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Nuclear medicine

Week 2; Lecture 5; Section 3: Sensitivity in PET

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Section 3

Sensitivity in PET

Sensitivity

Sensitivity is determined primarily by detector efficiency and solid angle coverage

True coincidence count rate $\mathcal{R}_{\rm True}$ for a positron-emitting source in air near midpoint between a pair of detectors is:

$$\mathcal{R}_{\rm True} = (\mathcal{R}_{\rm e^+})\, \epsilon^2 G \exp{(-\mu T)}$$

where:

- $\mathcal{R}_{\rm e^+}$ is the rate of positron emission (positrons/sec)
- ϵ is the intrinsic detector efficiency:

$$\epsilon = \frac{\text{no. of } \gamma\text{−rays recorded by detector}}{\text{no. of } \gamma\text{−rays “hitting”detector}}$$

- G is the geometric efficiency of an individual detector:

$$G \approx \frac{A_{\rm det}}{\pi D^2}$$

- μ is the linear attenuation coefficient, T the total thickness

Sensitivity: examples of efficiencies

Intrinsic detector efficiency for a variety of scintillators

Scintillator	$\mu_{scintillator}$ (cm^{-1})	ε (2 cm)	ε^2 (2 cm)	Photon yield (per keV)
NaI (TI)	0.34	0.49	0.24	38
BGO	0.95	0.85	0.72	8
LSO	0.88	0.83	0.69	20-30
GSO	0.70	0.75	0.57	12-15

Summary of section 3

Sensitivity determined by:

- Activity of the radiotracer;
- Intrinsic efficiency of the detector;
- Geometrical efficiency of the detector; and
- Containment of energy deposit in scintillator crystal