Purpose: Treatment plan evaluation based on daily images, to determine whether it is necessary to re-plan the treatment, is an essential element of adaptive radiotherapy. A fully automatic system, incorporating physician preferences and requirements of specific protocols quantified by a series of objective functions, was developed to evaluate treatment plans.

Methods: The evaluation system was developed using IDL 6.1 (ITT Visual Information Solutions, Boulder, CO). Based on customized evaluation guidelines, dosimetric parameters, including maximum dose, minimum dose, uniformity dose, dose coverage, conformity index, heterogeneity index, $\text{gEUD}$, and DVH for the targets and OARs are evaluated as series of cost functions which incorporate specific protocol constraints and physician requirements. The evaluation system was applied to IMRT plans of head/neck cancer patients. The Pinnacle Treatment Planning System (research version 9.0) was used to generate verification treatment plan trials, with image datasets, ROI structures, and dose distributions exported to evaluation system.

Results: Results show that the evaluation system can complete evaluation of a dose plan within 2~8 seconds. The system is capable of displaying and comparing dose distributions among different plans. It also demonstrates great flexibility in customizing cost functions based on physician preferences. This system is supported with various user-friendly options, graphical displays, and feasibly structure in adding new modules.

Conclusions: This evaluation system is capable of quantifying specific protocols and preferences of physicians and completing automatic evaluation almost in real-time. It is an essential a platform for adaptive radiation therapy and also valuable for initial treatment planning.

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