

Learning from Former Nuclear Workers: Specifying Plutonium Material Type for Worksite-specific Dose Assessment

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The United States Transuranium and Uranium Registries (USTUR) studies actinide biokinetics and tissue dosimetry by following up occupationally exposed workers. At the USTUR, postmortem tissue radiochemical analysis data are used to improve biokinetic models for radiological protection. For accurate assessment of radiation doses from intakes of plutonium, information on material type is important. In occupational settings, inhalation is the most common route of intake. In this study, activity concentrations of plutonium isotopes were measured in the lungs, thoracic lymph nodes (LNTH), liver, and skeleton from 291 former nuclear workers from Hanford (116 individuals), Los Alamos (40), and Rocky Flats (135). To characterize plutonium material type (solubility), the LNTH-to-lung activity concentration ratios and liver-to-respiratory tract activity ratios were calculated. Since smoking affects plutonium material transport in the respiratory tract, LNTH-to-lung ratios for smokers and non-smokers were compared. With limited data analyzed, a significant statistical difference in the LNTH-to-lung concentration ratios was observed among three sites ($p = 0.0008$) with median values of 21.1 ($n = 108$), 31.5 ($n = 37$), and 11.4 ($n = 121$) for Hanford, Los Alamos, and Rocky Flats, respectively. The LNTH-to-lung ratios were significantly different between smokers and non-smokers ($p = 0.0066$) with the corresponding median values of 19.7 ($n = 156$) and 41.8 ($n = 41$). Highly significant difference among three sites ($p < 0.00001$) was observed for the liver-to respiratory tract activity ratios with median values of 3.25 ($n = 99$), 0.49 ($n = 34$), and 0.35 ($n = 110$) for Hanford, Los Alamos, and Rocky Flats, respectively, indicating that, among the three worksites, Hanford workers were exposed to the most soluble plutonium material. Information on plutonium material solubility can be used to improve worksite-specific dose assessment in support of radiation epidemiology.

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