

Preface

Accurate exposure estimation in radiation epidemiologic studies is essential for reliable health risk assessment. Failure to account appropriately for uncertainties in dose estimation and model assumptions could lead to biased results in the evaluation of the radiation dose-response as well as incorrect confidence bounds for risk parameters. Assessment of absorbed dose is often subject to considerable uncertainties, and a variety of statistical approaches have been developed to incorporate dose uncertainties into the estimation and inference for the dose-response. The purpose of this Commentary is to provide a guide regarding available statistical methods for dose-response analysis that incorporate dose uncertainties, the types of studies to which the methods can be applied, and the advantages and disadvantages of the methods. This Commentary addresses studies of external and internal exposures and provides guidance on both shared and unshared uncertainty in the estimation of absorbed dose. Of particular interest are statistical methods for assessing dose-response in epidemiologic studies of internal emitters, for which doses are calculated using exposure and retention models with many parameters. Each parameter is associated with various sources and amounts of uncertainty.

This Commentary draws from and builds upon previous National Council on Radiation Protection and Measurements (NCRP) commentaries and reports on closely related topics, including:

- Commentary No. 14, *A Guide for Uncertainty Analysis in Dose and Risk Assessments Related to Environmental Contamination* (1996)
- Report No. 158, *Uncertainties in the Measurement and Dosimetry of External Radiation* (2007)
- Report No. 164, *Uncertainties in Internal Radiation Dose Assessment* (2009)
- Report No. 171, *Uncertainties in the Estimation of Radiation Risks and Probability of Disease Causation* (2012)
- Report No. 178, *Deriving Organ Doses and Their Uncertainty for Epidemiologic Studies* (2018)

The intended audience for this Commentary is dosimetrists, statisticians, epidemiologists, organizations, and decision makers concerned with evaluating health risks associated with exposure of cohorts to radiation.

This Commentary was prepared by Scientific Committee 1-28 on Recommendations on Statistical Approaches to Account for Dose Uncertainties in Radiation Epidemiologic Risk Models. Serving on Scientific Committee 1-28 were:

Co-Chairs

Jonine L. Bernstein
Memorial Sloan-Kettering Cancer Center
New York, New York

Harry M. Cullings
Radiation Research Effects Foundation
Hiroshima, Japan

Members

Michael B. Bellamy

Memorial Sloan-Kettering Cancer Center
New York, New York

Mark P. Little

National Cancer Institute
Bethesda, Maryland

Benjamin French

Vanderbilt University Medical Center
Nashville, Tennessee

Carmen D. Tekwe

Indiana University School of Public
Health
Bloomington, Indiana

NCRP Secretariat

Helen A. Grogan, *Staff Consultant*

Laura J. Atwell, *Director of Operations*

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Kathryn D. Held
President 2019 – 2024

Kathryn A. Higley
President