Provincial Collaborative IMRT QA Program: The Cancer Care Ontario Experience

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Outline

• Rationale

• Collaborative QA (CQA) Program
  – Program Development
  – Implementation
  – Results

• Next Steps
RATIONALE

IMRT Across Ontario

Multiple Institutions
Different Infrastructure
Variation in Practice
Different Resources
Variable Rate of Adoption of IMRT
IMRT Across Ontario

How do we assess planning and delivery performance in this environment?

Collaborative Quality Assurance (CQA) Program

Objectives:

– Current status assessment (techniques, processes)
– Measure IMRT planning and treatment delivery performance
– Tool for continuous quality improvement
Program Requirements

- Include an end-to-end test
- On-site visit
- Compatible with multiple vendors
- Adaptability for different treatment sites and delivery techniques
- Diagnostic capabilities
Planning Exercise

- Realistic clinical scenario
- Test clinical planning practice
- Ability to create planning exercises for different sites

Planning Exercise

- Site-specific CT datasets
- ROI burned into images for auto-contouring
- Planned using clinical processes
Dose Delivery (Measurement)

- Multiple measurements in single set-up
- Static gantry and rotational delivery
- Image Guidance

ArcCHECK™

- Helical distribution of diodes
- 21 cm array diameter and length
- Insert can be used
- Software compares measured and planned dose
Standard Plan Test

• Plan provided by CQA (Linac-specific plan)
• Isolate impact of planning practices

<table>
<thead>
<tr>
<th>Low Pass Rate</th>
<th>High Pass Rate</th>
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<tbody>
<tr>
<td>Center's Plan</td>
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### Standard Plan Test

- Plan provided by CQA (Linac/MLC-specific plan)
- Isolate impact of planning practices

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Machine performance or Beam Model

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### Standard Plan Test

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Difference in Planning Practice
PROGRAM IMPLEMENTATION
YEAR ONE

Visit Schedule

- Sent CT dataset and documentation
- 1-2 Weeks Prior to Visit
- CT-Simulation
- TPS Activities and Preparation for Delivery
- Day Of Visit
- Set-Up and Delivery at Tx Unit
Visit Schedule

Sent CT dataset and documentation
CT-Simulation
TPS Activities and Preparation for Delivery
Set-Up and Delivery at Tx Unit

1-2 Weeks Prior to Visit
Day Of Visit

Planning Exercise

<table>
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<tr>
<th>ROI</th>
<th>Dose Metric</th>
<th>Objective</th>
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<tbody>
<tr>
<td>PTV 70 Gy</td>
<td>V&lt;sub&gt;100% &lt;/sub&gt;(70 Gy)</td>
<td>&gt; 95%</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;95% &lt;/sub&gt;(66.5 Gy)</td>
<td>&gt; 99%</td>
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<tr>
<td></td>
<td>Mean Dose</td>
<td>&lt; 105%</td>
</tr>
<tr>
<td>PTV 56 Gy</td>
<td>V&lt;sub&gt;100% &lt;/sub&gt;(56 Gy)</td>
<td>&gt; 95%</td>
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<td></td>
<td>V&lt;sub&gt;95% &lt;/sub&gt;(53.2 Gy)</td>
<td>&gt; 99%</td>
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<td>Left Parotid</td>
<td>Mean Dose</td>
<td>&lt; 26 Gy</td>
</tr>
<tr>
<td></td>
<td>D&lt;sub&gt;50%&lt;/sub&gt;</td>
<td>&lt; 30 Gy</td>
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<tr>
<td>Cord</td>
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<td>Normal Tissue</td>
<td>V&lt;sub&gt;60Gy&lt;/sub&gt;</td>
<td>&lt; 5%</td>
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Visit Schedule

1-2 Weeks Prior to Visit

Sent CT dataset and documentation
CT-Simulation

Day Of Visit

TPS Activities and Preparation for Delivery
Set-Up and Delivery at Tx Unit

Visit Schedule

1-2 Weeks Prior to Visit

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CT-Simulation

Day Of Visit

TPS Activities and Preparation for Delivery
Set-Up and Delivery at Tx Unit
TPS Activities

- Images transferred to TPS
- Re-compute dose on phantom for H&N Plan
- Import Standard Plan and compute dose
- Compute calibration test field
- Transfer reference images to linac for set-up

Visit Schedule

1-2 Weeks Prior to Visit

Day Of Visit

Sent CT dataset and documentation

CT-Simulation

TPS Activities and Preparation for Delivery

Set-Up and Delivery at Tx Unit
Dose Delivery

- Phantom Set-Up
- Centre’s own IMRT plan
- Standard Plan
- Assess measured to planned dose agreement

PROGRAM RESULTS

YEAR ONE
Year 1 Results

- 13 visits completed
- 4 Delivery Systems and 5 TPS
- 16 H&N plans
  - 12 IMRT, 3 VMAT and 1 TomoTherapy
- High compliance with treatment planning objectives
- Variation in planning technique
3%/3mm Gamma

% Pass Rate

Head and Neck Plan

TG-119 Criteria

Létourneau et al. IJRBP, 2013
Ezzell et al, Med Phys, 2009
3%/2mm Composite (DTA)

% Pass Rate

Head and Neck Plan

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Létourneau et al, IJORBP, 2013
Thomas et al, IJORBP, 2012

Standard Plan

Group 1

% Pass Rate (3%/2mm)

H&N Plan  Standard Plan

Difference in Planning Practice
Year 1 Summary

- Quantitative evidence of good practice
  - Satisfy AAPM TG-119 guidelines
- Tighter tolerances highlight room for improvement
- Impact of system commissioning
- Provided some feedback for quality improvement
PHASE TWO
YEAR 2 to 6

Focus

• New Anatomic Sites
• Repeat Deliveries
• More Diagnostic Tests
• Better Feedback

Year 2 Development

• New planning exercise: Prostate
Phantom Positioning

- Facilitate CBCT image guidance
- MV markers for phantom setup error assessment by CQA
  (Accuracy: 0.2 mm and 0.1°)

Year 2 Results

- 14 Centres Visited
- Measurements on 22 linacs
- H&N plans were redelivered
- 17 Prostate Plans (12 VMAT and 5 IMRT)
- Independent assessment of phantom setup errors
Prostate Plans

Prostate: 96% vs. H&N: 92% (p = 0.03)

H&N Repeat Delivery

H&N Year 1: 92% vs. H&N Year 2: 93% (p = 0.77)
Year 2 Summary

• Higher performance for prostate (simpler task)
• Increase use of rotational delivery
• Year-to-year performance variation (H&N):
  – Variation at institutional level
  – No change on average
• Small phantom setup error
  (usually < 1.5 mm and 1°)

Next Steps

• Developing new anatomic sites
• Repeat deliveries for constancy assessment
• Increase feedback specificity with diagnostic tests:
  – Phantom setup error
  – MLC positioning
  – Beam model tests
• Encouraging transfer of expertise
  – Eliminating anonymity