

# Preface

The previous National Council on Radiation Protection and Measurements (NCRP) Report No. 171, *Uncertainties in the Estimation of Radiation Risks and Probability of Causation* (2012) discussed the impact of uncertainties in the available epidemiologic data and in approaches used to extrapolate from these data to estimate adverse health outcomes at low doses and low dose rates of ionizing radiation. NCRP Commentary No. 24, *Health Effects of Low Doses of Radiation: Perspectives on Integrating Radiation Biology and Epidemiology* (2015) reviewed the available data on low-dose effects at the whole animal, cellular, and molecular levels and how these data might be integrated with epidemiologic data. The approach proposed in Commentary No. 24 built upon one used in the field of risk assessment for environmental chemicals, namely to develop adverse outcome pathways for radiation-induced cancer and noncancer effects (specifically circulatory disease) and to identify the key events along such pathways.

Key events are envisaged to be used as parameters in biologically based dose-response (BBDR) models for estimating risks at low doses and low dose rates. Simple and sophisticated BBDR models had been developed over a number of years, but since knowledge of the etiology of adverse health outcomes has been greatly enhanced in recent years more realistic and predictive models have been developed and can be further developed. There now exists an extensive resource available for the application of the adverse outcome pathways and key-events approach as applied to the risks from exposure to environmental chemicals (notably, from the Organization for Economic Co-operation and Development). Also, additional radiation epidemiologic data are becoming available that should provide valuable input into BBDR models. In particular, initial results from the “One Million U.S. Workers and Veterans Study of Low-Dose Radiation Health Effects,” coordinated by NCRP, are available now and additional results from the study will be published over the next several years. These data can serve as an important component of any BBDR modeling approach for estimating radiation risks at low doses and low dose rates.

This Report extends the concepts and approaches discussed in NCRP Report No. 171 and Commentary No. 24 to further reduce uncertainty in radiation risk assessments at low doses and low dose rates, thereby enhancing the bases for radiation protection guidance. The Report reviews in detail the:

- Types of data that constitute key events for specific radiation-induced adverse health outcomes (*i.e.*, cancer and circulatory disease) and how an understanding of critical key events might be developed through a targeted research program. The most informative current epidemiologic data for an integrated approach are identified and how additional epidemiologic data might be obtained is discussed.
- Available BBDR models, including their value to the current task and their limitations. In this context, new predictive models are proposed together with the parameters that could be used for propagating such models.
- Research needs for defining adverse outcome pathways and for obtaining reliable key-event parameters.

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