Implementation of nuclear medicine quality assurance programme in Lithuanian hospitals

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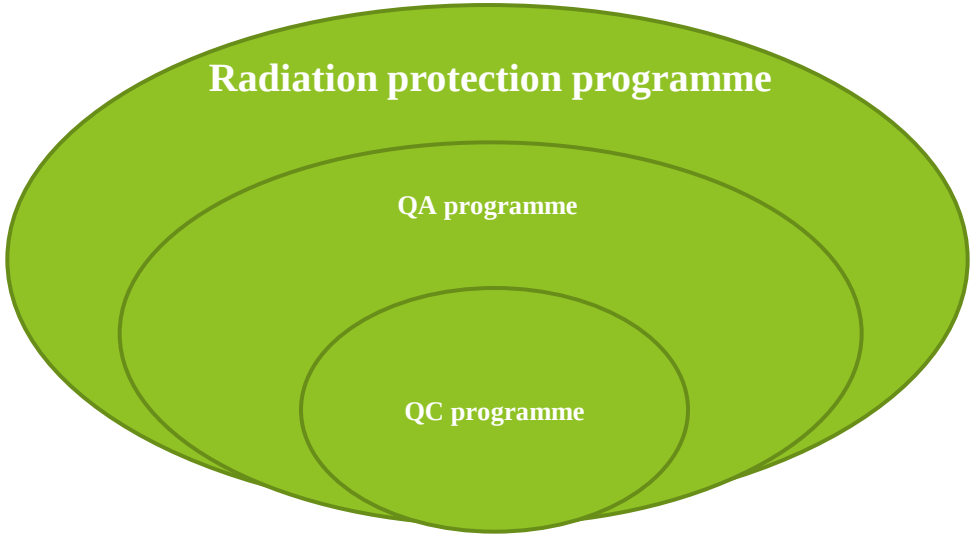
Requirements for QA in nuclear medicine in Lithuania

- There is requirement to have QA programme:
  - Including QC programme.
- Lisencee have to prepare, implement and review QA programe.
- There is no any guides what exactly should be included.
- International recommendations are very different.



National TC project LIT6006: “Improving the National Framework of Radiation Protection of Patients in Radiotherapy and Nuclear Medicine through Standardization of Quality Assurance and Quality Control Procedures and their Implementation in Hospitals”

- **Objective:** To improve cancer diagnosis and treatment through improved national framework for quality assurance and quality control in radiotherapy and nuclear medicine.
- **Results:**
  - Review and draft of legislations;
  - *Guidelines for improvement of QA system including quality control in nuclear medicine prepared and disseminated;*
  - Guidelines for improvement of QA system including quality control in radiotherapy prepared and disseminated;
  - Methodology on basic quality control and dosimetry tests for external dosimetric and clinical audits and independent evaluation of radiotherapy and nuclear medicine prepared and disseminated.

QA guidlines in nuclear medicine

- **It is drafting now!**
- Guidelines will include:
  - QA system purpose and application;
  - Some aspects of quality management systems (records follow-up, record keeping and review, and monitoring);
  - QA written operating procedures to ensure smooth treatment process;
  - Hospital employs whose must participate in maintaining QA system responsibilities (physicians, medical physicists, engineers, radiology technologist, nurses and etc.)
  - QC measurements (gamma camera, SPECT, PET and hybrid technologies, radiopharmaceuticals).

QC procedures for SPECT and gamma camera

Procedure	IAEA [8]	EANM	NEMA	AAPM TG177
Intrinsic flood field uniformity for ^{99}Tc	Ac, A, W	Ac, W/M	Ac, A	Ac, M
Intrinsic resolution and linearity	Ac, A, ½Y	Ac, ½Y	Ac, A	Ac, A
System spatial resolution and linearity	Ac, A, W	Ac, ½Y	Ac, A	Ac, W
System flood flied uniformity	A, ½Y	-	-	-
System planar sensitivity	Ac, A, ½Y	-	Ac, A	Ac, A
Energy resolution	-	Ac	Ac, A	Ac, A
Energy peaking (energy spectrum)	W	-	-	-
Whole body (WB) spatial resolution	-	Ac, A	Ac, A	Ac, A
Centre of rotation (COR) alignment	Ac, W/M	W/M	Ac, A	M
Pixel size	Ac, ½Y	Ac, ½Y	-	-
Tomographic uniformity	Ac, ½Y	-	-	Ac, A
Tomographic spatial resolution	-	Ac, ½Y	Ac, A	-
Total system performance	Ac, ½Y	½Y	-	-
Slice thickness	Ac, ½Y	-		-

Ac – acceptance, A – annual, ½Y – half yearly, M – monthly, W – weekly, D – daily

QC procedures for PET scanner

Procedure	IAEA	EANM	NEMA	ACR-AAPM
Spatial resolution	Ac,	Ac	Ac, A	A
Sensitivity	Ac,	Ac	Ac, A	A
Scatter fraction, count losses and random measurements	Ac	Ac	Ac, A	A
Energy resolution	Ac	Ac, D	-	Q
Image quality and accuracy of attenuation and scatter correction	Ac, A	Ac	Ac, A	A, Q
Coincidence timing resolution for TOF PET	Ac	Ac	-	-
Accuracy of PET/CT image registration	Ac	-	-	Q
PET detector stability test	D	D	-	-
Coincidence timing resolution tests	D	D	-	-
Test of PET/CT scan in clinical mode	D	-	-	-
Uniformity	Ac, Q	Ac	-	A, Q
PET normalization	Ac, M	Ac	-	-
2-D-3-D Radioactivity Concentration calibration	Ac, M	Ac	-	-
PET/CT offset calibration	Ac, Q	-	-	-
Routine image quality PET/CT test	Q	-	-	Q

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QC procedures for radionuclide calibrator

Procedure	IAEA	EANM	AAPM	NPL
High voltage	Ac, A, M, D	Ac, A, D	Ac, A, D	Ac, A, M, D
Display	C, Ac, A, M, D	-	-	Ac, A, M, D
Zero adjustment	C, Ac, A, M, D	D	Ac, A, D	Ac, A, M, D
System Electronic	-	-	Ac, A, D	-
Physical inspection	-	D	Ac, A, D	-
Clock cccuracy	C, Ac, A, M, D	D	Ac, A, D	-
Background	C, Ac, A, M, D	D	Ac, A, D	Ac, A, M, D
Check source response	C, Ac, A, M, D	D	Ac, A, D	-
Accuracy	C, Ac, A	Ac, A	Ac, A	Ac, A
Precision	Ac, A, M	Ac, A, M	Ac, A	Ac, A
Subsidiary calibrations	Ac, A	-	-	Ac, A
Linearity	Ac, A	A	Ac, A	Ac, A
Geometry	Ac	Ac	Ac	-

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QC procedures for radiopharmaceuticals

Radiopharmaceutical	Method	Limits, (%)
^{99m}Tc- nanocoll	TLC	>95
^{99m}Tc- mercaptoacetyltriglycine	TLC	>95
^{99m}Tc-sestamibi	TLC	>94
^{99m}Tc-macro albumin aggregated	TLC	>95
^{99m}Tc- methylene diphosphonate	TLC	>95
^{99m}Tc-tetrafosmin	TLC	>90
^{99m}Tc-diethylenetriamine pentaacetic acid	TLC	>95
^{99m}Tc-mebrofenin	TLC	>94
^{99m}Tc-pyrophosphate	TLC	>90
^{99m}Tc-exametazime	TLC	>80
^{99m}Tc-octreotide	TLC	>90
^{99m}Tc-dimercaptosuccinic acid	TLC	>95

Results

- The comparison of recommended tests and frequencies for different equipment and modalities demonstrated that there is a need to harmonize QC procedures.
- Guidelines from different organizations (IAEA, EANM, ACR, AAMP, NPL) have different opinions about routine test and its.
  - Also about measurement‘s tolerances.
- The recommendations of the IAEA and EANM should be used in creating QC programme (as part of QA).
  - manufacturers recommendations are simpler.
- There is shortage of information for modern equipment, for example, for equipment based on CZT detectors.

Thank you for your attention!