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Effect of patient' bladder voiding and body self attenuation on measured dose rates around patients undergoing PET/CT imaging using 18F-FDG

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Accurate dose rate estimates is important for radiation protection specialists conducting risk assessments and performing dose reconstruction in cases of accidental exposures. The American association of physicist in medicine (AAPM) in their report TG-108 shielding design for positron emitted tomography/computed tomography (PET/CT) imaging facilities recommends the use of a dose rate constant of $92 \mu\text{Sv/hr/GBq}$ for Fluorine-18 based compounds. The proposed value takes into account the effect of the patient' body self attenuation.

The objectives of this work was first to experimentally measure the patient attenuation factor by performing direct dose rate measurements from patients undergoing PET/CT imaging studies using fluorodeoxyglucose 18F (FDG). Second objective was to quantify the effect of patients' bladder voiding on the measured dose rate values measured from the patients before and after voiding; self -attenuation of radiation by patient's bodies was quantified, and found to cause a significant decrease in radiation exposure of about 37% due to non-uniform distribution of FDG and attenuation within the patients' bodies. The bladder voiding effect had a dose rate reduction factor of about 10% between dose rates measured before and after voiding. We have measured dose rates at one meter from 55 patients and found an average dose rate of $90 \mu\text{Sv/hr/GBq}$, therefore we conclude that dose rate constant proposed by the AAPM is adequate.

The presented data can be applied in radiation protection optimisation procedures, especially for the protection of the care givers from patients undergoing FDG PET/CT imaging when they are considered as external radiation source or hazard to others.

The presented information will benefit medical physicist working in nuclear medicine and radiation safety policy makers.

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