

Purpose: Empirical dose measurement with physical detectors is an essential aspect of quality assurance in radiation therapy. Factors such as patient setup, treatment plan error, and physiologic motion work to degrade the accuracy of dose delivery in moving from *in vitro* to *in vivo* dose measurements.

Method and Materials: This analysis draws from published measurements with diode dosimeters and the authors' experience with an implantable dosimeter system. The spread in measured values for three situations will be evaluated: (1) a solid-state dosimeter on a fixed phantom with a single field exposure, (2) a solid-state dosimeter attached to the skin surface of a patient, (3) a solid-state dosimeter implanted into the GTV of a tumor for the full course of external beam treatment.

Results: Histograms plotted for the three measurement situations show an increase in the variance of recorded values in moving from a fixed phantom to the interior of the patient. In particular, data from implanted sensors for breast and prostate patients both show a substantial number of dose deviations (from the treatment plan) above 5% and also at 8% and above. In addition to daily variations in delivered dose, with an essentially Gaussian character, offsets from a mean of zero were seen in the implanted dosimeter data.

Conclusions: This study highlights the chain of approximations occurring between the last empirical check of dose accuracy, at the machine level, and the actual delivered dose at depth in the patient. The data from the three evaluation setups is sensible in that one finds a series of expanding Gaussian distributions in going from a very well controlled to a less well controlled setup. The frequency of errors in excess of 5% for sensors at depth in patients suggests that clinically relevant deviations in dose at depth may be common.