As advances in radiotherapy technology have enabled treatments with increasing precision, they have also underscored the importance of accounting for positional uncertainties, such as patient setup error and organ motion, in the treatment planning process. The standard approach to conformal therapy planning is to define a planning target volume (PTV) that is to receive the prescribed dose and that encloses a clinical target volume (CTV) containing visible and subclinical tumor, with a margin to account for variation in CTV position relative to the treatment beams. Various imaging technologies and associated software tools have facilitated measurements of setup error and organ motion in sizable statistical samples of patients, thus permitting more accurate determination and assessment of PTV margins. Studies have shown that the magnitude of uncertainties may vary with direction and location, suggesting that the use of nonuniform margins may yield more optimal target coverage and normal tissue sparing than uniform ones.

This presentation will discuss various approaches to the design of target volumes in conformal therapy. Examples will be shown in which setup error and organ motion is characterized from measurements, then applied to the determination of appropriate PTV margins. Future directions will also be discussed, such as alternative approaches to PTV definition and computerized design of target volumes.

Educational Objectives:

1. Determination of planning target volume margins.
2. Review of future directions in target volume design.