AbstractID: 7401 Title: Monte Carlo computed dose kernels and convolution dose calculations for rapid internal dosimetry

Purpose: To compute tissue specific dose kernels using Monte Carlo (MC) methods for a variety of gamma-emitting radioisotopes to enable a rapid and accurate determination of organ doses from internal irradiation based on convolution dose algorithms. This is a part of the effort to develop countermeasures in response to a radiological terrorism or accident.

Methods and Materials: The EGSnrc Monte Carlo system was used to generate dose kernels in four types of materials (soft tissue, lung, bone, and air) for a series of possible isotopes that may be encountered in radiological terrorism. The list of isotopes includes: Cs-137, Ir-192, I-125, I-123, I-131, In-111, Tc-99m, Tl-201, Xe-133, and Sr/Y-90. Both gamma and beta emissions were considered for each. The dose kernels were constructed by extracting relative doses from the distributions generated by the EGSnrc simulations for each of the radioisotopes. These tissue-specific and isotope-dependent dose kernels are used in the convolution dose calculation algorithm. A software tool was developed with Matlab for rapid dose computation based on the algorithm. Preliminary comparisons were done.

Results: The dose kernels the radioisotopes in four media were generated, and the convolution algorithm was constructed with these kernels. The 3D dose distributions calculated with the convolution algorithms for three isotopes I-131, I-125, and Cs-137 distributed spatially in a heterogeneous phantom and a patient CT dataset were found to agree within 5% with those directly calculated with the MC method. The computing times for the convolution algorithm were a few minutes using a Pentium4 CPU and were at least 40 times shorter than those from the MC simulations.

Conclusion: The tissue-specific dose kernels are generated for a variety of possible radioisotopes that may be encountered in terrorism. The dose calculations using the convolution algorithm based on these kernels are fast and agree with the direct MC simulations.