Purpose: To determine the impact of a grid based Boltzmann solver (GBBS) on a cohort of cervical cancer patients treated with Ir-192 intracavitary brachytherapy with shielded applicators.

Methods: Retrospective plans were generated using BrachyVision v8.8 (TPS) with GBBS Acuros v1.3.1. The study includes 24 patients that had CT planning images acquired with CT/MR compatible applicators. Using the TPS applicator library, shielded colpostats and tandem (#AL13122005) were virtually positioned to replace the applicators seen on CT. Dwell weights were based on TG43 delivering 6 Gy to point A. Four GBBS calculations were performed to assess differences from the standard of practice TG43. The different GBBS calculations were: 1) no applicator modeled, body= 1 g/cc muscle, 2) applicator modeled, body=1g/cc muscle, 3) applicator modeled, CT-to-material mapping with contrast (vaginal packing, rectal, Foley balloon) = 1g/cc muscle, and 4) applicator model, CT-to-material mapping without material overrides. The multiple GBBS calculations allow differences from TG43 to be attributed to factors representing the modeling of source and patient boundaries (scatter conditions), tissue heterogeneities, and applicators.

Results: Differences between GBBS4 and TG43 at clinical dosimetric points were as follows: [mean ± standard (min, max)], Point A: -2.5% ± 0.5% (-3.8% , -1.2%), Point B: -1.5% ± 1.0% (-3.2% , 1.1%), ICRU rectum: -8.4% ± 2.5% (-14.0% , -4.1%), D2cc rectum: -6.2% ± 2.6% (-11.9% , -0.8%), ICRU bladder: -7.2% ± 3.6% (-15.7% , -2.1%), D2cc bladder: -3.4% ± 1.8% (-7.2% , -1.1%). Bar plots comparing the modeling factors previously listed show that applicator modeling is the largest contributor to differences from TG43.

Conclusions: Clinically significant dose differences (>5%) relative to TG43 exist when using a model-based dose calculation algorithm such as the GBBS with shielded applicators. Differences were largely due to applicator modeling, not tissue heterogeneities, source modeling, or patient boundary modeling.