The IAEA quality audits in radiotherapy

International Atomic Energy Agency

*presently MedAustron
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 1981:** TLD audits for ~70 SSDLs
- **SINCE 2005:** Quality Assurance Team for Radiation Oncology (QUATRO)
- **NEW:** TPS audit
Dose audit networks for radiotherapy

- Country participating in the IAEA/WHO TLD service
- National QA network or participant in international network other than IAEA
- QA network co-operating with IAEA
- Country not having radiotherapy or not participating in an audit network
IAEA/WHO TLD results for Co-60 and high energy X rays
1969-2009

1969-2009: N = 8060, m = 1.009, SD = 0.079, 80% res. within 5%

2008-2009: N = 1011, m = 0.998, SD = 0.067, 94% res. within 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)

IAEA-TECDOC-1543

March 2007
TLD results within the 5% limit (1)
In 2000-2009, 4440 beams were checked with 511 TLD results followed-up, of these ~50% in Eastern Europe.
IAEA/WHO TLD results, 2000-2009

Medical accelerators
2427 high-energy X-ray beams:
- 148 deviations
- beyond 5% level

Co-60 units
2013 Co-60 beams:
- 363 deviations
- beyond 5% level

Tolerance (dev. 5-10%)
- Medical accelerators: 4%
- Co-60 units: 6%

Tolerance (dev. 10-20%)
- Medical accelerators: 1%
- Co-60 units: 9%

Tolerance (dev. >20%)
- Medical accelerators: 1%
- Co-60 units: 3%

Misadministration? (dev. 5-10%)
- Medical accelerators: 1%
- Co-60 units: 9%

Misadministration? (dev. 10-20%)
- Medical accelerators: 1%
- Co-60 units: 6%

Misadministration? (dev. >20%)
- Medical accelerators: 1%
- Co-60 units: 3%
TLD results: use of ionization chambers

TLD results 2000-2009

<table>
<thead>
<tr>
<th>Chamber type</th>
<th>N</th>
<th>Mean $D_{TLD}/D_{stat}$</th>
<th>SD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer 0.6 cc</td>
<td>2807</td>
<td>1.005</td>
<td>2.9</td>
</tr>
<tr>
<td>Small volume 0.1 - 0.3 cc</td>
<td>316</td>
<td>1.008</td>
<td>3.9</td>
</tr>
<tr>
<td>Local make</td>
<td>229</td>
<td>1.016</td>
<td>5.1</td>
</tr>
<tr>
<td>No chamber details</td>
<td>1013</td>
<td>1.011</td>
<td>5.1</td>
</tr>
</tbody>
</table>

(N=4440; 75 deviations beyond 20% excluded)
## Dosimetry Codes of Practice used for beam calibration, TLD audits 2000-2009

**TLD results vs. dosimetry Codes of Practice**

N = 4440

<table>
<thead>
<tr>
<th>CoP</th>
<th>N</th>
<th>Mean $D_{TLD}/D_{stat}$</th>
<th>SD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$N_{Dw}$</td>
<td>1875 (13)*</td>
<td>1.003</td>
<td>2.6</td>
</tr>
<tr>
<td>$N_K$</td>
<td>1162 (13)</td>
<td>1.005</td>
<td>3.3</td>
</tr>
<tr>
<td>$N_X$</td>
<td>340 (7)</td>
<td>1.020</td>
<td>4.7</td>
</tr>
<tr>
<td>Ion chamber details only</td>
<td>129 (3)</td>
<td>1.020</td>
<td>5.4</td>
</tr>
<tr>
<td>No dosimetry data</td>
<td>858 (39)</td>
<td>1.011</td>
<td>5.1</td>
</tr>
</tbody>
</table>

*75 deviations beyond 20% excluded, in brackets*
Dosimetry Codes of Practice used for beam calibration, TLD audits 2000-2009

% participants using CoP

Year


ND,w based  Nk based  Nx based
TLD result distribution per country: m, SD

2000-2009: 82 countries participated in the IAEA/WHO TLD audits > 5 times; deviations exceeding 20% excluded
TLD results for SSDLs: 2000-2009

N = 733, m = 1.006, SD = 0.017, 98% results within 3.5%

All deviations outside 3.5 % have been explained and corrected
Comprehensive RT audit: QUATRO
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
  - 5 missions to-date

- **Asia**
  - Training of auditors in 2005 and 2009, regional workshops
  - 14 missions to-date, more planned

- **Europe**
  - Training of auditors in 2005 and 2006
  - 30 missions conducted, more planned

- **Latin America**
  - 2 QUATRO workshops in 2005
  - 10 missions in 2008-2010
Europe: recommendations by QUATRO

- Support staff continuous education
- Strengthen QA programmes and procedures
- Equipment: get more, use better
- Increase staffing level: MP, RO, RTT
- Better train staff: RTT, RO, MP
- Improve treatment protocols
- Improve structure and organization of cancer centres
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
Implementation of TPS audit

Steps in implementation of TPS audits:
1. IAEA multicentre pilot study
2. TPS test audit runs in Baltic countries and Hungary
3. National TPS audit exercises supported by IAEA (Europe)

TPS audit package is available from IAEA on request.
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 week links in hospital operations and procedures, and offers recommendations to address them.

 RESULT: QUALITY IMPROVEMENT