NCRP Commentary No. 34: Recommendations on Statistical Approaches to Account for Dose Uncertainties in Radiation Epidemiologic Risk Models

National Council on Radiation Protection and Measurements

NCRP Commentary No. 34, *Recommendations on Statistical Approaches to Account for Dose Uncertainties in Radiation Epidemiologic Risk Models*, evaluates multiple, commonly used, statistical approaches used to account for uncertainties in dosimetry estimates and reviews the application of various uncertainty estimation techniques.

Whenever possible, a rigorous analysis of dosimetric uncertainty should be included in every study, and statistical methods should be used to account for dosimetric uncertainty when estimating the radiation dose response.

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.

This Commentary addresses studies of external and internal exposures and provides guidance on both shared and unshared uncertainty in the estimation of absorbed dose, including:

- an overview of available statistical methods for dose-response analysis that incorporate dose uncertainties;
- exploration of the types of studies to which the statistical methods can be applied; and
- the advantages and disadvantages of the statistical methods explored.

The Commentary reviews eight different analytic methods commonly used to adjust for the effect of dose measurement error: simulation extrapolation, regression calibration, Monte Carlo maximum likelihood, Bayesian Markov chain Monte Carlo, two-dimensional Monte Carlo with Bayesian model averaging, frequentist model averaging, corrected information matrix, and moment reconstruction/moment-adjusted imputation. Each method has advantages and disadvantages that need to be weighed in each individual application.

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