

Purpose: The charge of Task Group 186 is to provide guidance to early adopters of model-based dose calculation algorithms (MBDCA) for brachytherapy dose calculations.

Methods: Contrary to external beam radiotherapy (EBRT), the brachytherapy (BT) community has not widely adopted heterogeneity-correction algorithms. Yet, BT dose calculation accuracy is highly dependent on scatter conditions and photoelectric effect cross-sections relative to water. In specific situations, differences between the current water-based BT dose calculation formalism (TG-43) and MBDCA can lead to differences in dose calculation exceeding a factor of ten. MBDCA raise three major issues that are not addressed by current guidance documents: 1) MBDCA doses are sensitive to specification of dose medium, resulting in energy-dependent dose differences between computing dose to water in homogeneous water geometry (TG-43), dose to the local medium in the inhomogeneous geometry, and the intermediate scenario of computing dose to water in the inhomogeneous geometry. 2) MBDCA doses are sensitive to voxel-by-voxel interaction probabilities. Neither conventional single-energy CT nor ICRU/ICRP tissue composition compilations provide useful guidance for the task. 3) Since each patient-source-applicator combination is unique, having reference data for each possible combination to benchmark MBDCA is an impractical strategy. Hence, a new commissioning process is required.

Results: TG-186 addresses in detail the above issues through literature review and provides explicit recommendations based on the current state of knowledge. These recommendations include voxel-by-voxel tissue/organ material assignments based on modern imaging devices, applicators and shields, transport medium definition, dose scoring medium effects, a proposed commissioning process, possible changes in BT dose prescriptions, and MBDCA limitations. When data are insufficient, interim recommendations are made and potential areas of research are identified.

Conclusions: Application of TG-186 guidance should retain practice uniformity in transitioning from the TG-43 to the MBDCA approach.