

Plutonium in Manhattan Project Workers: Using Autopsy Data to Evaluate Organ Content and Dose Estimates Based on Urine Bioassay with Implications for Radiation Epidemiology

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Purpose: Radiation dose estimates in epidemiology typically rely on intake predictions based on urine bioassay measurements. The purpose of this article is to compare the conventional dosimetric estimates for radiation epidemiology with the estimates based on additional post-mortem tissue radiochemical analysis results.

Methods: The comparison was performed on a unique group of 11 former Manhattan Project nuclear workers, who worked with plutonium in the 1940s, and voluntarily donated their bodies to the United States Transuranium and Uranium Registries.

Results: Post-mortem organ activities were predicted using different sets of urine data and compared to measured activities. Use of urinalysis data collected during the exposure periods overestimated the systemic (liver+skeleton) deposition of ²³⁹Pu by 155±134%, while the average bias from using post-exposure urinalyses was -4±50%. Committed effective doses estimated using early urine data differed from the best estimate by, on average, 196±193%; inclusion of follow-up urine measurements in analyses decreased the mean bias to 0.6±36.3%. Cumulative absorbed doses for the liver, red marrow, bone surface, and brain were calculated for the actual commitment period.

Conclusion: On average, post-exposure urine bioassay results were in good agreement with post-mortem tissue analyses and were more reliable than results of urine bioassays collected during the exposure.

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