AbstractID: 14482 Title: Out of Field Dose From Photon Radiotherapy: Magnitude, Evaluation, and Impact

Dose outside of the target volume is an unavoidable consequence of radiation therapy. This undesirable radiation is clearly a concern for pregnant patients as the fetus is highly radiosensitive. Similarly, out-of-field radiation is a concern for patients with implanted cardiac pacemakers or defibrillators as electronic failures may be induced by relatively low doses of radiation. Out-of-field dose has also received attention due to its potential for inducing late effects such as second malignant neoplasms, heart disease, or stroke. In recent years patient survival has increased due to more efficacious treatments resulting in more long-term survivors. These long-term survivors have an increased risk of developing a radiation induced late effect. Compounding this, modern radiotherapy techniques, such as intensity-modulated radiation therapy (IMRT) may increase the out-of-field dose, increasing the risk per person of developing a late effect. The above concerns surrounding out-of-field dose are confounded by the number and complexity of modern radiotherapy delivery techniques, such as IMRT, Tomotherapy, Cyberknife, and Gamma Knife treatments.

Out-of-field dose is not accurately reported by commercial treatment planning systems and other methods for assessing this dose are necessary. Therefore, measurements or calculations are often performed to evaluate out-of-field doses. As there are a variety of measurement and calculational options available, it is worthwhile exploring the strengths and limitations of each, as well as particular cautions that may be required. Monte Carlo calculations may be much more accurate than treatment planning system calculations, but require substantial infrastructure and modeling. Measurements may be a reasonable approach, but it is nevertheless possible to have substantial error in the measurement, particularly with TLD.

This presentation will examine the out-of-field dose associated with the variety of different treatment modalities that are currently available. The sources and relative importance of head leakage, collimator scatter, and patient scatter will be compared, and parameters that impact the out-of-field dose will be examined. The impact of treatment energy will be discussed, particularly in the context of neutron production and the biological potency of neutrons. Finally, approaches to measure and calculate the out-of-field dose will be examined, and the limitations and challenges of many such approaches will be explored.

Learning objectives:

1. Understand the magnitude of out-of-field dose and treatment parameters that affect it
2. Understand the limitations of treatment planning system calculations
3. Understand techniques and challenges of measuring out-of-field doses
4. Understand the impact of these doses on patient care