Quality Assurance in Radiotherapy

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RT team

- Radiation Oncologists
- Medical Physicists
- Radiation Technologists
- Radiation Nurses

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Philosophy of radiotherapy quality assurance

Scope of quality assurance protocols

- guarantee the validity of clinical trial results
- improve the quality of clinical practice minimising the risk of errors
- increase the likelihood of desired health outcomes at the population level (equality of access, consistency, etc)
Philosophy of radiotherapy quality assurance

Specific considerations of QART in a multicenter research setting

- determination of protocol ambiguities that may affect treatment delivery;
- education of sites in RT-specific trial guidelines;
- promotion of consistency between centers;
- ensuring sites meet minimum technical and personnel requirements;
- ensuring accuracy and integrity of data;
- estimation of inter-patient and inter-institutional variation;
- identification and correction of flaws in study design
5-years FFTF was significantly influenced by the quality of radiotherapeutical procedures: 70% with protocol violations (PV) vs. 82% without PV.
Quality assurance in radiotherapy

QA strategy of the EORTC Radiation Oncology Group (ROG)

1982-2005
- Site visits
- Evaluation of institutions’ staff and infrastructure
- Dosimetric checks of treatment units
- Cross-check of patients charts and portal images
- Radiobiological modelling of inter-institutional differences
- Mailed thermoluminescent dosimetry audits

2005-2011
- Level 1: Facility questionnaire, External reference dosimetry audit
- Level 2: Dummy run
- Level 3: Limited individual case Review
- Level 4: Extensive individual case Review
- Level 5: Complex dosimetry check
Quality Measures

1. Target volume definition
2. Radiation dose specification
3. Fractionation specification
4. Radiation prescription point specification
5. QA process use for RT
6. QA process adherence reporting for RT
Radiotherapy reporting quality

Reporting of RT in HL and NHL RCTs is deficient. Because the interpretation, replication, and application of RCT results depend on adequate description and QA of therapeutic interventions, consensus standards for RT reporting should be developed and integrated into the peer-review process.

<table>
<thead>
<tr>
<th>Measures of radiotherapy reporting</th>
<th>Adequacy of reporting</th>
</tr>
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<tbody>
<tr>
<td>1. Target volume description</td>
<td>23 38%</td>
</tr>
<tr>
<td>2. Radiation dose specification</td>
<td>54 89%</td>
</tr>
<tr>
<td>3. Fractionation specification</td>
<td>39 64%</td>
</tr>
<tr>
<td>4. Radiation prescription point specification</td>
<td>13 21%</td>
</tr>
<tr>
<td>5. Quality assurance process use</td>
<td>12 20%</td>
</tr>
<tr>
<td>6. Quality assurance process adherence reporting*</td>
<td>7 11%</td>
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Quality assurance in radiotherapy

In the last years radiation oncology is undergoing a rapid and radical transformation driving an exponential growth in the size, complexity, and quantity of data generated during the treatment process.

The increase is due, in part, to the success of image-guided oncology programs, which generate new images at each step in the treatment process — from diagnosis to verification, up to follow-up.

Modern QA ◊ digital data exchange and timely review
Quality assurance in radiotherapy in the 21st century

Database on infrastructure

To create data bank of the infrastructure of the member centres, to acquire data on equipment, staffing levels, treatment techniques and QA procedures.

Web-based quality assurance

To use medical informatics to facilitate the education, collaboration and peer review, providing an environment in which clinical investigators can receive, share and analyse treatment planning digital data.
Quality assurance
EORTC Radiation Oncology Group quality assurance platform: Establishment of a digital central review facility

Integrated modular central review platform
## Main system requirements

<table>
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<tr>
<th>Task</th>
<th>Parameters</th>
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| **General**                   | • Network reliability in terms of up-time and fidelity of data transfer  
                                 • Avoidance of local hardware and software installation  
                                 • Web-based accessibility from any geographic location  
                                 • Intuitive functionally evaluation tools  
                                 • Uniformity of data submission procedures for all trials  
                                 • Adequate firewall security  
                                 • Central storage and archiving in a queriable database |
| **Submission from centres to QART office** | • Ability to upload operating-system independent  
                                 • Reads in digital data (DICOM-RT) exported from multiple TPS |
| **QART office DDIQA**         | • Utilize VODCA software to ensure consistency, completeness, formatting, lack of corruption and recalculation of DVHs |
| **Central evaluation**        | • Document assessment of RT plan via a web-based evaluation matrix, standardize to facilitate consensus-building |
A scenario for a web-based radiotherapy treatment planning system

**Patients benefit**
- Accessibility of advanced radiotherapy treatment services, minimising patient’s transportation

**Physicians benefit**
- Consultation of expert colleagues
- Cooperation with reduce professional isolation

**Organisations benefit**
- Quality assurance in terms of dummy-runs and/or check of a real-patient treatment planning
- Minimisation of local-audits and the cost of on-site visit
- Evaluation and correlation of treatment outcome with radiotherapy parameters
RTQA platforms used by RTOG, EORTC or TROG:

- VodcaRT from Medical Software Solutions
- CERR software
- ITC remote review tool
- VelocityAI from Velocity Medical Solutions
- Mim software from Mimvista
- Artiview from Aquilab
- Swan

- 2008: retrospective test
- 2009: prospective test
- 2010: currently utilize to QART procedures on ongoing EORTC trials
VODCA 5 has been created to …

- Promote **in radiotherapy** clinical decision-support and knowledge management technologies in patient care and clinical research;

- Disseminate methods and tools for building healthcare knowledge applications that comply with the highest quality, safety and ethical standards;

- Connect individuals, hospitals, research groups and organisations who believe in the value of knowledge management, and support the share and reuse of clinical knowledge and data.
“Prospective quality assurance program and development of an Italian network for radiotherapy in patients affected by lymphoma enrolled in the clinical trials”

Proof of Concept (POC)

- 6 RT centres
- July-September 2012
- HL patients
The study coordinator can customise by himself the workflow, the forms, the databases and the reports.
“VODCA on the cloud”

The “VODCA Online Desktop” is a powerful cloud-based Desktop with a customisable secure storage and it is accessible from anywhere, including tablets.
VODCA 5

Visualisation and Organisation of Data for Cancer Analysis

- VODCA Control
- VODCA DICOM Server
• Databases

Every **patient dataset** has an unlimited amount of **user defined fields** subdivided into **3 categories**:

• **Patient** data,
• **Treatment** data, and
• **Clinical** data,

**Data fields** can be **added or deleted at any time** by the database administrator.
VODCA RT: “Patient data” display

- Module and selected data specific buttons
- New hierarchical organisation of the VOIs and DVHs
- Always available operations

Data Verification Protocol
VODCA 5

- VODCA RT: Module “Display”
Generating Consensus Contour:

**Apparent agreement:**
The apparent volume overlap is the agreement probability by which a voxel is selected by the experts.

**STAPLE**
• Data Modification
Module “Analysis” – DVH / DSH
Module “Analysis” – Dummy-run

The following parameters are calculated:

- DICE
- Sensibility
- Specificity
- Volume difference
- Isocentre difference
- **Data verification Protocol**

Available [Module] and [Tag] are listed in VODCA RT “Property”

Or in a format agreed with the EORTC HQ
Conclusions

QART

- Widen RT-DICOM IELSG37

- Prospective analysis with VODCA?

Grazie