Purpose: To quantify the cumulative dose contribution to implantable cardiac rhythm management devices (ICRMDs) from cone beam CT (CBCT) for patients undergoing radiotherapy and to investigate dose reduction strategies.

Methods: An implantable pacemaker (IP) and implantable cardioverter-defibrillator (ICD) with internal MOSFET dosimeters were used to measure the cumulative CBCT dose to the IP and ICD. Specifically, the MOSFET threshold voltage shifts resulting from standard clinical CBCT imaging protocols were recorded and compared to shifts caused by peripheral megavoltage dose associated with 6 MV IMRT treatment delivery. The dose assessments were performed on an anthropomorphic phantom with the IP or ICD placed in the left clavicular area both inside and outside of the CBCT field of view (FOV). Two dose reduction strategies were evaluated: the use of a 2 mm copper plate to shield the device during imaging and the use of partial-angle scanning.

Results: The average internal IP and ICD doses due to standard clinical CBCT imaging protocols with the device inside the FOV were in the 2.2 – 4.3 cGy and 0.8 – 1.9 cGy range, respectively, but could reach as high as 11.2 cGy per scan. Five centimeters outside the FOV, the dose can reach up to 10% of the in-field dose in the cranio-caudal direction and up to 70% in the medio-lateral direction. Copper shielding resulted in a 3-fold reduction in total CBCT dose and a posterior 180 degree scan reduced the dose by a factor of 8 in comparison to a full 360 degree scan.

Conclusions: The CBCT imaging dose to ICRMDs can be substantial and needs to be accounted for. Use of a MOSFET dosimeter during the first treatment fraction is an effective way of obtaining a reasonable upper limit of the average cumulative ICRMD dose. Partial posterior scans can greatly reduce this dose.