# A Bayesian Analysis of Uncertainties on Lung Doses Resulting from Occupational Exposures to Uranium

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In a recent epidemiological study, Bayesian estimates of lung doses were calculated in order to determine a possible association between lung dose and lung cancer incidence resulting from occupational exposures to uranium. These calculations, which produce probability distributions of doses, used the human respiratory tract model (HRTM) published by the International Commission on Radiological Protection (ICRP) with a revised particle transport clearance model. In addition to the Bayesian analyses, point estimates (PEs) of doses were also provided for that study using the existing HRTM as it is described in ICRP Publication 66. The PEs are to be used in a preliminary analysis of risk. To explain the differences between the PEs and Bayesian analysis, in this paper the methodology was applied to former UK nuclear workers who constituted a subset of the study cohort. The resulting probability distributions of lung doses calculated using the Bayesian methodology were compared with the PEs obtained for each worker. Mean posterior lung doses were on average 8-fold higher than PEs and the uncertainties on doses varied over a wide range, being greater than two orders of magnitude for some lung tissues. It is shown that it is the prior distributions of the parameters describing absorption from the lungs to blood that are responsible for the large difference between posterior mean doses and PEs. Furthermore, it is the large prior uncertainties on these parameters that are mainly responsible for the large uncertainties on lung doses. It is concluded that accurate determination of the chemical form of inhaled uranium, as well as the absorption parameter values for these materials, is important for obtaining unbiased estimates of lung doses from occupational exposures to uranium for epidemiological studies. Finally, it should be noted that the inferences regarding the PEs described here apply only to the assessments of cases provided for the epidemiological study, where central estimates of dose were sought. Approved dosimetry service assessments of exposures are unlikely to yield significant underestimates, as pessimistic assumptions of lung solubility would almost always be used.

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