Radiation Health effects

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Ionizing radiation has sufficient energy to affect the atoms in living cells and thereby damage their genetic material (DNA). Fortunately, the cells in our bodies are extremely efficient at repairing this damage. However, if the damage is not repaired correctly, a cell may die or eventually become cancerous

Exposure to very high levels of radiation, such as being close to an atomic blast, can cause acute health effects such as skin burns and acute radiation syndrome (“radiation sickness"). It can also result in long-term health effects such as cancer and cardiovascular disease. Exposure to low levels of radiation encountered in the environment does not cause immediate health effects, but is a minor contributor to our overall cancer risk.

Acute Radiation Syndrome from Large Exposures

A very high level of radiation exposure delivered over a short period of time can cause symptoms such as nausea and vomiting within hours and can sometimes result in death over the following days or weeks. This is known as acute radiation syndrome, commonly known as “radiation sickness.

It takes a very high radiation exposure to cause acute radiation syndrome—more than 0.75 (75rad) in a short time span (minutes to hours). This level of radiation would be like getting the radiation from 18,000 chest x-rays distributed over your entire body in this short period. Acute radiation syndrome is rare, and comes from extreme events like a nuclear explosion or accidental handling or rupture of a highly radioactive source

Radiation Exposure and Cancer Risk

Exposure to low-levels of radiation does not cause immediate health effects, but can cause a small increase in the risk of cancer over a lifetime. There are studies that keep track of groups of people who have been exposed to radiation, including atomic bomb survivors and radiation industry workers. These studies show that radiation exposure increases the chance of getting cancer, and the risk increases as the dose increases: the higher the dose, the greater the risk. Conversely, cancer risk from radiation exposure declines as the dose falls: the lower the dose, the lower the risk.

Radiation doses are commonly expressed in millisieverts (international units) or rem (U.S. units). A dose can be determined from a one-time radiation exposure, or from accumulated exposures over time. About 99 percent of individuals would not get cancer as a result of a one-time uniform whole-body exposure of 100 millisieverts (10 rem) or lower.[1] At this dose, it would be extremely difficult to identify an excess in cancers caused by radiation when about 40 percent of men and women in the U.S. will be diagnosed with cancer at some point during their lifetime.

Risks that are low for an individual could still result in unacceptable numbers of additional cancers in a large population over time. For example, in a population of one million people, an average one-percent increase in lifetime cancer risk for individuals could result in 10,000 additional cancers. The EPA sets regulatory limits and recommends emergency response guidelines well below 100 millisieverts (10 rem) to protect the U.S. population, including sensitive groups such as children, from increased cancer risks from accumulated radiation dose over a lifetime.

Limiting Cancer Risk from Radiation in the Environment

EPA bases its regulatory limits and nonregulatory guidelines for public exposure to low level ionizing radiation on the linear no-threshold (LNT) model. The LNT model assumes that the risk of cancer due to a low-dose exposure is proportional to dose, with no threshold. In other words, cutting the dose in half cuts the risk in half.

The use of the LNT model for radiation protection purposes has been repeatedly recommended by authoritative scientific advisory bodies, including the National Academy of Sciences and the National Council on Radiation Protection and Measurements. There is evidence to support LNT from laboratory data and from studies of cancer in people exposed to radiation

Exposure Pathways

Understanding the type of radiation received, the way a person is exposed (external vs. internal), and for how long a person is exposed are all important in estimating health effects.

- The risk from exposure to a radionuclide particular depends on:
- The energy of the radiation it emits.
- The type of radiation (alpha, beta, gamma, x-rays).
- Its activity (how often it emits radiation).
- Whether exposure is external or internal:

- External exposure is when the radioactive source is outside of your body. X-rays and gamma rays can pass through your body, depositing energy as they go.
- Internal exposure is when radioactive material gets inside the body by eating, drinking, breathing or injection (from certain medical procedures). Radionuclides may pose a serious health threat if significant quantities are inhaled or ingested.
- The rate at which the body metabolizes and eliminates the radionuclide following ingestion or inhalation. Where the radionuclide concentrates in the body and how long it stays there

Sensitive Populations

Children and fetuses are especially sensitive to radiation exposure. The cells in children and fetuses divide rapidly, providing more opportunity for radiation to disrupt the process and cause cell damage. EPA considers differences in sensitivity due to age and sex when revising radiation protection standards