Time for a Different Approach for Protection Against Ionizing Radiation

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Comments on ICRP-2005 Recommendations

The ICRP-2005 recommendations are very similar to its 1990 recommendations. They are still based on the 50-year-old linear no threshold (LNT) hypothesis of radiation carcinogenesis (and congenital malformations), which is contradicted by the science of biology. Generally, living organisms do not respond to ionizing radiation in a linear manner in the range from 1 mGy to more than 300 mGy acute.[1, 2, 21] Their response is bi-phasic. Beneficial health effects are apparent after low doses, and harmful effects are observed after high doses.[3, 4]

The ICRP still implies that chronic low dose radiation is a significant cause of cell damage, leading to cancer, but in fact this damage is swamped by the enormous amount of cell damage caused by the reactive oxygen species (ROS) generated by free radicals in the oxygen metabolism.[5] All aerobic organisms have a very powerful DNA damage-control system, which is essential for their survival. This antimutagenic system also operates against the DNA damage that is generated by ionizing radiation ROS and by chemicals.[6] The overriding effect of radiation on organisms is on their DNA damage-control system. As shown in Figure 1, high doses decrease biosystem activity (causing increased cancer mortality), but low doses stimulate biosystem activity (causing lower-than-normal cancer mortality). The ratio of metabolic DNA mutations to radiation DNA mutation from a low LET background of 0.1 cGy/year is about ten million to one.[5, 6]

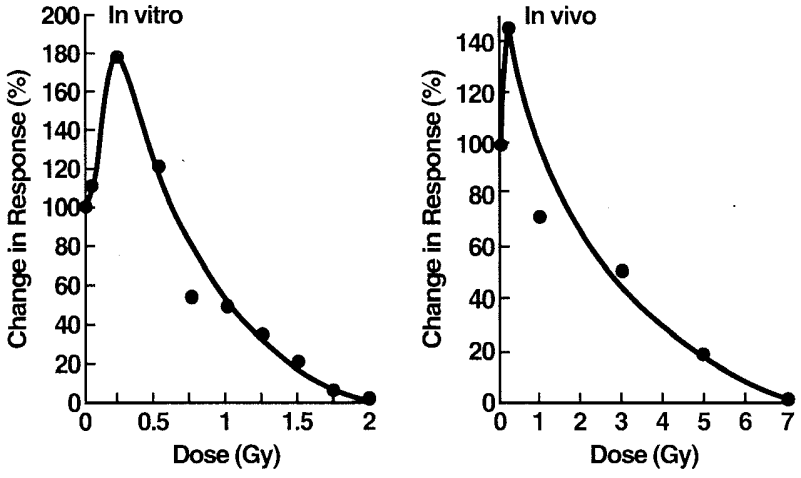

Figure 1. Immune system response to radiation. Mouse splenic cells primed with antigenic sheep red blood cells.[7]

ICRP recommendations create a negative image of all ionizing radiation applications. They perpetuate public fear of radiation, which is the principal barrier to public acceptance of nuclear power and the wider use of radiation in diagnostic medicine. Nuclear power plants are being closed prematurely in Sweden. People are refusing scans and are dying of diseases that could have been treated and cured at an early stage. Physicians are unwilling to use low dose irradiation therapies to cure infections[8] and cancer[9-11] because they were taught the myth that any amount of radiation is an important cause of cancer. These recommendations are inconsistent with the stated ICRP aim to protect man; they prevent the beneficial actions associated with low dose radiation exposure.

The ICRP urges radiation protection employees to make value judgements about the relative importance of risks and about balancing risks and benefits, but most people make their own judgements about the acceptability of risks and the balance of risks and benefits. The ICRP recommendations have created a massive scare about all human-made radiation (people are even afraid of sunshine), and the ICRP perpetuates this scare with on-going recommendations that are based on a hypothesis that is inconsistent with reality.[12] Its recommendations are simple, but they give the wrong answer. This is a very important social issue because of the harm caused by this scare. The precautionary principle advocated by the ICRP serves to increase – not reduce – risks because it directs scarce resources away from more serious risks.[13]

Scientists have known, since the discovery of ionizing radiation more than a century ago, that the real response of living organisms is biphasic, and that this applies not only for short-term effects, but also long-term effects.[14-16] This applies to cancer, to congenital malformations, and to many other biological indicators. Low doses reduce risk, even in radiation-sensitive cancer-prone individuals.[17, 18]

Scientists had reasonable protection recommendations in the 1930s, based on a threshold model, but the ICRP seems to have ignored more than 50 years of medical evidence in 1955 when it rejected current practice in favour of a linear risk model.[19] The driving force seems to have revolved around the political and social desire to stop atomic bomb development and proliferation,[13] as well as self interest in the increased funding of "radiation protection" organizations and activities. Today there is no bomb testing, and there are safeguard programs to stop proliferation, however, the ICRP continues to publish ever more stringent recommendations, based on linearity, in spite of the large amount of scientific evidence that contradicts this model. This is an unwarranted and unethical intrusion into people's lives.

The ICRP principles of protection are inappropriate in light of biology. Should we evacuate all living organisms from regions and accommodations where natural radiation levels exceed ICRP recommendations? Many healthy elk and caribou in northern Canada have survived for many centuries by eating lichen, from which they receive an annual dose of about 1000 mGy from polonium-210 (decay product of radon). The scare created by ICRP recommendations makes society very vulnerable to terrorist "dirty" bomb threats, leading to emergency evacuation procedures that would cause far more harm than the radiation exposure.

Natural background levels, as reported by UNSCEAR, range from about 1 to more than 700 mGy a year. The presumption of adverse health effects even at small increments of exposure

above natural background is not supported by biology (Figure 2) – this notion sustains the radiation scare. There is no biological basis to distinguish between exposures to natural radiation and exposures to human-made (artificial) radiation. The ICRP notion of different exclusion activity concentrations – by a factor of 100 – for these classes of sources makes no sense. It assumes that human-made radiation is 100 times less acceptable than natural radiation.

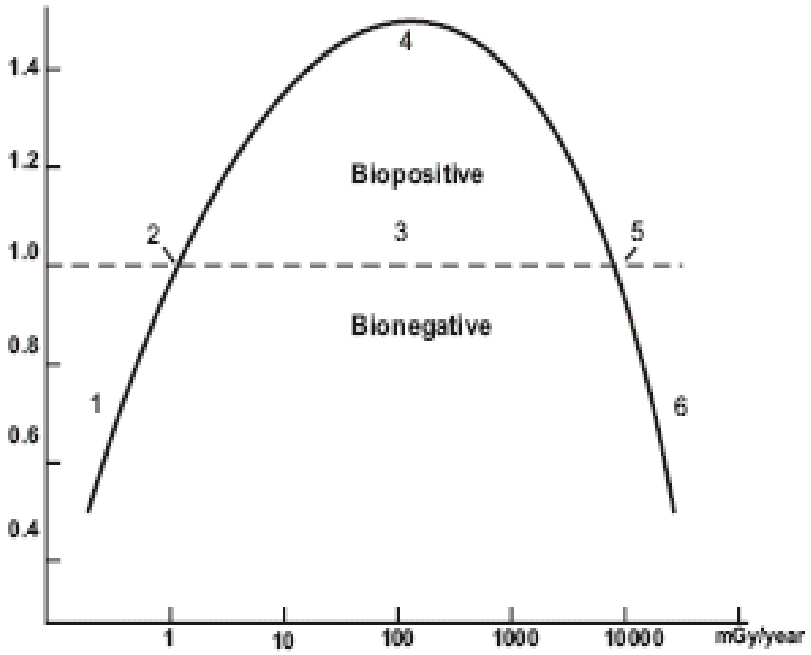

Figure 2. Idealized, complete dose-response curve.[15] The ordinate indicates approximate responses compared with the controls. The abscissa suggests mammalian whole-body exposures as mGy/year. The numbered areas are: (1) deficient, (2) ambient, (3) hormetic, (4) optimum, (5) zero equivalent point, and (6) harmful.

The ICRP dose recommendations in Table S1 are too low and too complicated. The constraints should be different for acute and chronic exposures, to take into account biological adapting and healing times. Acute exposures correspond to emergency situations, and there have been many cases where workers have received doses in excess of 1000 mSv in these situations. Chronic exposures of 100 mSv in a year are common in nature (Figure 3). So there is no need to lower radiation doses, because we are not at risk.

Concern about radiation exposure puts constraints on maintenance in nuclear facilities, and undue concerns could lead to inadequate maintenance (inadequate or infrequent inspections), additional forced power plant shutdown and increased risks to the surrounding communities due to the loss of power.

ICRP ideology on radiation exposure is used by anti-nuclear organizations to advocate nuclear phase out. The "problem of nuclear waste" is closely related to the ICRP recommendations. These issues cripple our ability to supply enormous amounts of pollution-free energy and vital radioisotopes, for very important medical procedures and treatments. Undue concerns about radiation create unnecessary conflicts, delays, barriers, costs and cancellations. It is necessary to bring the science of radiobiology – not myths – into the decision-making process.

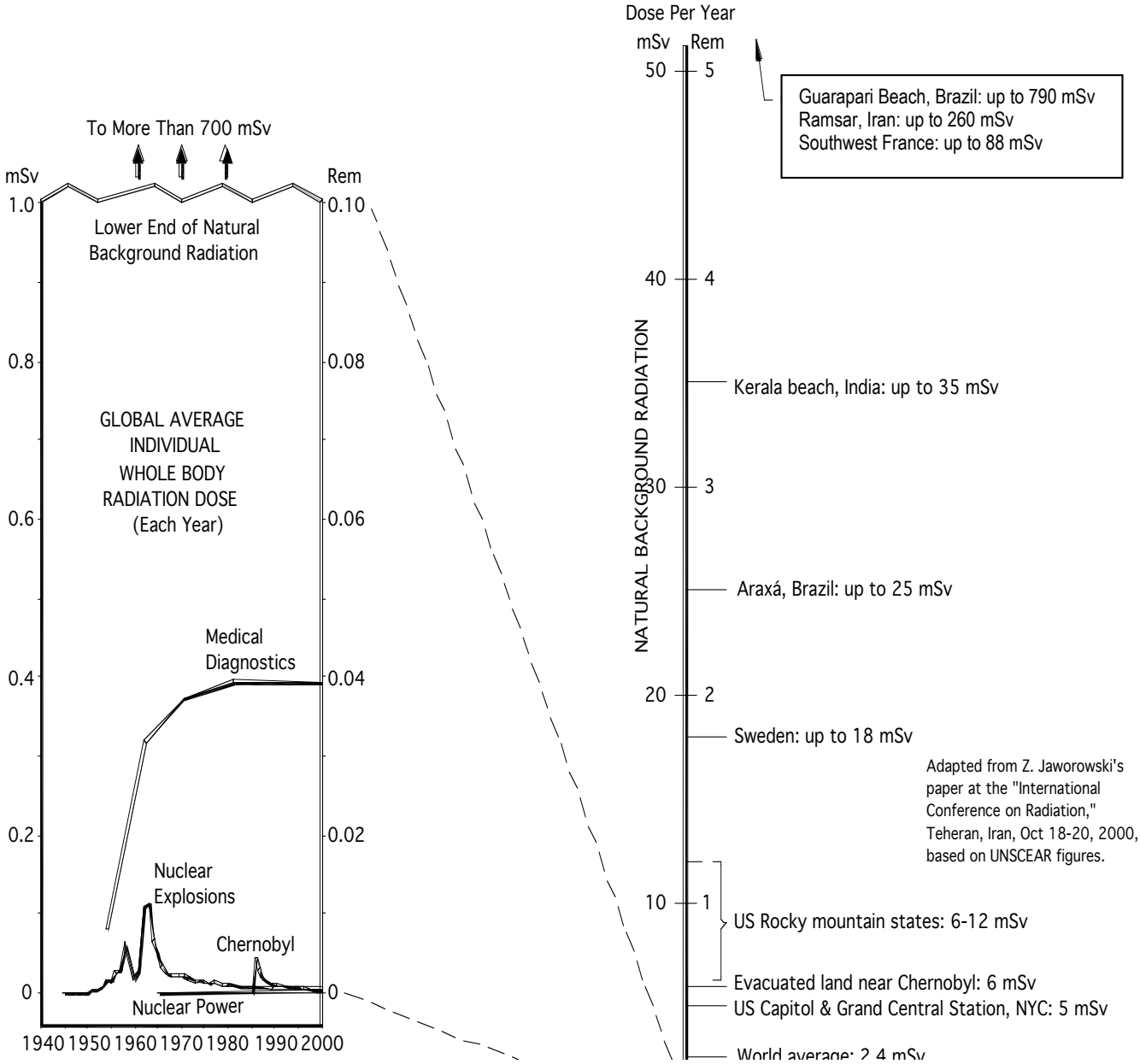

Figure 3. Comparing average annual dose: natural versus human-made radiation[20]

The ICRP development of effective dose models (weighting factors) seems to be based more on physics and mathematics than radiobiology. The damage-control biosystem (which includes the immune system) plays a crucial role in radiation health effects,[21, 22] but there is no evidence that the ICRP has taken this system into account in its models, theories and analyses. Low doses of radiation increase the activity of the damage-control biosystem resulting in lower-than-normal incidences of cancer and congenital malformations. The ICRP models are incorrect because they ignore this important radiobiological fact, which the ICRP calls "current uncertainties."

There is no need to reduce occupational and public doses. The doses have been orders of magnitude below harmful levels. Further reductions increase costs and cause additional delays to radiation-related projects. They amplify the radiation scare and increase the anxiety in radiation workers, patients and local residents for no health benefit.

Recommendation

Canadians can and should formulate their own radiation protection regulations. They should be based on good science, instead of adopting ICRP recommendations. The author is willing to participate with other Canadian and international scientists on this very important work.

Acknowledgement

This submission was reviewed by Myron Pollycove MD, Professor of Laboratory Medicine and Radiology, University of California at San Francisco.

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