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Inter-employee comparisons in the determination of absorbed dose to water

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Laboratory accredited by the Polish Centre for Accreditation, accreditation No. AB 1499*
* an actual scope of accreditation No. AB 1499 is available on the PCA website: www.pca.gov.pl

Introduction

Dosimetry audit in radiotherapy is **a key element** of quality assurance (QA) and safety in the treatment of patients with ionizing radiation.

Dosimetry audit in radiotherapy aims to verify and confirm that radiation doses delivered to patients are in line with therapeutic intent and meet specified quality standards.

The basis for performing a dosimetry audit in radiotherapy in Poland **is the determination of absorbed dose to water by thermoluminescent dosimetry method**.

In Poland dosimetry audit in radiotherapy is performed by the Secondary Standards Dosimetry Laboratory in Warsaw accredited by the Polish Centre of Accreditation.

Note: The accreditation No. AB 1499 granted on 9 April, 2014 covers the determination of absorbed dose to water for X-ray beams in the range of accelerating potentials of 4 MV to 25 MV and for electron beams in the energy range of 4 MeV to 22 MeV.

Introduction

According to **section 7.7.1 of the ISO/IEC 17025:2017** standard “General requirements for the competence of testing and calibration laboratories” [1], accredited laboratory shall have **a procedure for monitoring the validity of results.**
This monitoring shall be planned and reviewed and shall include, but not be limited to replicate tests using the same method.

And according to **section 7.7.3 of the standard** [1] data from monitoring activities shall be analysed and used to both control and improve the laboratory's activities.

These requirements are crucial in any laboratory activities.

Introduction

In this work, we will present the ways of implementing the aforementioned requirements.

In particular, we will discuss the procedure of the inter-employee comparisons in the determination of absorbed dose to water by thermoluminescent dosimetry method. These measurements are the basis for performing a dosimetry audit in radiotherapy.

In addition, we will highlight the most important aspects of these replicate tests, such as the establishment of acceptance criteria.

Finally, we will give some results from the routine activities of our laboratory and analyze these results according to the dispositions in our procedure.

Methods

Inter-employee comparisons in the determination of absorbed dose to water in practice:

At the Polish SSDL, meeting the requirements of the ISO/IEC 17025:2017 standard regarding inter-employee comparisons is described in the established **procedure:**

„Ensuring the validity of results”.

The subject of the procedure is **external and internal undertakings** to ensure the monitoring of the validity of the results of laboratory activities being within the scope of accreditation for compliance with the requirements of PN-EN ISO/IEC 17025.

Examples of external undertakings:

- participation in proficiency testing (PT);
- participation in interlaboratory comparisons (ILCs) other than proficiency testing.

Examples of internal undertakings:

- intermediate checks on measuring equipment;
- visual check of the equipment which is not a measuring instrument;
- metrological control of an additional measuring equipment (i.e. thermometers, barometers, hygrometers);
- inter-employee comparisons.

Methods

Inter-employee comparisons in the determination of absorbed dose to water in practice:

Our procedure: „Ensuring the validity of results" includes the **following forms** for documenting activities concerning internal undertakings:

- ✓ **Form No. 6**: „**Schedule for monitoring the validity of test results"**;
- ✓ **Form No. 7**: **„Review of the schedule for monitoring the validity of test results";**
- ✓ **Form No. 8**: **„Report on activities to monitor the validity of test results";**
- ✓ **Form No. 9**: **„Register of reports on the activity of monitoring the validity of test results";**
- ✓ **Form No. 10**: „**Tracking the direction of change of data from monitoring the validity of test results".**

Inter-employee comparisons in the determination of absorbed dose to water in practice:

In the form No. 6: „Schedule for monitoring the validity of test results" Head of the Polish SSDL **establishes the following aspects**:

- SSDL personnel assigned to perform activities to monitor the validity of test results;
- **activities to monitor the validity of test results**, which should include, if appropriate, at least:
  - visual inspection of non-measuring equipment, i.e. dispenser, elevator drive, TL powder annealing oven, air compression compressor, metal strainers, water phantom/positioning stand/PMMA phantom - before each use;
  - verification of the dosimetry set by comparing the average absorbed dose to water in a given measurement session with the value of the absorbed dose to water calculated using the law of radioactive decay of the Co-60 isotope;
  - monitoring of atmospheric conditions (ambient temperature, relative humidity, atmospheric pressure) during the determination of dose power in water for Co-60 gamma radiation or in a PMMA phantom/ on TL powder reading days;
  - **inter-employee comparisons**;
- planned date of implementation of activities to monitor the validity of test results covering the current accreditation cycle (the minimum frequency of activities is 1 time per accreditation cycle for each sub-discipline);
- criterion for acceptance of data analysis results from monitoring the validity of test results.

Methods

Inter-employee comparisons in the determination of absorbed dose to water in practice:

In the form No. 6: „Schedule for monitoring the validity of test results” Head of the Polish SSDL establishes the **following aspects concerning inter-employee comparisons**:

- repeat testing should be performed by different members of the SSDL staff in accordance with the currently valid test instruction being within the scope of accreditation No. AB 1499;
- planned date of implementation of repeat testing covering the current accreditation cycle (the minimum frequency of repeat testing is 1 time per accreditation cycle for each PWWD employee performing testing): depending on the number of employees performing the tests - as soon as possible after the employee in question is authorized to perform the test;
- acceptance criterion: expressed as a percentage, **the “Compliance” parameter should be in the range of ⟨98.3%; 101.7%⟩**, where the “Compliance” parameter is determined according to the following formula:

$$\mathbf{Compliance} = \frac{\mathbf{R_{employee\ x}}}{\mathbf{R_{employee\ y}}} \cdot 100$$

where:

$R_{employee\ x}$ - the average reading of 3 reference capsules with TL powder from one measurement series made by employee “x;”

$R_{employee\ y}$ - the average reading of 3 reference capsules with TL powder from one measurement series made by employee “y”.

Inter-employee comparisons in the determination of absorbed dose to water in practice:

The completed form **No. 6 „Schedule for monitoring the validity of tests results" is reviewed by the Head of the Polish SSDL or his deputy at least once a year** (at least every 12 months) **for its actuality** - especially in case of changes regarding measuring instruments, measuring equipment, personnel performing tests and test method.

Records of the review are made by the Head of the Polish SSDL or his deputy on the **form No. 7** „**Review of the schedule for monitoring the validity of test results**".

Note: If the schedule is considered invalid, the Head of the Polish SSDL or his deputy prepares a new schedule on the form No. 6.

Based on the current schedule of activities to monitor the validity of tests results, the staff of the Polish SSDL performs the scheduled activities and prepares records of these activities on the form **No. 8 „Report on activities to monitor the validity of test results"**.

Exemplary results

Acceptance criterion:
the "Compliance" parameter should be in the range of ⟨98.3%; 101.7%⟩.

Date of reading: 08-04-2024	Employee „x"	Employee „y"
Average reading: R	29048	29001
Compliance [%]	100.2	

Ok. !

Date of reading: 08-04-2024	Employee „x"	Employee „y"
Average reading: R	29048	28885
Compliance [%]	100.6	

Ok. !

Date of reading: 09-05-2024	Employee „x"	Employee „y"
Average reading: R	28627	28386
Compliance [%]	100.8	

Ok. !

Date of reading: 24-04-2024	Employee „x"	Employee „y"
Average reading: R	28930	29071
Compliance [%]	99.5	

Ok. !

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Conclusions

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The obtained results indicate that the values of the „Compliance” parameter for all employees of the laboratory met the predetermined acceptance criterion.

Comparisons of results between staff performing dosimetry audits are an important tool in the quality assurance process and to confirm the validity of the results.

References

1. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, General requirements for the competence of testing and calibration laboratories, ISO/IEC 17025:2017, ISO, Geneva (2017).

Thank you for your attention.