

## **Latent Bone Modeling Approach to Select Best Combination of Bones for Estimating Plutonium Activity Concentration in Human Skeleton**

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The United States Transuranium and Uranium Registries (USTUR) holds data and bone samples from 290 partial-body tissue donors. Bone samples collected at autopsy were radiochemically analyzed to estimate skeleton activity concentrations of plutonium, americium, and uranium. At the USTUR, the most commonly collected bone samples are rib, sternum, vertebral body, patella, clavicle, and femur middle shaft. Among these, patella, rib, and vertebral body are bones whose collection at autopsy is the easiest. This study applied the recently developed latent bone modeling (LBM) approach to select the best combination of sample bones for estimating the skeleton plutonium activity concentration ( $C_{skel}$ ). The analytical bone dataset contained plutonium concentrations for the 6 most commonly collected bones from 14 non-osteoporotic USTUR whole-body tissue donors with known  $C_{skel}$ . The LBM models were built for all possible combinations from these 6 bones. The LBM model residual standard error (RSE) was used to determine the best combination of bones. For two bones (15 combinations), RSEs ranged from 1.096 to 4.888 with the best combination being patella and clavicle; for 3 bones (20 combinations), RSEs ranged from 0.853 to 2.557 with the best combination being patella, clavicle, and rib; for 4 bones (15 combinations), RSEs ranged from 0.792 to 2.073 with the best combination being patella, clavicle, rib, and femur middle shaft; for 5 bones (6 combinations), RSEs ranged from 0.970 to 1.382 with the best combination being patella, clavicle, rib, femur middle shaft, and sternum. The LBM RSE for the 3 easy-to-collect bones (patella, rib, and vertebral body) was 1.522. The LBM RSEs for the two bone combinations of these 3 bones were 1.366 for patella and rib, 2.018 for patella and vertebral body, 2.499 for rib and vertebral body. It is worth noting that the patella and rib combination had smaller RSE (1.366) than that of patella, rib and vertebral body (1.522), although, in general, a smaller RSE is associated with a larger number of bones in the LBM.

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