Ionizing radiation

What is ionizing radiation?

- When certain atoms disintegrate, either naturally or in man made situations, they release a type of energy called Ionizing radiation (IR). This energy can travel as either electromagnetic waves (gamma or X-rays) or as particles (neutrons, beta or alpha).
- The atoms that emit radiation are called radionuclides.
- The time required for the energy released by a radionuclide to decrease by half (i.e., the "half-life") range from tiny fractions of a second to millions of years depending on the type of atoms.

Human exposure to ionizing radiation

Are people normally exposed to ionizing radiation?

- Human beings are exposed to natural radiation on a daily basis. The radiation comes from space (cosmic rays) as well as natural radioactive materials found in the soil, water and air. Radon gas is a naturally formed gas that is the main natural source of radiation.
- People can also be exposed to radiation from human-made sources. Today, the most common man made source of ionizing radiation are certain medical devices such as X-ray machines.
- The radiation dose can be expressed in units of Sievert (Sv). On average, a person is exposed to approximately 3.0 mSv/year of which, 80% (2.4 mSv) is due to naturally occurring sources (i.e., background radiation), 19.6% (almost 0.6 mSv) is due to the medical use of radiation and the remaining 0.4% (around 0.01 mSv) is due to other sources of human-made radiation.
- In some parts of the world, levels of exposure to natural radiation differ due to differences in the local geology. People in some areas can be exposed to more than 200 times the global average.

How are people exposed to ionizing radiation?

- Ionizing radiation may result from sources outside or inside of the body (i.e. external irradiation or internal contamination).
- Internal contamination may result from breathing in or swallowing radioactive material or through contamination of wounds.
- External contamination is produced when a person is exposed to external sources such as X-rays or when radioactive material (e.g. dust, liquid, aerosols) becomes attached to skin or clothes. This type of contamination can often be washed off the body.
What type of radiation exposure could occur in a nuclear power plant accident?

- If a nuclear power plant does not function properly, radioactivity may be released into the surrounding area by a mixture of products generated inside the reactor ("nuclear fission products"). The main radionuclides representing health risk are radioactive caesium and radioactive iodine. Members of the public may be exposed directly to such radionuclides in the suspended air or if food and drink are contaminated by such materials.
- Rescuers, first responders and nuclear power plant (NPP) workers may be exposed to higher radiation doses due to their professional activities and direct exposure to radioactive materials inside the power plant.

Health effects

What are the acute health effects of radiation exposure?

- If the dose of radiation exceeds a certain threshold level, then it can produce acute effects, such as skin redness, hair loss, radiation burns, and acute radiation syndrome (ARS\(^1\)).
- In a nuclear power plant accident, the general population is not likely to be exposed to doses high enough to cause such effects.
- Rescuers, first responders and nuclear power plant workers are more likely to be exposed to doses of radiation high enough to cause acute effects.

What long-term effects can be expected from radiation exposure?

- Exposure to radiation can increase the risk of cancer. Among the Japanese atomic bomb survivors, the risk of leukaemia increased a few years after radiation exposure, whereas the risks of other cancers increased more than 10 years after the exposure.
- Radioactive iodine can be released during nuclear emergencies. If breathed in or swallowed, it will concentrate in the thyroid gland and increase the risk of thyroid cancer. Among persons exposed to radioactive iodine, the risk of thyroid cancer can be lowered by taking potassium iodide pills, which helps prevent the uptake of the radioactive iodine.
- The risk of thyroid cancer following radiation exposure is higher in children and young adults.

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\(^1\) ARS is a set of signs and symptoms that may develop after whole-body doses above 1 Sv (i.e. about 300 times the annual dose to background radiation). It is related to the damage of the bone marrow, where the blood cells are produced. At higher doses (>10 Sv) other organs may be affected (e.g. gastrointestinal, cardiovascular)
Public health actions

Which are public health actions most important to take?

- In the case of a nuclear accident, protective actions may be implemented within a radius around the site.
- These actions depend on the estimated exposure (i.e., the amount of radioactivity released in the atmosphere and the prevailing meteorological conditions such as wind and rain. The actions include steps such as evacuation of people within a certain distance of the plant, providing shelter to reduce exposure and providing iodine pills for people to take to reduce the risk of thyroid cancer.)
- If warranted, steps such as restricting the consumption of vegetables and dairy products produced in the vicinity of the power plant can reduce exposure.
- Only competent authorities who have conducted a careful analysis of the emergency situation are in a position to recommend which of these public health measures should be taken.

How can I protect myself?

- Keep you and your family informed by obtaining accurate and authoritative information (for example, information from authorities delivered by radio, TV or the Internet) and following your government’s instructions.
- The decision to stockpile or take potassium iodide tablets should be based on information provided by national health authorities who will be in the best position to determine if there is enough evidence to warrant these steps.

What are potassium iodide pills?

- In the setting of a nuclear power plant accident, potassium iodide pills are given to saturate the thyroid gland and prevent the uptake of radioactive iodine. When given before or shortly after exposure, this step can reduce the risk of cancer in the long term.
- Potassium iodide pills are not "radiation antidotes". They do not protect against external radiation, or against any other radioactive substances besides radioactive iodine. They may also cause medical complications for some individuals such as persons with poorly functioning kidney and therefore taking potassium iodide should be started only when there is a clear public health recommendation to take this step.

Can pregnant women take potassium iodide pills?

- Pregnant women should take potassium iodide pills only when instructed by the competent authorities because the thyroid of a pregnant woman accumulates radioactive iodine at a higher rate than other adults and because the thyroid of the fetus is also blocked by giving potassium iodide pills to the mother.
WHO's response

What is WHO's role in nuclear emergencies?

- In accordance with its Constitution and the International Health Regulations, WHO is mandated to assess public health risks and provide technical consultation and assistance in association with public health events, including those associated with radiation events. In doing so, WHO is working with independent experts and other UN agencies.
- WHO's work is supported by a global network comprising more than 40 specialized institutions in radiation emergency medicine. The network, the Radiation Emergency Medical Preparedness and Assistance Network (REMPAN), provides technical assistance for radiation emergency preparedness and response.

What is the current risk of radiation-related health problems in Japan to those near the reactor at the time, and those in other parts of Japan?

- Given the amount of radiation so far released near the reactor, WHO believes that the public health risk is small.
- The assessment above can change if there are further incidents at these plants. Hence continuous monitoring of the situation is critical to provide an accurate assessment. However, radiation-related health consequences will depend on exposure. Exposure in turn is dependent on the amount of radiation released from the reactor, weather conditions such as wind and rain at the time of the explosion, the distance someone is from the plant, and the amount of time someone is in irradiated areas.