A statistical analysis would be needed to determine whether potentially 5 – 12% of the patients having dosimetry errors would have an impact on a trial outcome. In addition it is not known how, reducing or increasing the frequency of the audit, would impact on the outcome of a trial due to the uncertainty in patient dosimetry. Published data by Bentzen et al reviewing EORTC trial results indicate that, based on their TLD audit program, in cases where the beam calibration was low or high there were decreases in tumor control probability or increases in normal tissue morbidity, respectively, when looking at the clinical dose response data. The Bentzen article also indicated that sequential TLD audits improved the uniformity of the clinical outcome and that small deviations (2-3%) in beam output might lead to clinically important variations in outcome. These same conclusions were reached by Pettersen et al when they discussed the impact of dosimetry quality assurance and its impact on sample size in randomized clinical trials as well as by Boyer and Schultheiss who looked at the effect of dosimetry uncertainty on complication-free local tumor control.

### Results

Over the past 8 years approximately 5% of the megavoltage photon beams audited with TLD have fallen outside of the RPC’s ±5% dose criteria requiring some action and follow-up by the RPC staff. Today this would represent approximately ~140 photon and ~350 electron beams from nearly 3200 machines used to treat clinical trial patients. Of the approximately 770 institutions the RPC physicists have visited since its inception to conduct an on-site dosimetry review visit and who contribute ~85% of all clinical trial patients that receive radiotherapy, approximately 15 - 20% of these institutions per year (~150 institutions) (figure 3) have one or more photon or electron beams outside of the RPC’s criteria requiring an investigation by the RPC.

If one takes a closer look at the TLD results for institutions in terms of their patient contributions and limiting the data to photon beams, the percent of total patients per year affected by the photon beams outside the RPC’s TLD criterion ranges from 5 to 12% as seen in Figure 5. These data were derived from knowing the numbers of patients put onto clinical trials by each institution, the number of photon beams at each institution and the fraction of the photon beams outside of the RPC’s ±5% criterion for the TLD audit.

A further breakdown (figure 5) of these data in terms of photon beams only, and not institutions, show that the percent of photon beams that are outside of the RPC’s 5% criterion range from 3 - 5%. Very few institutions (~50 out of 150 per year) have unacceptable TLD results in two consecutive years. This is because the RPC investigates the discrepancies and follows up with the institution to make sure the errors have been resolved. Performing less frequent audits will result in more institutions with undiscovered calibration errors for longer periods of time.

### Materials & Methods

The RPC’s TLD program uses TLD 100 (LiF powder) in small capsules that are placed in acrylic blocks that serve as mini-phantoms. These blocks are mailed to institutions where they are irradiated to 300 cGy (see figure 2) and returned to the RPC for analysis. The criterion used by the RPC is ±5%. The RPC sends repeat TLDs to an institution after investigating the cause of the first TLD discrepancy.

### References


### Support

The investigation was supported by PHS grants CA10953 and CA81647 awarded by the NCI, DHHS.