Looking at the whole department workflows and evaluate potential issues

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Disclosures

• AHRQ R18 HS022204-01
• NCI UG3 CA211310-01
• ASTRO leadership
Incident Learning Data

Where Do Errors Originate?

Where Do Errors Originate?

QM program to minimize error
Stopping Errors
A traditionalist approach
ArcCHECK QA of Dose Distribution

Set1

- Patient Name: [Name]
- Patient ID: [ID]
- Plan Date: 3/14/2014
- SSD: 86.7 cm
- Depth: 2.9 an (3.3 cm H20)
- Energy: 6 MV
- Angle: [Angle]

Absolute Dose Comparison
- % Diff: 2.0
- Distance (mm): 2.0
- Threshold: 10.0
- Rotation Angle: 0.0 Degs
- Meas Uncertainty: Yes
- Dose Diff Thresh: 0.0 Oc Gy
- Use VanDyk: Yes

Summary (Gamma A)
- Total Points: 392
- Passed: 387
- Failed: 5
- % Passed: 98.7

*DTNGamma is using 2D

Dose Values in cGy

Set1

<table>
<thead>
<tr>
<th>CA</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>682.51</td>
<td>634.83</td>
</tr>
<tr>
<td>X2</td>
<td>682.51</td>
<td>634.83</td>
</tr>
</tbody>
</table>

Gamma Index Summary
- Points Within Threshold: Minimum 0.00, Maximum 1.42, Average 0.38, Stdv 0.27
Plans pass but wrong dose

Nelms et al. Med Phys, 38, 1037-1044 (2011)
Institutional patient-specific intensity-modulated radiation therapy quality assurance does not predict unacceptable plan delivery as measured by IROC Houston's head and neck phantom

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3 Department of Biostatistics, The University of Texas MD Anderson Cancer Center, Houston, Texas
Figure 3.
Percent differences between dose measurements and treatment planning system calculations.
Figure 5.
ROC curves for the ion chamber (a), film (b), and MapCheck (c), devices, indicating the
Incident Learning Data

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

Sensitivity (%)
Physics chart review
Therapist chart review
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Physician chart review
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Efficacy of Physics Plan Review

Workflow

Gopan et al. 2016
Efficacy of Physics Plan Review

62% of events

38% of events

Physics Plan Review

Workflow

Gopan et al. 2016
Efficacy of Physics Plan Review

49% Events Not Detectable

51% Events Potentially Detectable

Gopan et al. 2016
Validation with Simulated Errors

• Simulated errors in test patient cases
• Multiple simulations -> sensitivity & specificity
Validation with Simulated Errors

- Example application in pharmacology

Sarfati et al., J Clin Pharm Ther, 40, 55-62, 2015
Validation with Simulated Errors

- Example application in pharmacology

Sarfati et al., J Clin Pharm Ther, 40, 55-62, 2015
"Mock" plan with embedded errors

Error: incorrect isocenter location

Prescriptions

Whole Brain
Prescribe 300 cGy per fraction to 100% of point dose at "Iso" for 10 fractions. Beam weights are proportional to point dose. Actual point dose at "Iso" from all prescriptions/beams is 2999.75 cGy. 2 beams are assigned to this prescription.

Isocenter

Iso
Position patient such that lasers line up with patient marks. Move the laser LEFT 0.00 cm (looking from foot of table.) No up/down adjustment is required. No in/out table adjustment is required.
Results: Mock Plan Error Checks

- All errors
- Plan not matching Rx
- Incorrect CT

Gopan, Ford et al. 2017
Coming soon: AAPM Task Group 275

AAPM COMMITTEE TREE

Task Group No. 275 Strategies for Effective Physics Plan and Chart Review in Radiation Therapy

Charge
1. To review existing data and recommendations that support the use of physics plan and chart review; and to review the current recommendations on the qualifications for performing these.
2. To provide survey information on current practices in the community with respect to physics plan and chart review.
Plan → QA

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![Sensitivity (%)](chart.png)
Knowledge-based Planning: Plan quality metrics

(a) (b) (c)

Wu et al. Med Phys, 36, 5497 (2009)
Knowledge-based Planning: Plan quality metrics

Parotid DVH

Clinical plan

Replan

Wu et al. Med Phys, 36, 5497 (2009)
Reanalysis of RTOG 0126

ΔNTCP_{LQ} = 13.3%
ΔNTCP_{RS} = 5.6%
ΔNTCP_{HQ} = 2.8%

Automated Rules-Based Plan Checks

Plan Check Summaries:

- All Fields have MU less than 999
- Plan has only one trial: passed
- Rx method set to Prescribe: passed
- Isocenter for at least one beam is not named correctly
- CT couch removal check: passed
- Patient mark set check passed
- Lasers not at default position: passed
- Laser relative coordinates at zero check passed
- CT dataset extension check passed
- Dose grid voxel size check passed
- Outside patient air threshold check passed
- Beams all on a single treatment machine: passed
- No small couch kicks
- EPD plan (energy, machine, couch, no wedges, VMAT): passed
- Patient with pacemaker. Planned with at least one high energy beam

Dismiss
Probabilistic Network for Error Detection

• Bayesian Network

Conclusions
Measuring Quality Assurance

An “old” technology

A “new” technology

A different approach

EPID Dosimetry
Temozolomide + RT for Glioblastoma

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