Status and Challenges for New Technologies: AAPM perspective

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Disclosures

Chair: AAPM Work Group on Prevention of Errors

Outline

• Cost / effectiveness of new technology
  Clinical trials
  Spending more = better clinical results?

• Safety / quality aspects
  Implementing new technology
  Education and safe use
  Identifying risks
Costs

Medicare Expenditures Circa 2002

Source: Alhassani et al. NEJM, 2012

Benefits

- Often curative
- 800,000 patients / year in N. America
- ~70% of all cancer patients
Question: Does spending more result in better outcomes?

Quality and Outcomes

TROG 02.02

RT+cis +/- TPZ for H&N SCC

- 820 plans reviewed post-Tx
- 208 plans (25%) were not compliant with protocol
- In 97 / 208 (47%) violation was expected to have a major impact

Peters et al. JCO, 28(18), 2996, 2010

Quality and Outcomes

Seriously non-compliant (12% of plans)

Peters et al. JCO, 28(18), 2996, 2010
Question: Does spending more result in better outcomes?

Answer: Sometimes, but depends how well the procedure is performed.

Key Points
- There will be more emphasis on comparative effectiveness research.
- How well procedures are done is at least as important as which procedures are done.

- How does a physicist fit into all this?
- What is AAPM’s role?
**AAPM Role**

**TG113: Practice Standard for Clinical Trials**

- Identify physics practice standards that impact the quality of data for clinical trials and the treatment of patients in the imaging, planning, and delivery chain
- Propose achievable standards of accuracy for each part of the chain based on published reports
- Provide guidance to physicists, QA organizations, and those who design clinical trials on addressing issues in radiotherapy that are most likely to cause inconsistencies in treatment

*Slide courtesy of Jean Moran*

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**Charge of AAPM Task Group 113**

- Identify physics practice standards that impact the quality of data for clinical trials and the treatment of patients in the imaging, planning, and delivery chain
- Propose achievable standards of accuracy for each part of the chain based on published reports
- Provide guidance to physicists, QA organizations, and those who design clinical trials on addressing issues in radiotherapy that are most likely to cause inconsistencies in treatment

*Slide courtesy of Jean Moran*
Roadmap for New Technology

- Development
- Early researchers / vendors

- Expert Users
- Reports - Institutional

AAPM Task Group Reports

<table>
<thead>
<tr>
<th>TG179</th>
<th>2012</th>
<th>IGRT</th>
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<tr>
<td>TG148</td>
<td>2011</td>
<td>Tomotherapy</td>
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<td>TG101</td>
<td>2010</td>
<td>SBRT</td>
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<tr>
<td>TG142</td>
<td>2009</td>
<td>QA for linacs</td>
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<td>TG119</td>
<td>2009</td>
<td>IMRT commissioning</td>
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<td>2006</td>
<td>Respiration</td>
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AAPM Task Group Reports

- Planned or under review

<table>
<thead>
<tr>
<th>TG178</th>
<th>Gamma SRS calibration</th>
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<tr>
<td>TG198</td>
<td>Implementation of TG142</td>
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<td>TG210</td>
<td>Linac acceptance testing</td>
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<tr>
<td>TG218</td>
<td>Tolerances for IMRT QA</td>
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</table>
ASTRO White Papers on Safety

- **Introduction** Fraass PRO, 1(3), 188, 2011
- **IMRT** Moran et al. 2011
- **SBRT** Solberg et al. 2012
- **Peer-review** Marks et al. – in review
- **IGRT** Jaffray et al. – in review
- **HDR** in review

ASTRO White Paper: SBRT Safety

- 3D IGRT at each fraction
- Special staffing
- Specific training
- Independent check:
  - small FS dosimetry
  - TPS dose calc
  - End-to-end tests

Prescriptive Recommendations

**Limitations**

- Slow in coming
- Static snapshot
- Physics (QA/measurement) focus
- Not “hands on” training
- Not all-comprehensive
Example Pitfall: Frame-based SRS

- Frame placed in the morning
- Slip on head: prior to Tx, during Tx
- Result: Wrong location

Example Pitfall: Frame-based SRS

Example Pitfall: Frame-based SRS

Better placement
Example Pitfall: Frame-based SRS

**Preventive Measures**
- Eliminate error
  - Double check placement
- Detect error
  - Repeat depth helmet measurement
  - Patient engagement
  - Pt will feel frame slip

Alternate Approach to QI

Hazard Analysis: Identify the Highest-Risk Areas


Alternate Approach to QI
Alternate Approach to QI

TG100: Failure Mode and Effects Analysis

Report Pending

Failure Mode and Effects Analysis

FMEA Recipe
- Brainstorm for problems ("failure modes")
- Score each problem for importance

FMEA Scoring System
- How often does it occur? \( O \)
- How easy is it to spot? \( D \)
- How serious is it if undetected? \( S \)

Risk Priority Number = \( O \times D \times S \)
Example FMEA

- 53 failure modes, 43 scored
- Corrective action on top 4

<table>
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<th>Failure Mode</th>
<th>n</th>
<th>Before</th>
<th>After</th>
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<tr>
<td>Correction</td>
<td>4</td>
<td>273</td>
<td>163</td>
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- Effort
  - Core group of 7
  - Other staff (12)
  - Facilitator

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<td>Total: 1.5 hours @</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>20 hours</td>
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Ford et al. in preparation

Conclusions

- Safety is not different from Quality
- Safety / Quality are crucial focus areas
- Prescriptive QA is good but more is needed
- Hazard analysis is one tool

Shameless Advertisement

AAPM Summer School
Quality and Safety in Radiotherapy
June 16 – 20, 2013
Colorado Springs, CO
Training

Best formal training is in residency
Further training often vendor-supplied.
Limitations:
  • short (often few days) and one-time only
  • procedures oriented
  • no evaluation of learning

Competency Assessments