Purpose: To prospectively compare plans generated with iCycle, an in-house developed algorithm for fully automated multi-criterial IMRT beam profile and beam orientation optimization (Breedveld, Med. Phys. 2012), and plans manually generated by dosimetrists with the clinical treatment planning system.

Methods: For 20 randomly selected head-and-neck cancer patients with various tumour locations (of whom 13 received sequential boost treatments) we offered the treating physician the choice between an automatically generated iCycle plan and a manually optimized plan following standard clinical procedures. While iCycle used a fixed 'wish-list' with hard constraints and prioritised objectives, the dosimetrists manually selected the beam configuration and fine-tuned the constraints and objectives for each IMRT plan. Dosimetrists and treating physicians were not informed in advance whether a competing iCycle plan was made or not. The two plans were simultaneously presented to the physician who then selected the plan to be used for treatment.

For the patient group, we quantified differences in PTV coverage and sparing of critical tissues.

Results: In 32/33 plan comparisons the physician selected the iCycle plan for treatment. This highly consistent preference for automatically generated plans was mainly caused by improved sparing for the large majority of critical structures. With iCycle, the NTCPs for parotid and submandibular glands were reduced by 2.4% ± 4.9% (maximum: 18.5%, p=0.001) and 6.5% ± 8.3% (maximum: 27%, p=0.005), respectively. The reduction in mean oral cavity dose was 2.8 Gy ± 2.8 Gy (maximum: 8.1 Gy, p=0.005). For swallowing muscles, esophagus and larynx, the mean dose reduction was 3.3 Gy ± 1.1 Gy (maximum: 9.2 Gy, p<0.001). Moreover, for 15 patients, the target coverage was improved as well.

Conclusions: In 97% of cases, the automatically generated plan was selected for treatment because of superior quality. Apart from improved plan quality, automatic plan generation is economically attractive because of reduced workload.