Purpose:
To compare the dosimetric performance of a novel deterministic radiation transport method, Acuros XB (AXB), to Monte Carlo (MC) and two standard clinical convolution methods: the anisotropic analytical algorithm (AAA) and the collapsed-cone convolution (CCC)

Methods:
A multi-layer slab virtual phantom with three different materials (soft tissue, bone, and lung) was used for this study. 2.5, 5, and 10 cm fields for both 6 and 18MV were investigated. Depth dose and lateral dose profiles from AXB in Eclipse were compared to EGSnrc MC simulations, AAA in Eclipse, and CCC in Pinnacle3.. To quantify dose distribution differences between AXB and AAA or CCC, 3D gamma index analyses were conducted for regions defined by AAPM TG-53.

Results:
The AXB calculations were found to be closer to MC than both AAA and CCC for all the investigated fields. The average differences of depth dose profiles between MC and AXB, AAA or CCC was within 1.1%, 4.4%, and 2.2%, respectively for all fields and energies. More specifically, differences in bone were up to 1.1%, 6.4%, and 1.6%; differences in lung were up to 0.9%, 11.6%, and 4.5% for AXB, AAA and CCC respectively. AXB was also found to have better dose predictions than AAA and CCC at the tissue interfaces where back-scatter occurs. 3D gamma index analyses (percent of voxels passing 2%/2mm) showed that the dose differences between AAA and AXB are significant (under 60% passed) in bone for 6 MV, and in lung for both energies. The differences between AXB and CCC were smaller with over 90% passing except in lung for the 18 MV 10cm field.

Conclusions:
For the fields studied in heterogeneous media, AXB dose prediction ability appears to be comparable to MC and superior to current clinical convolution methods.