Purpose:To compare S values for three classes of adult computational phantoms for Iodine-131 in the thyroid.

Methods:S values between the thyroid (source organ) containing I-131 and important target organs were compared for three classes of computational human phantoms: stylized (mathematical), voxel and hybrid. S values were calculated for International Commission on Radiological Protection (ICRP) reference adult voxel phantoms and the University of Florida (UF) adult hybrid phantoms by using the Monte Carlo transport code MCNPX2.5, and compared with S values derived 30 years ago at the Oak Ridge National Laboratory (ORNL) for their stylized phantom but using a different transport code. Eleven target organs were selected for comparison: brain, breast, stomach wall, small intestine wall, colon wall, heart wall, pancreas, salivary glands, thyroid, lungs, and active marrow. We also computed and compared specific absorbed fractions (SAF) and chord length distributions (CLD) among the phantoms for source and target organ-pairs.

Results:Our analysis showed on average, an underestimation of S values and, consequently, of organ doses for the ORNL stylized phantoms compared to the ICRP and UF phantoms. Inter-organ distance and organ shape differences were identified as the main cause of the differences.

Conclusions:The ICRP and UF phantoms are considered to more realistically model the human anatomy than the ORNL stylized phantoms. Therefore, the S value differences likely arise from unrealistic locations and shapes of the thyroid and target organs in the stylized phantoms. In addition, the S value differences between ICRP and UF phantoms illustrate there can be differences among phantoms designed to match the ICRP reference anatomy data, which suggests that human variability has not yet been fully described. This comparison indicates the value of the newer generation phantoms for conducting more reliable internal dosimetry.