Purpose: To test a new property that can be used as an effective prognostic indicator of rectal toxicity against rectal bleeding data in prostate cancer patients.

Methods: The method is based on dose to surface and accounts for spatial relationship between rectal surface elements. A property that is a function of the dose at 2 points on the rectal surface weighted by a function dependent on the distance between the points is proposed as an alternative to DVH criteria for predicting rectal toxicity. The weighting function was described as a logistic function. The shortest distance between the points i and j on the rectal surface was approximated using the multistencil fast marching method (MFMM). This approach approximates a solution to the Eikonal equation which describes the propagation of an advancing wavefront from a source point, i. Then, the distance between any points, i and j, can easily be determined if the speed is constant. For each patient the maximum value of the property calculated for all surface elements is considered as a candidate for predicting rectal bleeding. The property was calculated for 170 patients who underwent external beam radiotherapy for prostate cancer and followed-up for rectal bleeding. The prognostic value of the property was evaluated using log-rank test for actuarial incidence of complications. A range of logistic function parameters was considered.

Results: Eighty seven cases using various combinations of the constants that control the slope and inflection point of the logistic function have been processed. The maximum value of the metric spanned a range from 32.37 to 599.8 (Gy•cm)^2. The analysis for the prognostic power of the property is in progress.

Conclusions: The proposed rectal surface property incorporates dose as well as spatial relationship between rectal surface elements. It is easily calculated for an arbitrarily complex geometry.