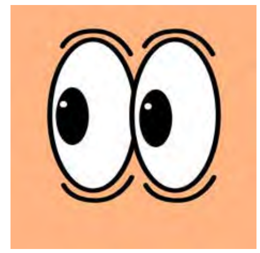
The Boice Report #24

NCRP National Council on Radiation Protection & Measurements

John D. Boice, Jr., NCRP President
ICRP Main Commissioner, UNSCEAR Delegation
Veterans' Advisory Board on Dose Reconstruction Board Member
Vanderbilt Professor of Medicine

The Eyes Have It



Radiation-related cataracts are in the eye of a storm. There is controversy over the new annual 20 mSv occupational dose limit for the lens of the eye recommended by the International Commission on Radiological Protection (ICRP) and accepted by many countries (ICRP Publication 118). The scientific and operational issues for reducing the current occupational dose limit from 150 mSv to 20 mSv are complex (HPS 2011 letter on Docket ID NRC-2009-0279). The only general agreement is that radiation-induced cataracts (serious lens opacities leading to visual impairment) can occur at doses lower than previously recognized—the previous threshold dose was thought to be about 5 Gy and now is estimated to be about 0.5 Gy. For members of the public, ICRP did not recommend changing the 15 mSv y^{-1} public dose limit to the lens of the eye. With an eye to shedding light on the evolving radiation protection issues, the National Council on Radiation Protection and Measurements (NCRP) initiated Scientific Committee (SC) 1-23, which met in March 2014 under the able chairmanship of Ellie Blakely and Larry Dauer (the committee is shown in the photograph on the next page).

So what are the major questions for SC 1-23 to address in the upcoming year? (And yes, the commentary will be completed in a year's time to be responsive to the U.S. Nuclear Regulatory Commission by providing timely guidance that might be useful in its ongoing rulemaking process.)

Is the mechanism for cataract formation stochastic or deterministic? It is not entirely clear whether the mechanism for radiation-induced cataracts is a deterministic (or threshold) process that requires a significant number of cells to become dysfunctional or possibly a stochastic process similar to cancer induction that would imply that, no matter how low the dose, a small (albeit undetectable) risk might be present. The most recent investigation from the study of the atomic-bomb survivors appears consistent with a threshold effect at 0.5 Gy; based on surgically removed lenses there were no significant findings at doses < 1 Gy, and the elevation at doses < 1 Gy appeared only in Nagasaki atomic bomb survivors (Neriishi et al. 2012). Nonetheless, some evidence supports a stochastic process (Bouffler et al. 2012).

Does protraction matter? It is not entirely clear whether the risk following protracted exposures is the same or lower than what has been seen following acute or brief exposures (Bouffler et al. 2012). Studies of interventional radiologists and cardiologists indicating that protracted exposure can result in serious lens opacities, albeit at high cumulative doses (Vano et al. 2010), as well as the recent ICRP Publication 118, imply that protraction may not be that important in lowering the risk. The quantification of dose to the lens is challenging in studies of protracted exposure. More research and guidance would be helpful.

What about severity? Noncancer effects of radiation exposure, such as coronary heart disease and cataracts, occur at dose levels lower than previously recognized. Coronary heart disease is substantially more serious than a cataract. Should equal weight be given to nonfatal outcomes as to fatal ones in protection guidance? Should cataracts be placed at the same level of concern as radiation-induced cancer? And if so, how could lens dose be incorporated into any computation of effective dose? The ICRP measure of detriment includes a factor for lethality but because cataract formation is a nonfatal outcome, dose to the lens might not contribute to effective dose under the current system of protection.

How low to go? The current annual occupational dose limit for lens of the eye in the United States is 150 mSv. The ICRP recommendation is 20 mSv y^{-1}. The annual whole-body occupational dose limit for the United States today is 50 mSv and is unlikely to change in the near future. The NCRP recommendation for occupational, cumulative, whole-body exposures is 10 mSv times age, which is actually more conservative (i.e., protective) than the 20 mSv y^{-1} limit in terms of limiting occupational, cumulative dose (NCRP Report No. 116). One perplexing issue for the United States would be considering an occupational limit to the lens of the eye that is lower than the limit for whole-body exposure—the ramifications with regard to implementation could be challenging and formidable to address.

NCRP Scientific Committee 1-23 on Protection Guidance for Lens of the Eye

Front row, left to right, Cindy Flannery (U.S. Nuclear Regulatory Commission), Eleanor Blakely (Lawrence Berkeley National Laboratory), and Gayle Woloschak (Northwestern University); back row, left to right, David Hoel (Medical University of South Carolina), Mike Grissom (NCRP consultant), Don Mayer (Entergy), Lawrence Dauer (Memorial Sloan Kettering Cancer Center), Eliseo Vañó (Complutense University, Madrid), and John D. Boice, Jr. (NCRP); side photos, top to bottom, Elizabeth Ainsbury (Public Health England), Joseph Dynlacht (Indiana University School of Medicine), Barbara Klein (University of Wisconsin-Madison), Raymond Thornton (Memorial Sloan Kettering Cancer Center), and Phung Tran (Electric Power Research Institute)

Radiation and Risk: Expert Perspectives

The concern about radiation exposure following the March 2010 tsunami and resulting damage to the Fukushima Daiichi nuclear facility compelled a group of radiation scientists to explain radiation risks to the general public. Some of these experts were convened in a panel sponsored by the Health Physics Society (HPS) at the National Press Club in Washington, DC, on 1 March 2012 in order to better inform the conversation around the one-year anniversary of Fukushima. Now, two years after the accident, HPS has published *Radiation and Risk: Expert Perspectives*, a compilation of papers on topics including natural radiation, medical applications of radiation, effects of natural and man-made radiation on the environment, safety controls of nuclear energy production, risk communication, and the regulatory implications of radiation safety. The publication is available on the HPS website at http://hps.org/documents/radiation_and_risk.pdf.