AbstractID: 14186 Title: Evaluation of Different Benchmark Measurements for Validating Monte Carlo MDCT Source Models Used in Estimating Radiation Dose

Purpose: Monte Carlo simulation has become a popular method of estimating dose from multidetector computed tomography (MDCT) exams. Typically, MDCT modeling techniques and scanner-specific input information are validated using physical dose measurements made under very simple conditions, such as homogenous cylindrical phantoms (i.e. CTDI). The purpose of this study is to investigate the sensitivity of such measurements in order to assess their utility in validating scanner-specific x-ray source information used in MDCT simulation packages. **Method and Materials:** Two 64-slice MDCT scanners were used to obtain three types of benchmark measurements: 1) half and quarter value layers (HVL/QVL), 2) bowtie profiles (exposure values across the fan-beam), and 3) $CTDI_{100}$ values. Analogous Monte Carlo simulations were performed using two types of x-ray source models; (A) one based on physical measurements and (B) one based on information provided from other sources. **Results:** HVL/QVL simulations using source model A resulted in average disagreements of 8.1% and 10.5% for Scanners 1 and 2, respectively, while source model B had errors of 2.2% and 39.8%. Similarly, bowtie profile simulations had average errors of 0.7% and 4.0% for source model A and 5.3% and 19.4% for source model B. Finally, $CTDI_{100}$ simulation errors were 1.3% and 3.5% for source model A and 4.1% and 34.9% for source model B. **Conclusion:** The results show that the errors between measurements and simulations for the HVL/QVL and bowtie profile measurements reveal more fundamental and specific information about the accuracy of source models than does $CTDI_{100.}$ This implies that $CTDI_{100}$ may not be as sensitive as more elemental measurements for verifying the accuracy of more complicated dose simulations. This study shows that while $CTDI_{100}$ may be a necessary benchmark it is not sufficient for MDCT Monte Carlo dosimetry validation. Further testing in heterogeneous phantoms is needed to extend these sensitivity evaluations.