The IAEA quality audits in radiotherapy

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IAEA audits in radiotherapy

**SINCE 1969:** IAEA/WHO TLD postal dose audits of radiotherapy beam calibration (40 years of operation):
121 countries, ~1700 hospitals, ~8000 beams

**SINCE 2005:**
Quality Assurance Team for Radiation Oncology (QUATRO)

**NEW:** TPS audit
IAEA/WHO TLD results for Co-60 and high energy X rays
1969-2008

1969-2008: N = 7467, m = 1.009, SD = 0.081, 79% res. within 5%

2006-2008: N = 1428, m = 1.005, SD = 0.055, 92% res. within 5%

±5%
Follow-up of poor TLD results

The IAEA dosimetry travel kit used for QA missions to radiotherapy hospitals

On-site Visits to Radiotherapy Centres: Medical Physics Procedures

Quality Assurance Team for Radiation Oncology (QUATRO)

March 2007
IAEA/WHO TLD results within the 5% limit

Approx. 96% acceptable TLD results after follow-up
IAEA/WHO TLD results (2006-2008)

Medical accelerators
863 high-energy X-ray beams:
26 deviations beyond 5 % level

Co-60 units
565 Co-60 beams:
83 deviations beyond 5 % level

IAEA
Modern radiotherapy: challenges and advances in radiation protection of patients Versailles, 2-4 Dec 2009
Dosimetry Codes of Practice used for beam calibration, TLD audits 2006 - 2008

TLD results vs. dosimetry Codes of Practice N=1404
(24 deviations beyond 20% excluded)

- ND, w: 64% (n=904, m=1.003, SD=0.025)
- NK: 13% (n=187, m=1.004, SD=0.029)
- Nx: 4% (n=53, m=1.012, SD=0.045)
- Unknown: 19% (n=260, m=1.012, SD=0.051)
Percentage of acceptable TLD results per world region, 2006-2008

<table>
<thead>
<tr>
<th>Region</th>
<th>1st check</th>
<th>After follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>All regions</td>
<td>90%</td>
<td>95%</td>
</tr>
<tr>
<td>AF</td>
<td>95%</td>
<td>98%</td>
</tr>
<tr>
<td>AM</td>
<td>92%</td>
<td>97%</td>
</tr>
<tr>
<td>EM</td>
<td>94%</td>
<td>98%</td>
</tr>
<tr>
<td>EU</td>
<td>88%</td>
<td>93%</td>
</tr>
<tr>
<td>SE</td>
<td>92%</td>
<td>96%</td>
</tr>
<tr>
<td>WP</td>
<td>95%</td>
<td>98%</td>
</tr>
</tbody>
</table>
New IAEA procedures: TPS audit

Set of practical tests for dosimetry calculations reflecting basic treatment techniques in a typical radiotherapy hospital

IAEA scientific secretary: S. Vatnitsky
Evaluation of the IAEA pilot study results

5 RTPSs: Algorithms without modeling lateral transport

3 RTPSs: Algorithms with modeling lateral transport

CMS XIO
Helax
Cadplan/Eclipse
Pinnacle
Theraplan Plus
Elekta PrecisePlan
CAD3D
Optirad
## Results of auditing of TPS (Baltic countries)

<table>
<thead>
<tr>
<th>Test case</th>
<th>Measurement point (number)</th>
<th>Acceptance level, %</th>
<th>Range of deviations, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard SSD 10x10cm² single field</td>
<td>3</td>
<td>2</td>
<td>[-1.4;1.8]</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>4</td>
<td>[11.3;0.8]</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3</td>
<td>[-4.5;4.6]</td>
</tr>
<tr>
<td>Extended SSD</td>
<td>3</td>
<td>3</td>
<td>[-5.2;2.2]</td>
</tr>
<tr>
<td>Oblique incidence</td>
<td>1</td>
<td>3</td>
<td>[-4.3;4.4]</td>
</tr>
<tr>
<td>Field with blocked corners</td>
<td>3</td>
<td>3</td>
<td>[-2.1;2.2]</td>
</tr>
<tr>
<td>Four field “box” technique</td>
<td>5</td>
<td>3</td>
<td>[-2.5;6.1]</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>4</td>
<td>[-6.6;12.0]</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>4</td>
<td>[-11.8;8.5]</td>
</tr>
<tr>
<td>Customised blocking, large low density inhomogeneity</td>
<td>2</td>
<td>3</td>
<td>[-1.4;1.8]</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>4</td>
<td>[8.5;12.2]</td>
</tr>
<tr>
<td>L-shaped field with blocked central axis</td>
<td>3</td>
<td>3</td>
<td>[-3.3;7.5]</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>5</td>
<td>[-2.8;4.9]</td>
</tr>
<tr>
<td>3-field plan with asymmetrical wedged beams</td>
<td>5</td>
<td>3</td>
<td>[-2.8;4.9]</td>
</tr>
<tr>
<td>3-field plan with non-coplanar beams</td>
<td>5</td>
<td>3</td>
<td>[-3.9;5.2]</td>
</tr>
</tbody>
</table>

Similarly, a national TPS audit run was performed in Hungary in 2008.
Comprehensive audit: QUATRO

- Numerous requests received by IAEA from Member States
- Guidelines for comprehensive audits of radiotherapy practices: QUATRO
- International Basic Safety Standards are a foundation
- IAEA also developed methodology for clinical audit in diagnostic radiology and nuclear medicine
- Input to EC guidelines for clinical audit as per 97/43/Euratom.
Purpose of QUATRO

Quality Assurance Team for Radiation Oncology

Peer review and evaluation of the quality of all elements involved in radiation therapy (staff, equipment and procedures, patient protection and safety, overall performance)

Any areas for improvement are identified with a view to designating the institution as a centre of competence complying with the IAEA criteria.

GOAL: QUALITY IMPROVEMENT
On-site audit procedures

- Typically 5 days per RT department
- Entrance briefing
- Assessment: complete tour of facility, staff interviews, review & evaluation of procedures and documentation, measurements, tests of procedures, observation of practical work
- Exit briefing: feedback to the department, preliminary recommendations, questions, discussion.
QUATRO audits: summary

- **Africa**
  - 2 QUATRO workshops in 2006
  - QUATRO guide used for internal audits
  - 4 missions to-date

- **Asia**
  - Training of auditors in 2005 and 2009, regional workshops planned
  - 8 missions to-date, 10 missions planned in 2010-2011

- **Europe**
  - Training of auditors in 2005 and 2006 (7 audit teams)
  - 25 missions conducted to-date, further missions planned

- **Latin America**
  - 2 QUATRO regional workshops in 2005
  - 10 QUATRO missions in 2008-2010
Conclusion

- The IAEA/WHO TLD audits contribute to the improvement of the status of radiotherapy dosimetry worldwide.
- QUATRO is a useful tool for peer reviewing radiotherapy practices; it documents weak links in departmental operations and procedures, and offers recommendations to address them.

RESULT: QUALITY IMPROVEMENT