

Purpose: To verify the adequacy of shielding installed in a PET/CT facility and to validate the predictions of the computer program used to design it.

Method and Materials: Optically stimulated luminescence dosimeters (Landauer, Glenwood, IL) were placed at various locations and integrated over three month intervals within a PET/CT facility containing two PET/CT scanners (GE Healthcare, Waukesha, WI), two empty bays for expansion, and 16 patient uptake rooms. Software written by us was used to design the radiation shielding based upon high projected workloads in all four scanner bays. The software produces a two-dimensional plot of weekly radiation dose superimposed on the facility floor plan. Typical lead thicknesses ranged from 10-25 cm (2-5 HVL at 511 keV). The facility was re-analyzed using the current patient workload (32 patients/day, 18-FDG radiopharmaceutical, 60 minute uptake, 30 minute scan) and the as-built shielding thicknesses. A cluster of four dosimeters was deployed in one location to assess the inter-dosimeter variation.

Results: Measured (predicted) weekly mrem doses were 67(86) inside an uptake room, 25(14) and 43(13) inside the scanner rooms, 1(7) outside of the scanner rooms, 2.2(1.5) at a nursing station, 1.3(2) in a central hallway, and <0.1(<1) in the public areas adjacent to the clinic. The variation among the cluster of four essentially identically exposed dosimeters was 12%.

Conclusion: Two-dimensional dose maps help in visualizing the context of and explain the point measurements. In addition to the conservatism built into the program, x-rays and variability in source locations (primarily dosed patients) may explain the discrepancies between the calculations and the measurements. At maximum workload the radiation dose levels within the uptake rooms would likely exceed the regulatory limit for occupational exposure. Movement of dosed patients within the facility constitutes a significant and complicated source of radiation that should be modeled for better accuracy.