Radiation Standards Should Protect the Most Vulnerable

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Many federal regulations governing public and worker exposure to ionizing radiation fall short because they rely on Reference Man.

"Reference Man" is the hypothetical person on which many federal radiation protection standards are based. These standards affect many areas of people's lives, including limits on radioactive contaminants in air and drinking water, clean-up of contaminated sites, and workplace exposures. Ionizing radiation is classified by the U.S. Environmental Protection Agency (EPA) as a known human carcinogen.

> ***"Reference man is defined as being between 20-30 years of age, weighing 70 kg [154 pounds], is 170 cm in height [5 feet 7 inches], and lives in a climate with an average temperature of from 10^{o} to 20^{o}C. He is a Caucasian and is a Western European or North American in habitat and custom."***
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> **(International Commission on Radiological Protection, 1975)**

Challenges of Using Reference Man

The problem with using Reference Man is that most people fall outside the definition. In fact, women and children are generally more sensitive to the harmful effects of radiation. For the same radiation dose, women have a greater chance of getting cancer than men. Women's higher cancer risk per unit of radiation exposure is not properly reflected in current regulations. Neither are early miscarriages or fetal malformations potentially caused by radiation exposure. Radioactive hydrogen (called tritium) crosses the placenta and can cause early miscarriage as well as malformations. The risk to children is even more pronounced. A female infant drinking milk contaminated with radioactive iodine is 70 times more at risk of thyroid cancer than an adult male for the same radiation exposure.

Time for a Change

The basis for U.S. radiation health protection standards should protect those most at risk. In a report dated January 2008, EPA's Science Advisory Board recommended that the agency move away from Reference Man toward "Reference Family." Last May, then-Senator Barack Obama and Representative Henry Waxman wrote EPA asking questions about the agency's use of Reference Man. In its response, EPA declared that it "does not believe in the continued use of Reference Man." This was a welcome statement but other parts of the EPA response – and, more importantly, EPA's actions – contradict it. The use of Reference Man persists in a widespread manner, including within the EPA.

Outdated and Dangerous Standards

Several U.S. agencies base their radiation-related regulations on Reference Man. For instance:

- The EPA's Federal Guidance Report 11 (FGR 11) is widely used by government and industry for compliance calculations. The dose conversion factors in FGR 11 are based on Reference Man. Further, Reference Man is used to assess compliance with the Clean Air Act. In drinking water, Maximum Contaminant Levels (MCLs) for transuranic radionuclides (e.g., plutonium) are based on Reference Man.

- The Department of Energy's Order 5400.5 for the protection of the public is based on FGR 11.
- The Nuclear Regulatory Commission's occupational radiation protection regulations, specified in 10 CFR 20, are based entirely on Reference Man, except for declared pregnant workers. For the public, air concentration limits are derived from those for workers.
- The default values in RESRAD – the official computer program used by government and industry to estimate allowable residual radioactivity – use Reference Man. Dose conversion factors for women are not included. Dose conversion factors for children are included, but their use is not mandatory.
- The regulations have not kept pace with important developments in the scientific understanding of radiation risks. For instance, the International Commission on Radiological Protection and the National Academies' BEIR VII committee have developed age-specific and sex-specific dose and risk factors, but many regulations still use Reference Man. Even the EPA has published age-specific and sex-specific dose and risk factors (in Federal Guidance Report 13), but it does not apply them to all its regulations.

U.S. Regulations Must Be Updated

Environmental health regulations have improved over the years, but neither regulations nor research has been fully oriented to protecting the most vulnerable. Combined exposure to radiation and synthetic chemicals may contribute to increasing rates of breast cancer. Exposure to ionizing radiation could increase the number of cells with the potential to form breast cancers later in life, and exposure to chemicals that mimic estrogen could enhance the survival of such cells. Such combined risks are ignored in U.S. environmental health standards.

RECOMMENDATIONS:

- End the use of Reference Man. Compliance with radiation regulations should be based on the part of the population that would receive the highest radiation dose.
- Review rules regarding protection of prospective parents and pregnant women to ensure that future generations are not endangered due to work place exposures.
- Prohibit discrimination based on genetic information when creating or enforcing workplace health protections, including protections for pregnant women, and ensure strict privacy in genetic matters.
- Pass legislation requiring all federal regulations that affect public health and the environment to be regularly reviewed and revised so as to protect those most at risk.
- Fund research to better understand and estimate the human health effects of combined exposure to radiation and toxic chemicals.

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