Purpose:
An optimization program using Adaptive Simulated Annealing (ASA) algorithm was developed in Rush University Medical Center for HDR volumetric brachytherapy. The purpose of this paper is to benchmark our program against a well established commercial system (IPSA) and compare optimized plans using physical dose-based IPSA and gEUD-based cost functions.

Methods:
Eight cervical cancer Syed-template cases were used. The prescribed dose was 35Gy in 5 fractions from HDR brachytherapy after 45Gy from external beam. Treatment plans were generated based on IPSA cost function using both IPSA and ASA programs and a gEUD-based cost function using ASA program. The dosimetric parameters compared include V150% and V200% for PTV, V75%, for bladder and rectum, Homogeneity Index (HI), Conformity Index (COIN), gEUD of each ROIs, tumor control probability (TCP), and normal tissue complication probability (NTCP). Friedman rank test was used to analyze the statistical significance of these differences between plans.

Results:
For PTV dose distribution homogeneity and conformity, the ASA plans were slightly better than IPSA plans but the differences were not statistically significant. In IPSA plans, the average Bladder V75% was lower than that in ASA plans; but the average Rectum V75% was higher than that in ASA plans and the differences were significant. The average PTV_gEUD and TCP of gEUD-based plans were larger than those of IPSA plans, but the differences were not significant. The Bladder gEUD and NTCP of IPSA plans were lower than those of gEUD-based plans, but the differences were not significant. The Rectum gEUD and NTCP of gEUD-based plans were lower than those of IPSA plans, and the differences were significant.

Conclusions:
Our ASA optimization program can generate comparable optimized plans to IPSA. The dose distribution in gEUD-based plans is less homogeneous and less conformal than in IPSA plans. However gEUD-based plans have better OARs sparing than IPSA plans.