An Intake Prior for the Bayesian Analysis of Plutonium and Uranium Exposures in an Epidemiology Study

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In Bayesian inference, the initial knowledge regarding the value of a parameter, before additional data are considered, is represented as a prior probability distribution. This paper describes the derivation of a prior distribution of intake that was used for the Bayesian analysis of plutonium and uranium worker doses in a recent epidemiology study. The chosen distribution is log–normal with a geometric standard deviation of 6 and a median value that is derived for each worker based on the duration of the work history and the number of reported acute intakes. The median value is a function of the work history and a constant related to activity in air concentration, M, which is derived separately for uranium and plutonium. The value of M is based primarily on measurements of plutonium and uranium in air derived from historical personal air sampler (PAS) data. However, there is significant uncertainty on the value of M that results from paucity of PAS data and from extrapolating these measurements to actual intakes. This paper compares posterior and prior distributions of intake and investigates the sensitivity of the Bayesian analyses to the assumed value of M. It is found that varying M by a factor of 10 results in a much smaller factor of 2 variation in mean intake and lung dose for both plutonium and uranium. It is concluded that if a log–normal distribution is considered to adequately represent worker intakes, then the Bayesian posterior distribution of dose is relatively insensitive to the value assumed of M.