



NCRP Report No. 178: Deriving Organ Doses and Their Uncertainty for Epidemiologic Studies (with a focus on the One Million U.S. Workers and Veterans Study of Low-Dose Radiation Health Effects)

National Council on Radiation Protection and Measurements

Key Points

- ◆ The goal of the dosimetry is to estimate annual absorbed doses to the organ or tissue that is assumed to be the origin of the radiation-induced cancer;
- ◆ Adjust dose reconstruction methodology for the study populations;
- ◆ Close coordination & interaction between dosimetric and epidemiologic teams is critical to success;
- ◆ Optimize resources: identify and apply a decision dose below which forgoing detailed dosimetry will substantially reduce effort without affecting the epidemiologic results;
- ◆ Obtaining doses from other facilities where individuals may have worked is important to consider.

Overview

This Report provides guidance in the derivation of organ doses and their associated uncertainty for epidemiologic studies in general, but with a focus on the populations that make up the One Million U.S. Workers and Veterans Study of Low-Dose Radiation Health Effects (MWS).

What's New and Why Is It Important?

Radiation protection guidance for occupationally exposed workers is based in large part on the risk estimates from the Japanese atomic-bomb survivor study. The MWS is an epidemiologic investigation of earlier U.S. workers and veterans exposed gradually over time and is considered more representative of U.S. worker populations, with respect to health, ethnicity and lifestyle factors, than the Japanese atomic-bomb survivors exposed during wartime in 1945 (where the predominant exposure occurred in less than a second). The aggregated MWS population is 10 times larger than the adult Japanese study population and has more individuals with cumulative recorded doses >100 mSv. Thus, the MWS has the potential to improve estimates of radiation risk and the related uncertainties for lower-level exposures that occur over a period of many years. Key elements of the report include:

Assessment of Organ Doses from External Sources

- The basic procedure for estimating organ doses from external irradiation is similar for all the study populations and starts with using personal or environmental measurement data that can be applied to a scenario of exposure.
- The process of deriving organ doses from dosimeter results is relatively straightforward for photons. For many of the study populations in the MWS, the sensitivity of the derivations is not very dependent on the photon energies or on the geometry of irradiation. However, exceptions are found in those study populations exposed to low photon energies.

Assessment of Organ Doses from Internal Sources

- Organ doses from internal sources can be estimated from bioassays or other biological techniques and must be combined with organ doses from external sources.
- Although the major source of radiation exposure for many study populations of the MWS comes from external penetrating radiation, some study populations have a meaningful component of radionuclide intakes that requires addressing specific assessment techniques. However, detailed dose reconstructions for such intakes may not be justified (based on considerable time and effort) below some screening level of intake of a given radionuclide.

Evaluation of Uncertainties

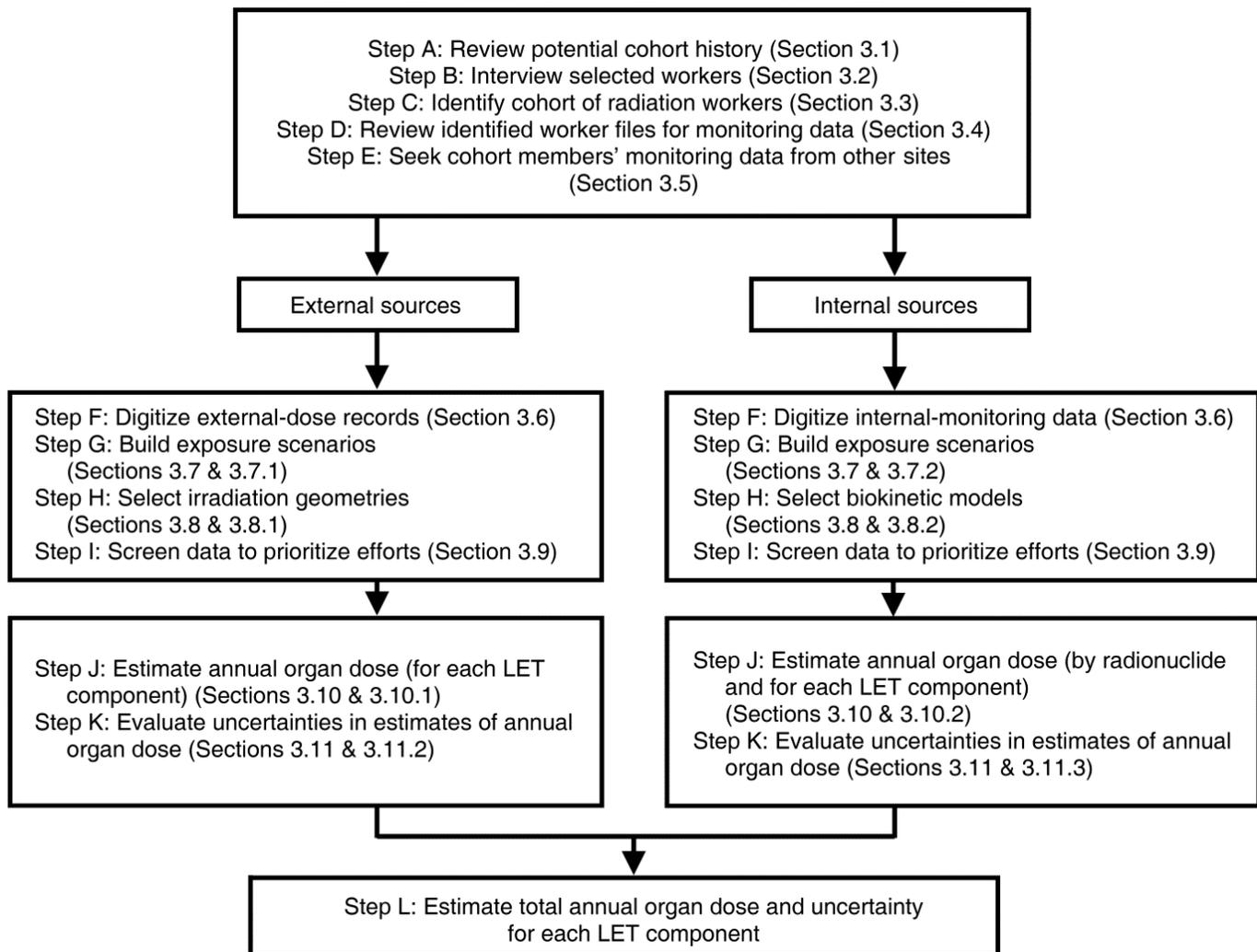
- All organ dose estimates obtained in a dose reconstruction have limitations and uncertainties that should be identified and considered when interpreting the results of the epidemiological investigation.



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The dose reconstruction process described in NCRP Report No. 178 is structured into the basic steps illustrated in the figure below. The noted subsections of Section 3 discuss in detail each step (A-L) in the process. Section 4 of the report provides detailed descriptions of the application of the dose reconstruction process for each of the study populations currently included in the MWS.

Basic steps of a worker dose reconstruction project (excerpt from Figure 3.1)



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