

Honoring the past  
 Celebrating the present  
 Preparing for the future  
 Houston, Texas • July 17 - 31, 2006



## Quality in Radiation Therapy: what is it and how do you achieve it?



1. Overview of definitions and approaches to Quality  
*Pawlicki*
2. ROSIS  
*Knöös*
3. Peer Review Quality Audits  
*Halvorsen*
4. The Regulator's Viewpoint  
*Zelac*
5. QA in IGRT  
*Bissonnette*
6. Evidence Based QA  
*Dunscombe*

6. Evidence Based Quality Assurance

## Evaluation of Linear Accelerator Performance Standards using an Outcome Oriented Approach

Alejandra Rangel, Nicolas Ploquin,  
Ian Kay, Peter Dunscombe

Medical Physics 35, (2008) 2513 - 2518

6. Evidence Based Quality Assurance

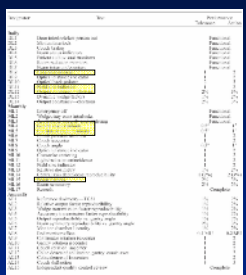
## Objective

To quantify the dosimetric changes resulting  
from sub-optimal machine performance

6. Evidence Based Quality assurance

## Linac performance standards\*

- Performance standards are stated in terms of tolerance & action levels
- Tolerance levels are considered not to compromise treatment quality
- Action levels require an intervention



\* P. Dunscombe, C. Arseneault, J.P. Bissonnette, *et. al.* "The development of quality control standards for radiation therapy equipment in Canada," J. Appl. Clin. Phys 8, 108-118 (2007)

## Materials & Methods

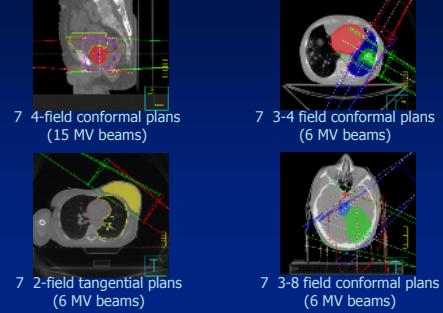
### Linac performance characteristics

- Output constancy
- Gantry angle readouts
- Collimator angle readouts
- Laser alignment (x3)
- Field size indicator
- Beam flatness



## Materials & Methods

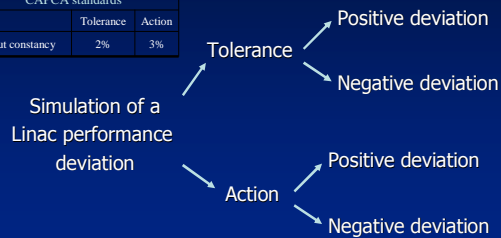
### 28 3DCRT plans



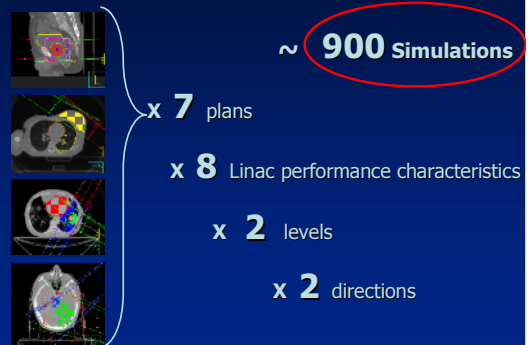
## Materials & Methods

### Evaluation of Levels of Performance

CAPCA standards		
Test	Tolerance	Action
Output constancy	2%	3%

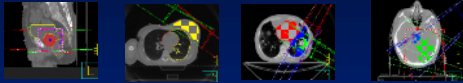


## Materials & Methods



## Materials & Methods

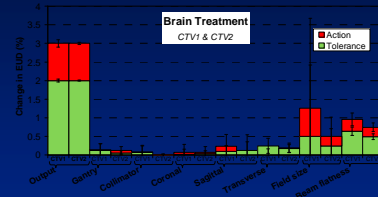
### Calculation of EUD



28 reference plans + ~900 test plans

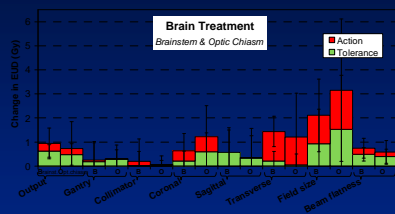
Equivalent Uniform Dose

## Results: Brain CTV



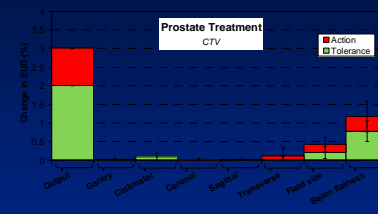
- Bars = Average  $\Delta$ EUD per course of treatment
- Error bars = 1 Std dev for  $n = 7$

## Results: Brain OARs



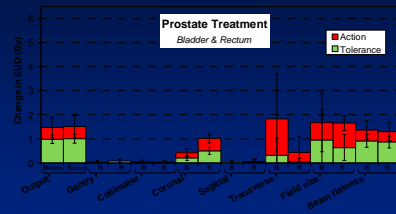
- 1<sup>st</sup> bar in each section = Brain Stem effects
- 2<sup>nd</sup> bar in each section = Optic Chiasm effects

## Results: Prostate CTV



- Bars = Average  $\Delta$ EUD per course of treatment
- Error bars = 1 Std dev for  $n = 7$

## Results: Prostate OARs



- 1<sup>st</sup> bar in each section = **Bladder** effects
- 2<sup>nd</sup> bar in each section = **Rectum** effects

## Sensitivity analysis

- The “a” value used in the calculation of the Equivalent Uniform Dose is not known accurately
- For a  $\pm 20\%$  change in “a” our results vary by
  - $< 0.1$  Gy for the organs at risk
  - $< 0.1\%$  for the targets

## Conclusions

- CAPCA Tolerance Levels are shown to maintain average EUD deviations to within 2% and 2 Gy.
- However they show markedly different effects over the range of 2% or 2 Gy.
- The efficiency with which resources are allocated within a linac quality control program can be enhanced by analyzing the relative importance of the various performance standards.

## Final Thoughts

- Will these results provoke a re-write of TG 40?  
NO
- Will these results guide the distribution of QC resources?  
MAYBE
- Will there be more work on putting QA programs on an objective basis?  
HOPEFULLY

....radiation oncology researchers need to further develop methodology for critical assessment of health technologies as a complement to randomized controlled trials.

Søren Bentzen. "Randomized controlled trials in health technology assessment: Overkill or overdue?"

Radiotherapy and Oncology 86 (2008) 142-147



## **Quality in Radiation Therapy: What it is and how do you achieve it?**

Wednesday 30<sup>th</sup> July; 10am – Noon  
Room 350

AAPM Annual Meeting  
July, 2008