Objective: to discuss dose reporting issues emphasizing problems with dose inhomogeneity.

The ICRU Report 50 describes and recommends systematic methods for dose prescribing, recording, and reporting for photon beams. The supplement to ICRU Report 50 - the ICRU Report 62 further explores the problem discussing some weaknesses in the recommendations of the Report 50. Because a dose distribution is intrinsically a multidimensional object (with volumetric and temporal dimensions), the problem of concise but also clinically meaningful reporting is not trivial. Ideally, a dose report of a given treatment plan should be perfectly correlated with the clinical consequences of the plan. After all, one of the essential objectives of dose specification is to provide relevant data for subsequent analyses of the observed clinical results, in order to optimize the treatment strategy. Unfortunately, dose distributions are never exactly uniform, and may often be far from it, especially for normal tissues. It is impossible to quantitatively evaluate, compare, and score two or more non-uniform three-dimensional (3D) dose distributions without reducing them to the corresponding single numbers. It is intuitively sensible to represent a 3D dose distribution for a given structure of interest by a single number - a dose that, when delivered uniformly to that structure, would result in the same relevant effect (say, probability of local control for tumors, or probability of complication for normal tissues). This concept of Equivalent Uniform Dose (EUD) has recently been proposed and investigated [1, 2]. The EUD takes into account dose inhomogeneity and absolute volume of the irradiated structure, and may also incorporate dose per fraction effects and cell proliferation. The EUD concept can be applied to both tumors and normal structures. It can be shown that for tumors the EUD is always bounded by the minimum target dose and the mean target dose. For normal structures the EUD is bounded by the mean dose and the maximum dose. For a given dose distribution (or a given dose-volume histogram) the value of EUD is organ dependent. For example, the EUD is closer to the maximum organ dose for the spinal cord, and it is closer to the mean organ dose for the lung.

It should be emphasized that the clinical response of a given patient depends not only on the delivered dose distribution but also on other non-dosimetric considerations (for example histology, gender, age, concurrent chemotherapy, genetic predisposition, and stress). In addition, some important functional end-points depend not only on the local dose but also on the dose outside the structure of interest. For example, in lung cancer treatment radiation pneumonitis may develop in the unirradiated lung. Clearly, this effect is not determined by the dose distribution within this lung no matter how we report that dose.

1. Niemierko, A. Reporting and analyzing dose distributions: a concept of equivalent uniform dose. Medical Physics. 24(1): 103-10; 1997.

2. McGary, J. E.; Grant, W., 3rd; Woo, S. Y. Butler, E. B. Comment on "Reporting and analyzing dose distributions: a concept of equivalent uniform dose" [Med. Phys. 24, 103-109 (1997)] [letter; comment]. Medical Physics. 24(8): 1323-4; discussion 1325-7; 1997.