

## How Safe is "Safe"? Radiation Exposure From Intraoperative CT in Traditionally Safe Operating Room Zones

*Amy Ford, MD; Bartosz Wojewnik, MD*

*Loyola University Medical Center, Maywood, IL, United States*

**Purpose:** Radiation exposure is an occupational hazard for all operating room staff. The NCRP (National Council on Radiation Protection and Measurements) recommends a maximum occupational whole-body radiation exposure of 5,000 mrem/year, with lower limits of 100 mrem/year for the general public and a 100- mrem prenatal total for pregnant women. Intraoperative CT has many applications within orthopaedic surgery. During a scan, safety measures may be taken to decrease exposure, including wearing lead aprons and increasing the distance from the source by moving to the substerile room or to the outside of the operating room. The purpose of this study is to quantify the amount of radiation exposure that occurs in areas of the operating room that are generally believed to be safe.

**Methods:** The experiment was conducted in a standard operating room at a Level-I tertiary referral center. The Medtronic O-arm surgical imaging system was used, and a phantom comprised of a lucite block simulated a 70- kg body. Inovision 451P-RYR radiation survey instruments were used to measure exposure rate and integrated dose per scan. Six locations were measured, including the position of the anesthesiologist (80 cm), the position of the radiation technologist (180 cm), the substerile room (500 cm), the operating room door (600 cm), the next-room nursing station (960 cm), and the hallway (1000 cm).

**Results:** Mean exposure rate was highest at the anesthesiologist (2200 mrem/hr), followed by the door (25.33 mrem/hr), the technologist (21.0 mrem/hr), the substerile room (8.2 mrem/hr), the hallway (2.633 mrem/hr), and then the next-room nursing station (1.557 mrem/hr). The mean integrated doses per scan were 15.03 mrem for the anesthesiologist, 0.170 mrem for the technologist, 0.136 mrem at the door, 0.033 mrem in the substerile room, 0.014 mrem in the hallway, and 0.005 mrem at the next-door nursing station.

**Conclusion:** Reaching the annual nonoccupational maximum would take 6 scans at the anesthesiologist's position, 588 scans at the technologist's position, 735 scans at the door, 3030 scans in the substerile room, 7142 scans in the hallway, and 20,000 scans in the adjacent operating room. Exposure at the operating room door is equivalent to 1.7% that of a chest radiograph. Although there is measurable radiation exposure outside of the operating room, the magnitude is low enough to be clinically insignificant for the 1-time accidental exposure. This study provides data that reinforce the need to wear protective gear or leave the room during the use of intraoperative CT, but unsuspecting next-door operating room staff need not worry about uninformed exposure.