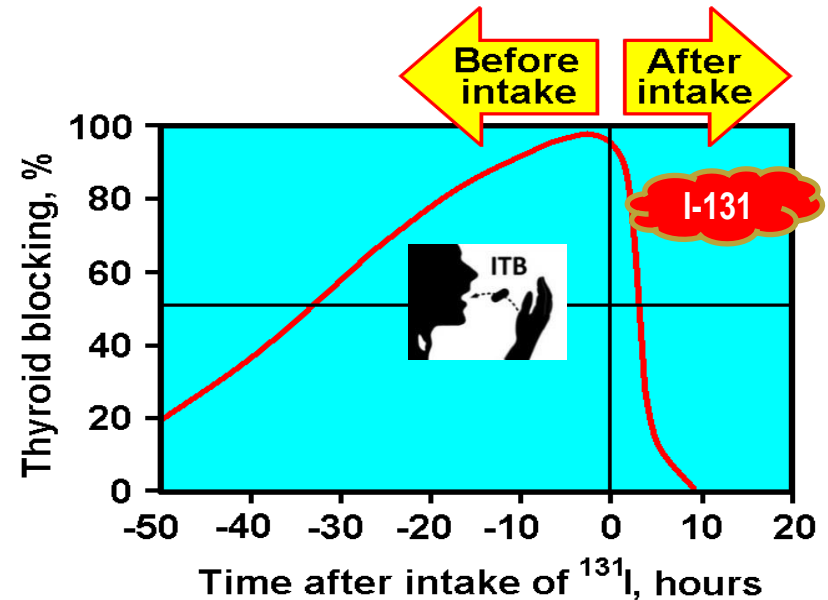
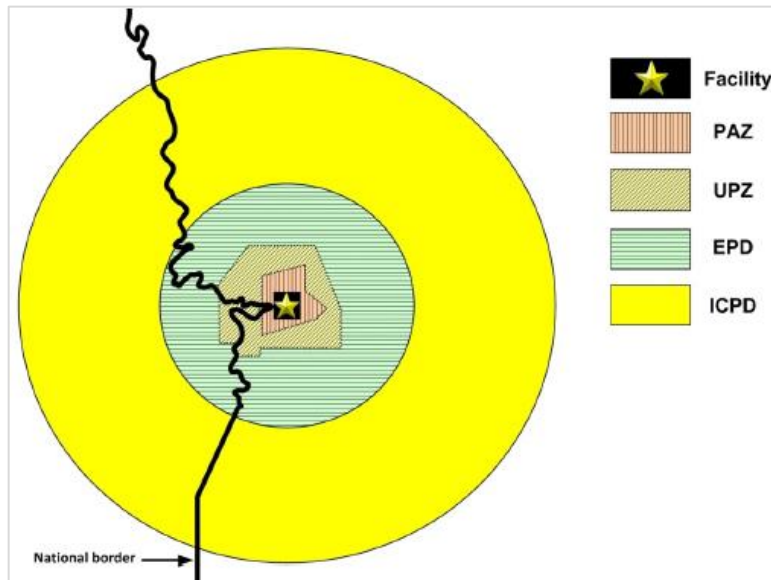
GSR Part 7 on Iodine Thyroid Blocking (ITB)

- For reducing risk of thyroid cancer a generic ITB criterion applies as follows: projected dose $H_{\text{thyroid}} > 50$ mSv [*due to radioactive iodines only*] in the first 7 days (Table II2, Annex II).
 - ITB is prescribed (a) if exposure to radioactive iodine is possible, (b) before or shortly after a release of radioactive iodine, and (c) within only a short period before, or after the intake of radioactive iodine (Annex II, Table II-2, footnote C)
- 5.52. The operating organization and response organizations shall ensure that arrangements are in place for the **protection of emergency workers and protection of helpers** in an emergency for the range of anticipated hazardous conditions... These arrangements, shall include:
 - (e) **Provision of iodine thyroid blocking**, as appropriate, if exposure due to radioactive iodine is possible;



Iodine Thyroid Blocking (ITB)

- ✓ An urgent protective action to reduce risk of thyroid cancer
- ✓ Should be administered within hours to be effective, based on the plant conditions, before or shortly after the release (precautionary)
- ✓ Implemented as early action, based on monitoring and assessment
- ✓ ITB effectiveness is significantly reduced by delay of administration



Public Health Considerations for ITB Implementation (WHO 2017)

- ITB should be implemented as a component of comprehensive public health approach in combination with other protection actions (evacuation and sheltering, restriction of contaminated food and drinking water consumption). KITB should not be considered as a single alternative.
- Provisions for ITB implementation need to be carefully considered at the planning stage (planning zone size, stockpile acquisition and maintenance, pre-distribution and logistics in case of emergency)
- Higher priority population groups should be identified (i.e. children and adolescents, pregnant and breast-feeding women, people living in iodine deficiency areas) as well as those at higher risk of side-effects.
- Optimal timing of administering stable iodine:
 - administration can start 24 hours before and up to 2 hours after the expected exposure (if impossible, KI can be administered up to 8 hours after the exposure);
 - taking KI later than 24 hours following the exposure may carry more harms than benefit (by prolonging the biological half-life of radioactive iodine in the thyroid);
 - single KI administration should be sufficient. In the case of prolonged or repeated exposure to radioactive iodine, and/or unavoidable ingestion of contaminated food and water, and when evacuation is not feasible, consider repeated administration of KI (however, neonates should not receive repeated KI)

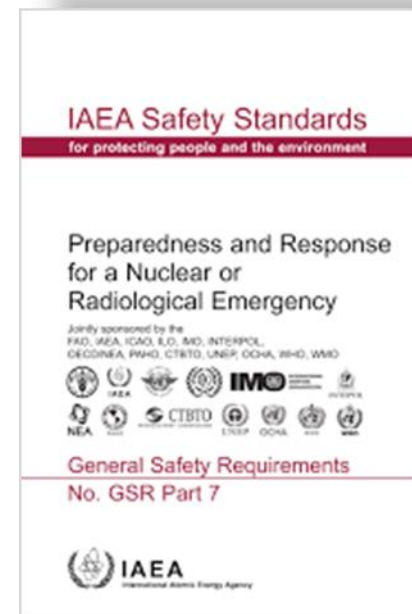


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GSR Part 7 on long-term follow-up

Req. 5.68. Arrangements shall be made for the identification of individuals who are in those population groups that are at risk of sustaining increases in the incidence of cancers as a result of radiation exposure in a nuclear or radiological emergency.

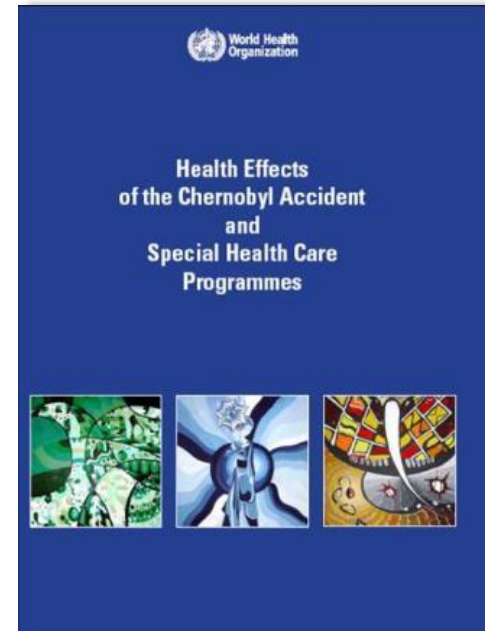
Arrangements shall be made to take longer-term medical actions to detect radiation-induced health effects among such population groups in time to allow for their effective treatment. These arrangements shall include the use of pre-established operational criteria in accordance with the protection strategy (see para. 4.28(4)).



Long-term health monitoring programmes

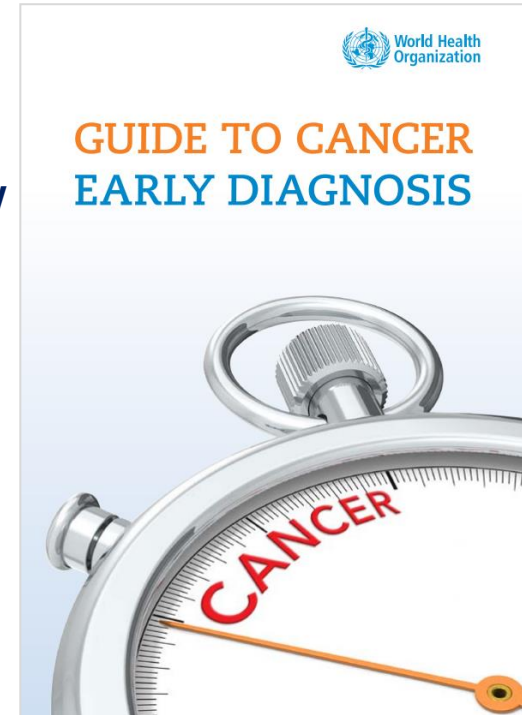
According to the **1986 WHO report**, there are three general categories of long term follow-up

- Clinical follow-up of persons exposed to high doses causing deterministic effects
- Health monitoring for persons exposed to effective doses above 100 mSv (consistent with Annex II of the GSR Part 7) for potential stochastic effects
- **Screening of the asymptomatic populations** exposed to low doses (epidemiological studies or reassurance purposes)



Screening of asymptomatic populations

- For most radiation-exposed populations screening is primarily directed towards early detection of certain types of cancer (e.g. thyroid cancer in children exposed to radioactive iodine)
- The choice of early detection tests depends on the type and pathway of exposure, radionuclide involved, etc.
- A priority for screening is usually given to vulnerable population subgroups at higher risk of developing a specific radiation-related health hazard (e.g. infants, children, pregnant and breast-feeding women).
- General cancer screening programmes guidelines are available: http://www.who.int/cancer/publications/cancer_early_diagnosis/en/



Screening programs: purpose

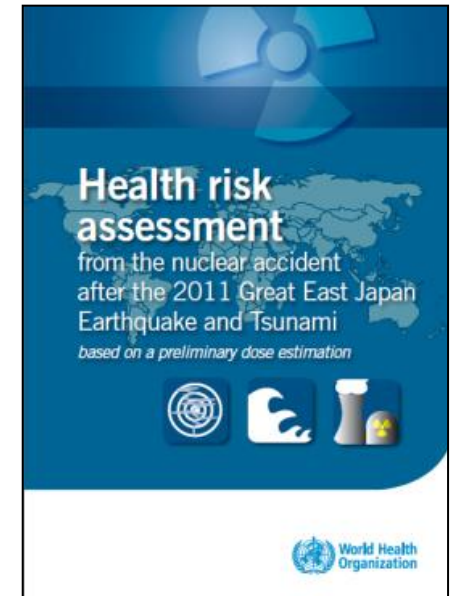
- The goal is to detect disease as early as possible, with the assumption that earlier diagnosis will result in reduced morbidity and mortality.
- Health monitoring and surveillance can also provide reassurance in response to the population's concerns about health risks
- **The challenge lays in identification of populations at risk and whether screening will produce more benefits than potential harm (unjustified invasive interventions, psychological stress, ethical considerations stigmatization, social impact).**
- Epidemiological studies primarily serve the benefit of advance in science but not always for the benefit of affected individuals



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Screening Programme: Must-haves

- Screening must be beneficial to the population
- Most vulnerable population or population subgroups should be identified with the highest risk of a specific outcome
- An accurate practical screening tool should be available
- Early detection of the disease must lead to improved survival
- Effective treatment of the disease should be available
- The benefits of the screening must be greater than any potential harm (individual and public health dimensions)



(WHO, 2013)

Thyroid screening in Fukushima

- A thyroid ultrasound screening program for 360,000 children most of whom were exposed to a very low doses of I-131 immediately after the accident, is currently being conducted in Fukushima prefecture as a part of the Health Management Survey (166 thyroid cancer cases diagnosed by end-2015)
- This screening for thyroid disease is likely to lead to an increased incidence of thyroid diseases due to earlier detection of non-symptomatic cases (e.g. data from the Adult Health Study of the A-bomb survivors, Chernobyl, and healthy people screening data)
- Psycho-social, ethical, legal implications of such programs can be quite significant
 - Clinical dilemma among specialists on managing papillary microcarcinomas (*M. Merdad et al. Journal of Otolaryngology - Head & Neck Surgery*201443:32)
 - High anxiety levels reported in children and parents (*Hino, Murakmi et al. Tohoku J. Exp. Med.*, 2016, 239)
 - Association "311 Thyroid Cancer Family" filed lawsuits against TEPCO and Fukushima prefecture government (*Asahi Shimbun* 2016-03-24)



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Psycho-social implications of long-term follow-up programs

- Psychosocial impact was found to be the largest after Chernobyl accident (WHO, 2006)
- In addition to socio-economic impact of the accident itself exacerbated by disintegration of Soviet Union, and lack of timely, reliable and clear information, the fact of people undergoing a long-term medical monitoring, have contributed to the over-all rates of anxiety, stress, and other mental health outcomes in the affected population.
- Although, medical follow-up provided some reassurance (and was also linked to small social benefits), being labelled a "*Chernobyl victim*" further reinforced the stigmatization and affected people's lives.
- Fukushima population is reported to be reluctant to respond to the requests of interviews and invitations to medical check-up. The population exhibits a high level of anxiety and chronic stress and a certain social stigma is attached to residents of affected areas.



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In Summary

- **Public health aspects of planning and implementing all urgent and longer-term protective actions must be always taken into account to ensure that emergency response interventions do more good than harm**
- **The justification of protective actions such as mass evacuation in the aftermath of a major accident, should involve a comprehensive risk benefit analysis of all available options to protect the population against radiation-related and non/radiological risks**
- **RN emergencies require inter-sectoral response, where coordination with health authorities is critical for consistent and harmonized implementation of GSR Part 7**
- **Lessons and experience with managing public health and social consequences of natural disasters and other emergencies can be applied to RN EPR**
- **Existing EPR system based on radiological protection principles and values needs to be further enriched by taking into account non-radiological consequences (ethical, psycho-social, cultural values, social determinants of health, community resilience and engagement)**



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Radiation emergencies



The scale and types of radiological and nuclear emergencies may range from an isolated occupational or medical over-exposure of a person, to a major catastrophe with global dimensions. Regardless the scale or a cause of an accident, there is a common denominator: human health. The International Health Regulations (2005) include in its' scope radio-nuclear hazards and countries should meet the core national capacities requirements for response to radiation emergencies. Public health sector must be prepared to respond and to provide medical care to the injured. WHO and its global network REMPAN assist countries to strengthen preparedness and response to radiation emergencies.

WHO's role in the global response to radiation emergencies

Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE)

For strengthening coordination in response to radiation emergencies the international organizations with relevant responsibilities have formed IACRNE, where International Atomic Energy Agency (IAEA) is the prime coordinating agency. Functional links have been established between agencies to ensure continuous communication prior to, during, and after emergencies and the arrangements are described in the Joint Radiation Emergency Management Plan of the International Organizations (EPR-JPLAN 2013).

[More on IACRNE](#)

[Incident and emergency centre](#)

[Joint radiation emergency management plan of the international organizations](#)

Related links

- [WHO work in emergencies](#)
- [International Health Regulations \(2005\)](#)
- [IHR Monitoring and Evaluation: Joint Expert Evaluation tool](#)
- [Fukushima Five Years on](#)

Contact us

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Events and activities

- [IAEA-WHO Joint Webinar on Medical Preparedness and Response for Nuclear or Radiological Emergencies](#)
- [Guidelines on Public Health Response to Radiological and Nuclear Emergencies](#)
- [Iberoamerican Conference on Radiation Protection in Medicine \(in spanish\)](#)
- [The 14th International Congress of the International Association of Radiation Protection](#)
8-12 May 2016/Cape Town, South Africa
[Bonn Call for Action](#)