# Radiation exposure in PET, SPECT, CT and hybrid systems – commonly asked questions

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In modern Nuclear Medicine Departments very different types of radiations can coexist, since gammas, betas, X-rays might be present, with eventually neutrons on facilities including cyclotron based activities. As working with unsealed sources of ionizing radiation, Nuclear Medicine Technologists (NMTs) should clearly understand the nature of the distinct materials they are dealing with as well as the inherent security rules and how their behavior will affect their own radiation exposure, as well as others (staff, patients and members of the public) and environment.

In this Mini-course we will not have the time to cover all the topics equally, so we will focus on the most important ones, like X-rays, gamma and beta radiation exposure.

The three elementary radiation protection rules are exposure time, distance to the irradiating source and shielding devices used. Radiation exposure of an individual will always greatly depend on the strict application of these rules, as well as on the type, energy and half-life of the emitter. Other potentially critical factors are the administered doses, the type of facility (space available), the patient workflow and the number of professionals per type of task (for instance: doses partition – especially when done manually – doses transport and administration, patient preparation and positioning, etc.)

The use of PET in clinics has been demonstrated as the ever fastest growing medical imaging specialty, being actually present all over the world, showing a sustained increasing tendency, often with two figures. It is known that in the context of PET and PET/CT, radiation protection rules are much stricter than in the context of conventional Nuclear Medicine because of the higher gamma energy emitted, reason why they will receive special attention.

The physical characteristics of positron emissions results in a potentially higher radiation risk for staff involved. The penetrating ability of the high-energy 511 keV gamma photons produced from the annihilation reaction of a positron and an electron is greater than that of the 140 keV emissions characteristic from the classical $^{99m}$Tc-based compounds. The specific gamma ray dose constant, defined as the dose rate in the air for 1 MBq of a radionuclide at a distance of 1 meter, is six times higher for $^{18}$F than for $^{99}$mTc.

Even if values published demonstrates always values comfortably far from the legal annual limits, the staff involved with PET and PET-CT procedures usually presents higher effective doses. This is due to the higher gamma ray energy of positron-emitting nuclides, which moreover is emitted twice per single decay event and correspondingly more difficult to provide an efficient set of shielding measures. Furthermore, close to the patient, a non-negligible dose is emitted by positrons at the patient surface, that are known to be not so effectively absorbed by air as by soft tissues. To reduce radiation exposure it has been clearly demonstrated the need and the adequacy of a policy of continuous education through professional life and a permanent pro-active attitude concerning this critical issue.

To complete the presentation, a complete set of questions, chosen from the most relevant FAQ, considering the issues here treated and the health professionals involved, were prepared and will be presented with the correspondent answers and comments.

**References**

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