Implementation of New Radiotherapy Technology: The Need for Quality (No matter where in the world)

David Followill, Ph.D.
ICARO2 Meeting
Vienna, Austria
June 20, 2017
Need for Quality Audits and Peer Review

One of the most important contributing factors to errors in radiotherapy dose delivery is Human Error.

The WHO report on “Radiotherapy Risk Profile” states that 60% of all radiotherapy incidents are attributable to human error.
Crucial Elements for Successful Implementation

Appropriate education and training

Required hardware/software and dosimetry equipment

Hospital’s commitment for staffing

A commitment to support ongoing QA

Good communication between RT staff and hospital administration

Input from all involved staff prior to purchase
Increase in Complexity

Reference Calibration

Dosimetry Parameters

TPS

Hetero corrections, MLC, model based TPS

SBRT, IMRT, SRS

VMAT, MR guidance, IGRT, FFF beams, small field dosimetry
Evaluation of Reference Beam Output

- TG-21 Implementation
- TG-51 Implementation
What do we hope to achieve with Quality Audits and Peer Review?

Improve the accuracy of dose delivery to the intended location
Avoid errors and enhance patient safety
Ensure the best possible treatment for our patients
Improve outcomes from clinical trials
Meet regulatory requirements
Learn from our mistakes
Mission of the IROC is to minimize the dose uncertainty.
of Advanced Technologies in Radiotherapy

TRACKING

TPS

HETERO CORRECTION

GRT

IMRT

GATING

SBRT

Respiratory Control
Imaging, Planning and Delivery - QA required at each step

Positioning and Immobilization → Image Acquisition (CT, MR) → Structure Segmentation → treatment planning

File transfer and management → Plan validation → Position verification → treatment delivery
Imaging, Planning and Delivery - QA required at each step

Black Box
Fault Tree for Intensity-modulated Radiation Therapy
Thus the need for an end-to-end QA audit tool to verify the intended treatment goal.

Deliver the correct dose to correct location as planned
Phantom Family

2 prostate phantoms

33 lung phantoms

8 Spine phantoms

10 liver inserts

24 H&N phantoms

19 SRS phantoms
CyberKnife Findings

- Pencil Beam Algorithm in lung showed a **13-15% error** (overestimation) compared to phantom TLD in target
  - Profiles were correct shape, but wrong absolute dose.
CyberKnife Findings

• Implementation of Monte Carlo algorithm in lung resulted in results that were ±2%.
Summary

• Radiotherapy is a continually evolving complex and highly technical treatment modality that, unlike other therapies, deliver doses to the tumor that can be quantified precisely.

• Human intervention as treatments continue to evolve and become more complex may tend to introduce errors.

• Through the use of quality audits:
  • the delivery of radiotherapy treatments have improved,
  • errors have been detected and corrected and
  • our patients feel more secure that their treatments are accurate and safe.
Thank you
Questions?