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Opinion

Our Radiation Protection Policy Is A Hazard To Public Health

By Theodore Rockwell

Where public-health policy is concerned, it makes sense to be conservative. But when we try too hard, we may actually do more harm than good. An egregious example is our policy on low-level ionizing radiation, primarily gamma rays and neutrons. Regulations are based on the premise that any amount of radiation, however small, must be considered hazardous. This premise was not derived scientifically, and the policy based on it is not conservative but is actually detrimental to public health.

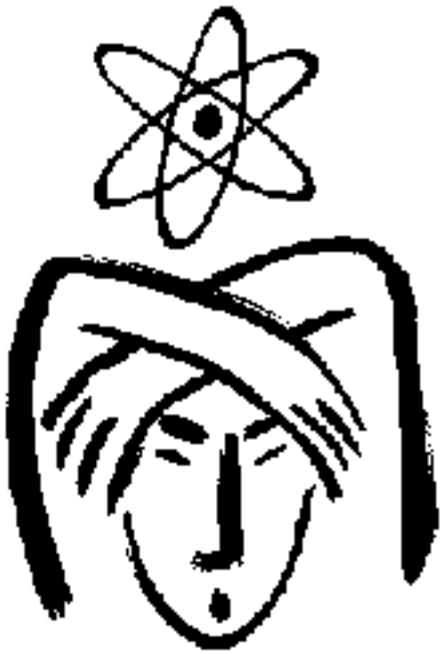


Illustration: John Overmeyer

Fear of harmless amounts of radiation has created situations that are directly inimical to health. Examples: More than 100,000 European women chose to have unnecessary abortions after the Chernobyl accident out of a groundless fear of bearing "nuclear mutants." Thousands of people die needlessly each year from pathogens infecting beef, poultry, eggs, and seafood that could easily be sterilized by irradiation. Thousands more die each year from breathing particulates from coal-fired power plants, yet the option of replacing them with nuclear plants that emit no particulates is hardly considered. About 1 million medical procedures involving radiation are performed each day in the United States. These are our latest and best medical techniques, yet thousands of people avoid such life-saving procedures out of fear of radiation. That fear has also led to burdensome and costly regulatory

requirements that are pricing these procedures off the market.

Fear of radiation has made nuclear technology a non-option for many problems it is uniquely able to solve, such as global warming and air, water, and ground pollution. It also can be used for countless applications in space, commerce, and industry, including radiography of heavy metal parts and sterilization of medical instruments and bandages. We worry about water shortages, yet most of the Earth is covered with water. Energy is all it takes to make it potable and pump it where needed. Such possibilities are seldom mentioned in the media or in our schools.

In addition, while funds are lacking for everyday medical care, billions of dollars are spent to reduce perceived radiation hazards that are trivial or nonexistent. Under present standards, liquids less radioactive than natural substances like salad oil are deemed "dangerous," and when they are spilled in a remote location, the site must be "decontaminated" at great expense. Storing even low-level radioactive waste requires multimillion-dollar studies with grotesque scenarios of atoms migrating through miles of desert soil to "contaminate" a possible water source in the distant future.

It is easy for scientists to scoff at the foolishness of media and regulators in instances like these. But we are more responsible for this situation than we want to admit. U.S. policymakers and radiation regulators are required by law to rely on the best scientific advice, which is presumed to reside in the congressionally established National Council on Radiation Protection and Measurements (NCRP). The NCRP has hypothesized that the hazard from radiation is cumulative and linearly proportional to the radiation dose. This is the Linear No-Threshold (LNT) model. This is like saying that if 100 aspirin tablets taken in one dose will harm a person, then one aspirin a week for 100 weeks will also harm.

Even more pernicious than trying to control individual doses down to negligible levels is the NCRP concept of collective dose, in which negligible individual doses are added up to predict casualties in an exposed population. For example, if we give one aspirin to each of 100 persons, this model says a harmful dose has been delivered and one casualty is assumed to occur although no individual has been harmed.

The LNT model was derived from data on A-bomb survivors and other high-dose exposures. There is a roughly linear relationship from lethal levels above 500 rad to about 20 rad, below which no health effects are seen. Because of the uncertainties of cancers that might appear later, it was considered prudent in the 1950s to presume that this relationship continued down to zero radiation. However, during the past 10 to 20 years, research by molecular biologists has shown that radiation acts like other toxins in that large amounts can be damaging, but small amounts may be beneficial. The beneficial effects of low-level radiation are summed up by T.D. Luckey of the University of Missouri (*Health Physics*, **43**[6]:771-89, 1982): "Extensive literature indicates that minute doses of ionizing radiation benefit animal growth and development, fecundity, health and longevity. Specific improvements appear in neurologic function, growth rate and survival of young, wound healing, immune competence, and resistance to infection, radiation morbidity, and tumor induction and growth. Decreased mortality from these debilitating factors results in increased average life span."

The beneficial effects of low-level radiation have been convincingly demonstrated in a number of major studies. A 1991 Department of Energy report, entitled "Health Effects of Low-Level Radiation in Shipyard Workers" (G.M. Matanoski, DOE DE-ACO2-79 EV10095), summarizes 10 years of epidemiological research by the Johns Hopkins School of Hygiene and Public Health. The report covers 700,000 American shipyard workers, 108,000 of whom were occupationally exposed to radiation. To eliminate the "healthy worker artifact," the researchers carefully matched radiation workers with similar workers in the same shipyard who were not exposed. They found that the irradiated workers had 24 percent lower death rates and 25 percent lower cancer mortality than the unexposed workers, and those with the highest radiation exposure showed the most benefit. (Of course, even the highest radiation exposures were well below levels known to be harmful.) This conclusion is supported by several studies in other countries.

Bernard L. Cohen made a meticulous study of 1,729 counties containing 90 percent of the U.S. population, comparing lung cancer incidence with radon levels in those counties (*Health Physics*, **68**:157-74, 1995). The data show that lung cancer decreases with increasing radon level and that this relationship is statistically valid to a very high degree, departing from the linear model by 20 standard deviations. Beneficial effects were also shown in a report on 31,710 women who were examined by X-ray fluoroscopy between 1930 and 1952. Again, the effects of the X-rays proved to be beneficial, not harmful (A.B. Miller et al., *New England Journal of Medicine*, **321**:1285-9, 1980).

Most interesting is research by Japanese radiobiologists on the effects of "inoculating" mice with small doses of radiation to stimulate the immune system prior to massive irradiation for cancer therapy (K. Sakamoto et al., *Japanese Journal of Cancer Chemotherapy*, **14**[5]:1545, 1987; *Oncologia*, **20**[2]:1211, 1987). Ordinarily the heavy radiation therapy led to only a 35 percent survival rate. But up to 90 percent of the mice receiving "inoculation" treatment survived subsequent high-level irradiation.

The LNT model is based on the premise that a single alteration in a DNA chain could lead to cancer and a single gamma ray might cause such an alteration. This is true in some abstract sense, but not meaningful. We have to look at the numbers.

The human body has about 1014 (100 trillion) cells, and each one of these cells routinely undergoes about 200,000 DNA alterations each day just from the action of free radicals created in the normal process of cellular metabolism. That's 70 million alterations per year. In addition, there are 60,000 different kinds of genes in the body, and one of each gene is in each cell. Each kind of gene undergoes about 400,000 replication mutations each day, a total of 24 billion gene mutations daily in our body. Now, if any single mutation in the DNA were to cause cancer, we would never make it past the first year of our lives. What saves us? After all, the world we first evolved in eons ago was at least 10 times more radioactive than it is today. The answer is that we are protected by a number of cellular processes of DNA damage prevention, damage repair, and damage removal. These are the critical mechanisms that protect us from cancer.

How does radiation damage compare with the natural damage caused by everyday living? We

know that 1 rad of radiation causes about 20 DNA alterations total in each cell. The NCRP annual limit is 0.1 rad, which would cause about two DNA alterations per cell. The important point is that the damage from radiation is indistinguishable at the cellular level from the damage routinely experienced from metabolism. So the NCRP would "protect" us from two DNA alterations per year from radiation, among 70 million alterations of the same kind in each cell from routine metabolism.

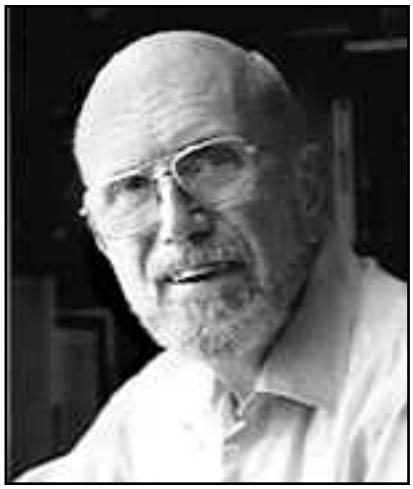
Even a lethal dose of radiation, say 1,000 rad, would cause only 20,000 alterations, still only 0.02 percent of the natural background noise. It is not through additional DNA alterations that high-level radiation injures us; the critical factor in determining whether we get cancer from these mutations is the cellular repair and removal processes. The effect of radiation is interesting: Like many other toxins, high-level radiation degrades these processes, but low-level radiation actually stimulates them. That is why high-level radiation may hurt us but low-level radiation may help us.

In addition to questioning the scientific basis for the LNT model, we must ask if the model leads to reasonable regulatory requirements. The NCRP individual limit for the public (vs. workers) is 0.1 rem per year-considerably less than the average natural radiation background. For limiting the collective dose, NCRP's Report 121 requires that individual doses greater than 0.001 rem per year be controlled. The average American gets about this much radiation each day from natural sources and ordinary living. Many people have lived for generations in places where they routinely get this amount of natural radiation every few hours without detrimental health effects. Some rooms in the U.S. Capitol and in New York's Grand Central Station, built of naturally radioactive granite, are also this radioactive.

If doses as low as 0.001 rem per year are hazardous, we should curtail living or traveling to Colorado, Norway, and other high-radiation locations. We should prohibit flying, mountain climbing, and skiing where cosmic rays exceed the NCRP limits. And we should outlaw use of masonry for building construction.

Use of natural gas in the home or office can result in six times the dreaded 0.001 rem per year (from radon). Even sleeping with another person or moving to a hill or up 10 floors in a building increases one's radiation dose beyond the permissible minimum. A hypothetical model that leads to such silly conclusions is not good science. Using the NCRP approach, a harmless individual radiation dose is multiplied by 100 million people downwind of the Chernobyl accident to "predict" that the radiation will kill 30,000 of these people. When I asked a senior regulatory official if he really believed this, he said, "It's a moot question; 25 to 35 million of these people will get cancer from other

Photo: G.F. Stork



Theodore Rockwell (tedrock@cpcug.org) is a founding officer of MPR Associates Inc., an Alexandria, Va.-based engineering firm, and a founding director of Radiation,

causes, so you would never see an additional 30,000."

This position is scientifically, as well as ethically, indefensible. If we really believe that 30,000, plus or minus hundreds or thousands, may die from this accident, then mumbling about precision is irresponsible. There is no legitimacy in predicting deaths at radiation levels far below where any actual health effects are observed. It is important to our scientific integrity and credibility to resolve this matter scientifically. If knowledgeable scientists voice no objections, we cannot blame the media or politicians for conclusions drawn directly from numbers and statements we scientists and engineers have created or accepted.

Science, and Health Inc., an international public-interest group in Needham, Mass., addressing this situation. He is the author of several books, articles, and patents on radiation and nuclear power.

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