

The Boice Report #63



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Cells, Humans, and Bill

The holy grail of radiation risk assessment is seeking and providing the most valid estimates of health effects below about 100 mGy (absorbed dose). There are great uncertainties inherent in epidemiologic studies of exposed persons at lower doses, and it is generally agreed that effects observed above 100 mGy are more reliable than those observed at less than 100 mGy.

For over 70 years, the field of radiation risk estimates has not been able to make effective use of radiation biology data from laboratory animal, cellular, and molecular studies. Rather, these data are largely used to support the epidemiology-based risk models.

In 2015, the National Council on Radiation Protection and Measurements (NCRP) published [Commentary No. 24](#), *Health Effects of Low Doses of Radiation: Perspectives on Integrating Radiation Biology and Epidemiology*.

To go beyond, Scientific Committee 1-26 ([SC 1-26](#)) has been convened to address more fully “Approaches for Integrating Radiation Biology and Epidemiology for Enhancing Low-Dose Risk Assessment.” SC 1-26 is chaired by Julian Preston, PhD, and Werner Rühm, PhD. The other committee members are shown in the photo collage below.



SC 1-26 members, left to right: Chairman R. Julian Preston (U.S. Environmental Protection Agency [EPA], retired), Cochairman Werner Rühm (Helmholtz Zentrum Muenchen), Armin Ansari (CDC), Edouard Azzam (Rutgers University), John Boice (NCRP), Simon Bouffler (Public Health England), Mark Little (National Cancer Institute), Roy Shore (Radiation Effects Research Foundation, retired), Igor Shuryak (Columbia University), Michael Weil (Colorado State University), Jerry Puskin (EPA, retired, NCRP staff consultant)
Photos courtesy of NCRP

The Purpose—What’s it all about?

The SC 1-26 report will describe available and potential approaches for combining data from epidemiology and radiation biology studies into models for predicting low-dose and low-dose-rate radiation effects.

The Background—How did we get here?

[NCRP Report No. 171](#), *Uncertainties in the Estimation of Radiation Risks and Probability of Causation* (2012), discussed the importance of uncertainties in epidemiologic data and in the approaches to extrapolate from these data [to estimate adverse health outcomes](#) at low doses and dose rates.

NCRP Commentary No. 24 reviewed the available data on low-dose effects at the whole animal, cellular, and molecular levels and how they might be integrated into a single approach with epidemiologic data. The challenge for SC 1-26 is to integrate such knowledge and then develop a practical approach to improve estimates of risk at low doses and dose rates.

Goals and Timing—How to get there?

Bridging the gap from molecules to epidemiology might benefit from the “key event” approach and biologically based models used in conjunction with high-quality radiation epidemiology data, such as the [Million Person Study of Low-Dose Health Effects](#). The goal is to reduce the overall uncertainty in low-dose risk estimates and management. SC 1-26 will consider [adverse outcome pathways \(AOPs\) for radiation-induced cancer](#) in an attempt to identify the key events along the pathway.

Approaches currently used for risk assessment for chemicals in the environment will also be considered. Biologically based dose-response (BBDR) models will be evaluated to estimate cancer risks at low doses and dose rates (Preston [2015](#), [2017](#); [Rühm et al. 2017](#)). Concurrently, additional radiation epidemiology data are becoming available that should significantly enhance the predictive outcome of any integrated models. [NCRP SC 1–25](#) is reviewing recent epidemiologic studies, focusing on the quality of the dose-response models.

These data will serve as a critical component of any BBDR modeling approach for estimating radiation risk at low doses and low dose rates. NCRP is helped along this path by the collaboration and financial support of the Centers for Disease Control and Prevention (CDC).

Bill, Cells, and Humans



Bill Morgan, left, recognized in 2013 for his years of service as NCRP scientific vice president and chair of Program Area Committee 1 (Basic Criteria, Epidemiology, Radiobiology, and Risk) by NCRP President John Boice
Photo courtesy of NCRP

[William F. \(Bill\) Morgan](#) was a top-tier radiation scientist, visionary leader, and all-around good guy. He died prematurely in 2015 at the age of 62. NCRP helped organize two symposia in Bill's honor at the 2016 Radiation Research Society Annual Meeting—one in conjunction with the [Radiation Research Society](#) and the other with the [Conference on Radiation Health](#).

The symposia presentations were expanded and published as a [special issue](#) of the *International Journal of Radiation Biology (IJRB)* in 2017. The authors include eminent scientists in radiation biology, radiation epidemiology, radiation protection, and radiation medicine. Practically all topics are relevant to radiation protection for low-dose and low-dose-rate exposures. The topics include the linear no-threshold ([LNT](#)) model for radiation protection (and not for radiation risk assessment); the [epidemiologic basis of radiation protection standards](#)—with in-depth coverage of the dose and dose-rate effectiveness factor (DDREF), the low-dose effectiveness factor (LDEF), and the dose-rate effectiveness factor (DREF); and the [biological basis of radiation protection](#). The need and approaches for [biologically based models](#) to improve the estimation of low-dose risk was addressed, and the Multidisciplinary European Low-Dose Initiative ([MELODI](#)) was summarized.

Other topics of current interest in radiation protection include the [lens of the eye](#), interaction between mutations in [the ATM gene and radiation](#) and the subsequent risk of second primary breast cancer, a critical review of the [dosimetry](#) used in epidemiologic studies, the importance of an [unstable genomic landscape](#), and the latest evaluation of [cardiovascular disease in the Japanese atomic bomb survivor study](#).

This *IJRB* volume provides informative summaries of current radiation epidemiology and radiation biology approaches that enhance the understanding of low-dose radiation risks. This understanding will improve radiation protection guidelines for the general public and workers. This *IJRB* volume should be on your bookshelf (for those of you who still have books) or at least in your PDF reference files!