AbstractID: 4979 Title: The Effect of Subcutaneous Fat on Patient Effective Dose in Diagnostic Radiology

Purpose: To quantify the dependence of effective dose on subcutaneous fat thickness in x-ray radiography and develop a set of relative radiation risk factors for comparing overweight to "lean" patients.

Materials and Methods: Using the MCNP Monte Carlo code and geometric phantoms patterned after Christy *et al*, effective dose calculations were performed for abdominal and chest radiographs of a "normal weight" adult male phantom. The effective dose, E_o, was normalized to the number of x-rays exiting the patient to model a constant exposure to the image receptor. Varying thicknesses of adipose tissue were then added to the anterior, lateral, and /or posterior regions of the torso of the phantom and the normalized effective dose, E, calculated at the same kVp and source to image receptor distance. The ratio E/E_o provides an index of the increased stochastic risk. Anterior:lateral:posterior fat ratios used ranged from 6:5:1 to 1:3:6 with total anterior plus posterior additional fat thicknesses extending from 1 to 30 cm.

Results: For AP and PA projections, both the lateral fat and the fat layer proximal to the x-ray beam had negligible effect on E/Eo. E/Eo was shown to depend only on the *distal* fat layer thickness with an exponential dependence of the form exp(kx), where k is an exam/kVp specific constant, and x the distal fat layer thickness. For the AP abdominal projection, k values were 0.127, 0.119, 0.106, and 0.094 cm^{-1} at 80, 100, 120, and 140 kVp, respectively. R^2 for all fits were better than 0.96. E/Eo ranged as high as 12.4 for an extremely obese patient with 20 cm of posterior fat at 80 kVp.

Conclusions: Overweight and obese patients incur significantly elevated stochastic risks from radiographic procedures as compared to their lean counterparts, depending upon the kVp and fat layer thickness closest to the image receptor.