Risk assessment for Physics Plan Review – Update from TG275

Perry Johnson, et al.

March 19, 2017
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Why is this important?

Effectiveness (%)

- Physics chart review
- Physics weekly chart check
- Therapist chart review
- Checklist
- EPID dosimetry
- Physician chart review
- Port films: check by therapist
- Port films: check by physician
- SSD check
- Online CT: check by therapist
- Timeout by the therapist
- In vivo diode measurements
- Online CT: check by physician
- Chart rounds
- Pre-treatment IMRT QA

Quality Control Quantification (QCQ): A Tool to Measure the Value of Quality Control Checks in Radiation Oncology

Eric C. Ford, PhD, Stephanie Terezakis, MD, Annette Souranis, Kendra Harris, MD, Hiram Gay, MD, and Sasa Mutic, PhD

Society level recommendations

- ACR technical standard for the performance of radiation oncology physics for external beam therapy
- ACR-ASTRO practice parameter for radiation oncology
- AAPM Task groups – 11, 40, 59

Continuing medical physics consultation

- Billing code – CPT 77336
- Assessment of treatment parameters, QA of dose delivery, and review of patient documentation reported per week of therapy.

Why is this important?
Why is this important?

Task Group 40

– Procedure for checking of technical parameters.
  • Daily dose, total dose, and fractionation scheme.
  • Machine, mode, and energy.
  • Fields parameters, algorithm, etc.

– Is prescription “reasonable”?

– Request, i.e. special physics consult, in-vivo dosimetry, etc.

– Proper documentation

– “Consistency from rx to plan to sim sheet to MU calculation to daily record.”
Addressing the knowledge gap

1. Review existing data and recommendations
2. Survey information on current practices
3. Provide risk-based recommendations
4. Provide recommendations to software vendors
ACR technical standards

- Medical physicist must develop a chart review protocol.
- Should review new or modified treatments.
- Assess accuracy of information as well as completeness and clarity of record.
- Physics chart review must be conducted at least weekly.
- EOT check must be performed within 1 week of EOT.
1. Technical parameters
   • Dose grid, density overrides, couch tolerance table, isocenter consistency, etc.

2. Data transfer/plan consistency
   • Agreement from RX to TPS to R&V to delivery

3. Documentation/communication
   • Setup photos/instructions, document approvals, special requests, etc.

4. Plan quality
   • Target coverage, DVH parameters, etc.

5. Clinical decision making
   • Contouring, image registration, treatment approach, etc.

1) Native to current systems   2) Custom solutions   3) Vendor solutions
How do we check “charts”?
EMR and treatment management software
- Designed/improved using incident learning
- Checks:
  - Inconsistency in delivery
  - Overrides
  - Documentation
- Pre-screening of chart checks
- “Spend more time investigating and less time searching”
Custom automation (PCT – Univ. of Mich)

• Goal to reduce amount of time checking “mundane details” and more time dedicated to plan quality

• Designed w/ lean thinking
Custom automation (EcCk – Wash Univ.)

TABLE I. List of patient chart checking tasks supported by EcCk.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 On-demand physics initial chart checking</td>
<td>Check the treatment plan parameters against R&amp;V system, the documents and their approvals, and the IMRT QA results prior to the physics approval of the treatment sessions.</td>
</tr>
<tr>
<td>2 On-demand dosimetrist chart checking</td>
<td>After the approved treatment plans have been imported into the R&amp;V, check the completeness, accuracy and consistency of treatment plan parameters and required documents.</td>
</tr>
<tr>
<td>3 On-demand final chart checking</td>
<td>After a patient’s treatment course has completed, check the completeness of treatment records and presence of all required documents, per ACR requirements.</td>
</tr>
<tr>
<td>4 Automatic physics daily/weekly checks</td>
<td>Check the treatment plan parameters to ensure consistency of treatments from fraction to fraction. Check weekly for changes in patient weight, documentation changes, setup parameters, rejection of portal images, and treatment couch position trends.</td>
</tr>
</tbody>
</table>

- Technical vs clinical vs quality
- Many items difficult to check once sent to R&V
Custom automation (planCheck – Mass Gen)

Automating checks of plan check automation
Tarek Halabi, Hsiao-Ming Lu
Journal of Applied Clinical Medical Physics,
Vol. 15, No. 4, 2014

Automated survey of 8000 plan checks at eight facilities
Med. Phys. 43 (9), September 2016

- PDF parser to compare documents with treatment management software
  - “Oncologist do not review or sign DICOM RT files”
- Versatility and ease of implementation
Custom solutions

Table 3
Items checked for compliance with the TROG 03.04 'RADAR' trial involving 3DCRT for prostate cancer

<table>
<thead>
<tr>
<th>Item</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Slice Thickness</td>
<td>Automatic</td>
</tr>
<tr>
<td>Immobilisation device used as planned</td>
<td>Manual</td>
</tr>
<tr>
<td>Planned dose compared to nominated dose</td>
<td>Automatic</td>
</tr>
<tr>
<td>DRR created for treatment position verification</td>
<td>Manual</td>
</tr>
<tr>
<td>Number of treatment fields</td>
<td>Automatic</td>
</tr>
<tr>
<td>Maximum dose for combined plan</td>
<td>Automatic</td>
</tr>
<tr>
<td>95% Coverage of PTV1</td>
<td>Automatic</td>
</tr>
<tr>
<td>95% Coverage of PTV2</td>
<td>Automatic</td>
</tr>
<tr>
<td>95% Coverage of PTV3</td>
<td>Automatic</td>
</tr>
<tr>
<td>CTV Contoured Appropriately</td>
<td>Manual</td>
</tr>
<tr>
<td>Margin of PTV1 appropriate</td>
<td>Automatic</td>
</tr>
<tr>
<td>Margin of PTV2 appropriate</td>
<td>Automatic</td>
</tr>
<tr>
<td>Margin of PTV3 appropriate</td>
<td>Automatic</td>
</tr>
<tr>
<td>Rectal wall contoured as recommended</td>
<td>Manual</td>
</tr>
<tr>
<td>Left femoral head contoured as recommended</td>
<td>Manual</td>
</tr>
<tr>
<td>Bladder contoured as recommended</td>
<td>Manual</td>
</tr>
<tr>
<td>Conformity index for PTV1</td>
<td>Automatic</td>
</tr>
<tr>
<td>Conformity index for PTV2</td>
<td>Automatic</td>
</tr>
<tr>
<td>Conformity index for PTV3</td>
<td>Automatic</td>
</tr>
<tr>
<td>DVH constraints on rectum</td>
<td>Automatic</td>
</tr>
<tr>
<td>DVH constraints on left femoral head</td>
<td>Automatic</td>
</tr>
<tr>
<td>DVH constraints on bladder</td>
<td>Automatic</td>
</tr>
<tr>
<td>Beam Energy</td>
<td>Automatic</td>
</tr>
<tr>
<td>Prescription point</td>
<td>Manual</td>
</tr>
<tr>
<td>Percentage isodose encompassing rectum</td>
<td>Manual</td>
</tr>
<tr>
<td>Dose per fraction</td>
<td>Automatic</td>
</tr>
</tbody>
</table>

Items are verified either automatically or manually using SWAN. Fig. 4 provides a sample report generated for these items.
Vendor solutions – Mobius 3D

Mobius3D Benefits

- Verifies dose throughout the patient treatment volume
- 3% accuracy for IMRT & VMAT plans with complex anatomy
- Patient heterogeneities are automatically handled
- Verifies DVH objectives are met by your plans
- RTOG and TG-101 DVH objectives are pre-loaded
- Validates beam model commissioning in your TPS
- Creates PDF reports for every patient’s plan
- Billing code 77300 for secondary calculations
- Every modern treatment planning system is compatible
- Conventional linacs and Tomotherapy are compatible
Vendor solutions – Sun Nuclear Per Fraction
New directions

Automation
• Cost reduction
• Productivity
• Availability
• Reliability
• Performance

Smart systems
• Daily dashboards
• Local “red flags”

Big data
• Statistical process control
• Bayesian modeling

Beyond the chart
• Comprehensive checking
• Outside the bailiwick
Beyond the chart

**ViewRay plan checks**

- Deformable registration
- Contours
- Isocenter location
- Table placement
- Beam placement
- Rules for adaptation
- Etc...
Beyond the chart

Contouring errors in lung SBRT

- 25 of 472 (5%) had violation
  - PTV, n = 17
  - Ribs, n = 5
  - Spinal canal, n = 2
  - Heart, n = 1
- For 17 PTVs, V100\text{mean} = 90%
  - Range, 75 – 95%

<table>
<thead>
<tr>
<th>Reason for PTV Change</th>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITV not contoured even though 4D-CT available</td>
<td>4</td>
</tr>
<tr>
<td>Inadequate coverage of GTV or ITV</td>
<td>3</td>
</tr>
<tr>
<td>Inadequate margin from ITV to PTV</td>
<td>1</td>
</tr>
<tr>
<td>Not specified</td>
<td>9</td>
</tr>
</tbody>
</table>

PTV, planning target volume; ITV, internal target volume; 4D-CT, four-dimensional computed tomography; GTV, gross tumor volume.

The Impact of Peer Review of Volume Delineation in Stereotactic Body Radiation Therapy Planning for Primary Lung Cancer: A Multicenter Quality Assurance Study

Andrea C. Lo, MD,** Mitchell Liu, MD, CM, FRCPC,**† Elisa Chan, MD, FRCPC,**†‡ Chad Lund, MD, FRCPC,**‡ Pauline T. Truong, MD, CM, FRCPC,**‡ Shawn Loewen, MD, FRCPC,**‡‡ Jeffrey Cao, MD, FRCPC,**‡ Devin Schellenberg, MD, FRCPC,**‡‡ Hannah Carolan, MD, FRCPC,**‡ Tanya Berrang, MD, FRCPC,**‡ Jonn Wu, MD, FRCPC,**‡ Eric Berthelet, MD, CM, FRCPC,**‡‡ and Robert Olson, MD, FRCPC**‡‡

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Summary

• Physics plan/chart review = safety, quality, and value
• Evolving nature of the plan/chart review
• Automation will play a role
• Vendors are helping fill gaps
• Step outside our comfort zone
Questions?