Radiation Health Risks: Facts and Fiction

The topic of ionizing radiation tends to evoke strong emotional and negative feelings in some sectors of the population. This response is due, in part, to a lack of understanding about what ionizing radiation is and how it affects human health. In addition, there are varying opinions regarding potential injurious effects—some based on sound science, others driven by misunderstanding. If we focus entirely on science, we find that within the past 10 years, a large number of publications have featured new epidemiology and radiobiology findings.

For instance, the National Academy of Sciences collated, reviewed, and disseminated information in support of new cancer risk estimates (BEIR VII 2005). International groups subsequently published their own risk estimates and analyses. These groups include the International Commission of Radiation Protection (ICRP 2008), the United Nations Scientific Committee to Evaluate Atomic Radiation (UNSCEAR 2008-9), and the International Agency for Research on Cancer (IARC 2010). The U.S. Environmental Protection Agency (EPA) also released a preliminary radiation risk analysis last December, followed this month by a peer review from the EPA Science Advisory Board. This important body of research will likely lead to new standards for radiation exposures in the United States and a revision of Federal Guidance Report 13 for all radionuclides.
The Issues

Revised cancer risk estimates developed by the National Academy of Sciences (BEIR VII 2005) will impact regulatory standards set by EPA and the Nuclear Regulatory Commission (NRC). The risk models used are complex and are not necessarily in full agreement with more recent international commissions. One subject that has received attention is the degree to which cancer effects from acute exposures are extrapolated and reduced for chronic exposures. Previously, a conservative factor of 2 was used to estimate the cancer risks of chronic exposure derived from acute exposure risk; that factor has now been reduced to 1.5. The International Commission for Radiological Protection (ICRP) has taken issue with this change. The German government has reduced it to 1. The French National Academy of Sciences argues that low doses are of little concern, and the basic model of a linear, no-threshold cancer effect model is scientifically inappropriate. Other non-cancer effects, primarily cardiovascular, are currently being analyzed and may become a future risk issue.

The public’s limited understanding of radiation, and a strong entrepreneurial spirit, have resulted in increased litigation claims. Litigation is present in many forms and scopes. It can simply involve a single worker and a health condition attributable to occupational radiation exposures. It can also involve exposures with anticipated future health effects. Going beyond the individual employee, there are situations where environmental contamination leads to class action suits with various, sometimes questionable, demands for remedy, such as long-term population medical screening. The Three Mile Island incident is an example of a large class action suit. Others include residents in the vicinity of uranium processing and enrichment facilities, or other industrial facilities where Naturally Occurring Radioactive Material (NORM) is present.

NORM and Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) are receiving increased international attention. The predominant radioactivity in NORM stems from the presence of radioisotopes in the decay chains of uranium and thorium. NORM is present in a surprising number of industries and can be found in such things as fly ash, phosphate fertilizers, and even granite countertops, to name a few. The petroleum industry also comes face to face with radiation in the extraction of oil and gas, where scale builds up in the pipes. The reaming of scale from the pipes, as well as vessels with drained water or sludge, creates disposal issues, and more importantly, worker exposure to NORM radiation. This problem has received attention in the U.S. Gulf Coast area, as well as in Europe and South America.

Nuclear power reactors are receiving renewed attention worldwide because of the urgent need for increased electrical power, fear of carbon emissions, limited fossil fuel stores, and projected future energy costs. Suddenly, there are new proponents for the nuclear energy option. With 104 functioning nuclear power plants in the U.S., the Electric Power Research Institute (EPRI) has estimated that projected future demand necessitates that 45 additional plants be built by 2030. Existing plants require periodic re-licensing, with some seeking to expand their facilities. Although the NRC regulates the nuclear industry, there are public concerns over radiation exposures, the danger of reactor accidents, and how these might affect neighboring communities. These concerns often lead to objections by neighborhood and environmental groups when approvals are sought from state utility commissions.

Medical radiation use has dramatically increased in the last decade. In the early 1980s, about 15% of an individual’s radiation exposure was related to medical/dental applications. That share has now risen to 48%.
The liberal use of medical radiation has caused an increase from 3.6 mSv per year to 6.2 mSv for average background radiation exposures. The increasingly popular use of CT scans, which are relatively high dose compared to traditional x-rays, accounts for a large part of the increase. An estimated 70 million scans were performed in 2006, with many patients receiving multiple scans. The reliability of the equipment and its use are at issue. Recently, a class action suit was filed because of allegations that a faulty machine resulted in unnecessarily high exposures to a large number of patients.

Technical Approach

The wide range and complexity of radiation health issues requires the expertise of several interacting scientific disciplines. For environmental issues, basic health physics and dosimetry are needed, where actual environmental measurements are made. Disagreement often occurs with regard to establishing the amount and type of radiation exposures that individuals have experienced, which involves exposure and dose reconstruction. As with chemicals, individual radionuclides have individual pharmacokinetic profiles that have been established by the scientific community. In some instances, specific experiments are called for. In the petroleum industry, actual radionuclide measurements were made during the reaming out of the scale containing NORM. These published measurements afforded reasonable estimates of the amount and type of radionuclides one might expect in oil-pipe scale cleaning. These data allowed for scientific estimates to be made, as opposed to biased guesses.

Epidemiological studies account for effects observed in the context of large groups of people. Examples of this process include the population studies conducted after the Three Mile Island incident. Communities in the vicinity of previous uranium processing facilities have also been scrutinized extensively through epidemiological studies. In many instances, litigation drives community studies and worker population analyses, which must be carefully designed and carried out lest the results be inherently flawed. Proper, unbiased evaluation is a must.

The use of epidemiological studies is complex because of the generally very large body of scientific literature that opposing sides can selectively employ (“cherry pick”). In the case of radiation, there is often a lack of understanding of the various types of radiation and their associated risks. One example is the interpretation of increased early childhood leukemias observed near German nuclear power plants, which has been studied extensively. One possible explanation for the observed increase in leukemias is that nuclear power plants bring new families into rural populations, and the influx of new people brings infections new to the original inhabitants, resulting in immunological effects and increased leukemias (i.e., the Kinlen hypothesis).

Finally understanding and properly applying actual quantitative risk models is very important in determining a “probability of causation,” which can play a key role in litigation.

Exponent’s Expertise

Exponent offers unparalleled multidisciplinary expertise and rapid response capabilities to provide stewardship in addressing issues of radiation health effects. We provide our clients with a team of scientific, engineering, environmental, risk, and health specialists that is unique in the industry. Our scientists routinely publish in the areas of quantitative risk modeling, and have worked extensively with National Institute of Health, EPA, U.S. Department of Energy, NASA, and other government
agencies. Our consultants have been key participants in national and international committees formed to assess the scientific literature and to develop pertinent risk models. These important committees include the Radiation Advisory Committee of EPA, EPRI, National Academy of Sciences, IARC, UNSCEAR, and IAEA.

Exponent features in-house scientists, epidemiologists, and physicians who are experienced in conducting epidemiological studies and assessing particular health issues. We also have several highly experienced nuclear power engineers with proven experience on high-profile projects of national and international significance—often in a dispute resolution setting. Depending on the scope of your needs, Exponent can build a full-fledged scientific team, or simply provide a single internationally recognized consultant. Exponent stands ready to assist you in the conduct of single or multifaceted investigations involving issues of radiological contamination; occupational, public safety, and engineering assessments; and standards compliance.

**Relevant Exponent Publications**


Comment on the Updated U.S. Preventive Services Task Force Report on Routine Mammograms for Women Age 40–49

On November 16, 2009, the U.S. Preventive Services Task Force (USPSTF), an independent panel of experts in primary care and prevention that systematically reviews the evidence of effectiveness and develops recommendations for clinical preventive services, released new recommended guidelines for how often women should have a mammography. Breast cancer is the second leading cause of death of women in the U.S., and film mammography is the standard for detecting breast cancer. The use of mammography screenings, along with treatment advances in recent years, has been credited with significant reductions in breast cancer mortality. In 2002, the USPSTF reported convincing evidence of the procedure’s validity, due to its demonstrated effectiveness in randomized, controlled trials of screening. Updated research, however, shows that although screening with film mammography reduces breast cancer mortality, there is greater absolute reduction for women aged 50 to 74 years than for
women aged 40 to 49 years. The strongest evidence for the greatest benefit is among women aged 60 to 69 years. This information has led the USPSTF to recommend against routine screening mammography in women aged 40 to 49 years. The task force recommends that the decision to start regular, biennial screening mammography before the age of 50 years should be an individual one and take patient context into account, including the patient’s values regarding specific benefits and harms.

Dr. Hoel has been involved in the issues related to effective mammography and radiation risk for over 10 years. He co-authored the National Cancer Institute’s Health Consensus Development Conference Statement regarding breast cancer screening in a special article of the Journal of National Cancer Institute in 1997. He also testified before the United States Senate Committee on Appropriations: Subcommittee on Labor, Health and Human Services Education. Please contact Dr. Hoel if you would like more information.

References

November 2009 U.S. Preventative Services Guidelines
http://www.ahrq.gov/clinic/uspstf09/breastcancer/brcanrs.htm#rationale


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About Exponent Health Sciences

Exponent is a leading engineering and scientific consulting firm dedicated to providing solutions to complex problems. Exponent has one of the foremost health sciences consulting practices in the United States. Our scientists, physicians, and regulatory specialists evaluate a full range of environmental and public health issues, including potential health effects associated with environmental agents, chemicals, consumer products, food safety and nutrition, and pharmaceutical products. Our clients rely on us for incisive and objective assessments that address physical, chemical, and biological phenomena in order to arrive at solutions that can be relied upon to make important decisions. In addition, Exponent performs research and analysis in more than 90 science-and engineering-related technical disciplines.

More information about our Health practice, as well as our other capabilities, can be found at www.exponent.com.

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