Status and Challenges for New Technologies: AAPM perspective

Eric Ford, PhD
University of Washington, Seattle

AAPM-SEFM-AMPR Joint Symposium
AAPM Charlotte, NC, June 19, 2012

Disclosures

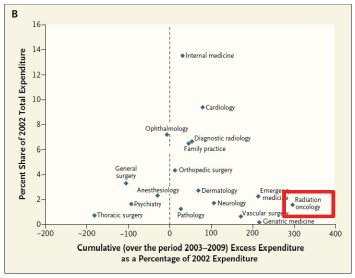
Chair: AAPM Work Group on

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

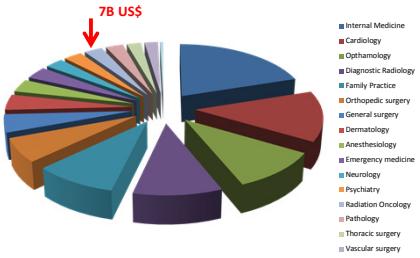
Costs



Estimated Excess Spending by State (Panel A) and by Selected Specialties (Panel B).

Alhassani et al. NEJM, 2012

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

<u>Question:</u> Does spending more result in better outcomes?

Quality and Outcomes

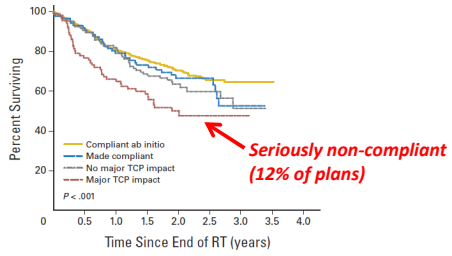
TROG 02.02

<u>RT+cis +/- TPZ for H&N SCC</u>

- 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



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.

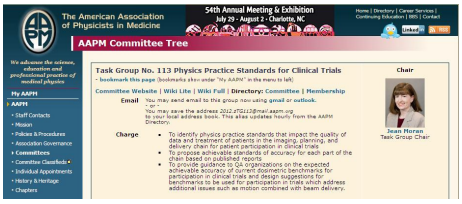
Key Points

- **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



Report Pending

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

AAPM Role

Therapy Emerging Technology Assessment Working Group

Roadmap for New Technology

Development
Early researchers / vendors

Expert Users
Reports - Institutional

AAPM Task Group Reports
Description, Prescriptive QA

Training

AAPM Task Group Reports

TG179	2012	IGRT
TG148	2011	Tomotherapy
TG135	2011	CyberKnife
TG101	2010	SBRT
TG142	2009	QA for linacs
TG119	2009	IMRT commissioning
TG76	2006	Respiration

AAPM Task Group Reports

Planned or under review

TG178		Gamma SRS calibration
TG198		Implementation of TG142
TG210		Linac acceptance testing
TG218		Tolerances for IMRT QA

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


Practical Radiation Oncology (2013), 2, 2–9

pro

www.practicalradonc.org

Special Article

Quality and safety considerations in stereotactic radiosurgery and stereotactic body radiation therapy: Executive summary

Timothy D. Solberg PhD[1,*], James M. Balter PhD[2], Stanley H. Benedict PhD[3], Benedick A. Fraass PhD[4], Brian Kavanagh MD[5], Curtis Miyamoto MD[6], Todd Pawlicki PhD[7], Louis Potters MD[8], Yoshiya Yamada MD[9]

[1]Department of Radiation Oncology, University of Texas Southwestern Medical Center, Dallas, Texas
[2]Department of Radiation Oncology, University of Michigan Health System, Ann Arbor, Michigan
[3]Department of Radiation Oncology, University of Virginia Health System, Charlottesville, Virginia
[4]Department of Radiation Oncology, Cedars-Sinai Medical Center, Los Angeles, California
[5]Department of Radiation Oncology, University of Colorado, Denver, Aurora, Colorado
[6]Department of Radiation Oncology, Yale University, New Haven, Connecticut
[7]Department of Radiation Oncology, University of California, San Diego, California
[8]Department of Radiation Medicine, Long Island Jewish Medical Center, New Hyde Park, New York
[9]Department of Radiation Oncology, Memorial Sloan Kettering Cancer Center, New York, New York

Received 6 May 2011; revised 10 June 2011; accepted 16 June 2011.

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

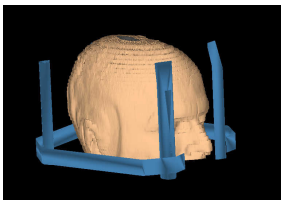
Prescriptive Recommendations

<u>Limitations</u>

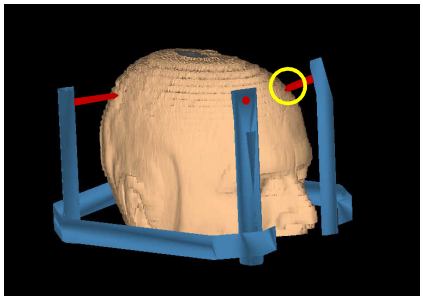
- Slow in coming
- Static snapshot
- Physics (QA/measurement) focus
- Not “hands on” training
- Not all-comprehensive

Example Pitfall: Frame-based SRS

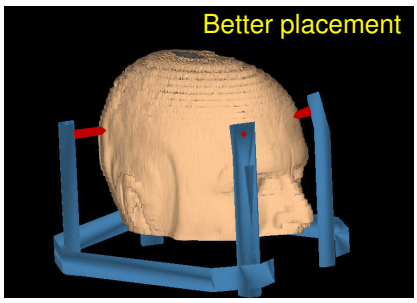
- Frame placed in the morning
- Slip on head: prior to Tx, during Tx
- Result: Wrong location



Example Pitfall: Frame-based SRS



Example Pitfall: Frame-based SRS



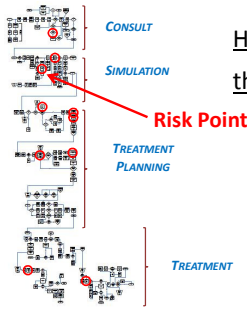
Example Pitfall: Frame-based SRS

Preventive Measures

- Eliminate error
  - ✓ Double check placement
- Detect error
  - ✓ Repeat depth helmet measurement
  - ✓ Patient engagement

    Pt will feel frame slip

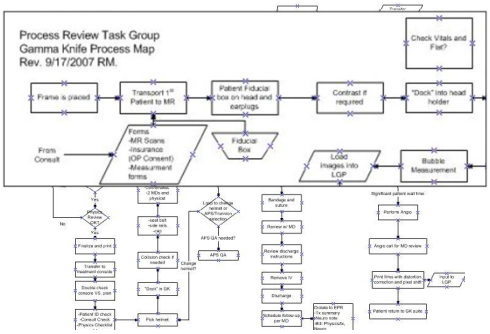
Alternate Approach to QI



Hazard Analysis: Identify the Highest-Risk Areas

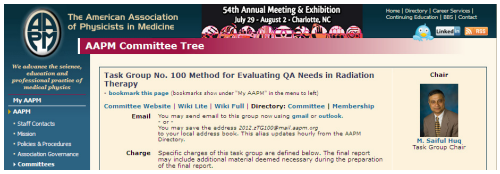
Ford et al. Int J Radiat Oncol Biol Phys, 74(3), 852-858, 2009

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 x D x S

Example FMEA

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

Failure Mode	*n*	Before	After	*p*
Correction	4	273	163	0.03

- Effort

Core group of 7	Total: 5 hours @
Other staff (12)	Total: 1.5 hours @
Facilitator	20 hours

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

EXTRA SLIDES

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

UWMC Radiation Oncology
Competency Assessment

Procedure: Active Breathing Coordinator on the Treatment Unit

Staff: _____ Date: _____

Task	Sign-off
Equipment and functionality • Familiarity with ABC equipment (valve, snorkel, cart), connection, functionality of monitors • Opening and beginning a session in the software • Meaning of colors (red/blue traces) • Exhale vs. Inhale breath-holds	
Patient Preparation • Proper use of the snorkel and nose piece • Positioning the patient and use of activation buttons • Iso-marking the patient	
Patient Imaging and treatment • Coaching the patient through a breath-hold • Performing a breath-hold CBCT scan • Performing treatment with ABC	