Elekta MOSAIQ and Philips Pinnacle

Anne W. Greener, Ph.D., FACR
U.S. Department of Veterans Affairs
VA New Jersey Health Care System – East Orange, New Jersey
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Conflicts
NONE

Professional Affiliations
Member, AAPM Subcommittee on Training and Practice of Medical Dosimetry
Member, AAPM Working Group for Prevention of Errors
Member, AAPM TG-275 – Strategies for Effective Physics Plan and Chart Review in Radiation Therapy
Learning Objectives

The participant will be able to:

• Apply plan/chart methodology using Pinnacle/MOSAIQ configuration.
• Identify three high-risk failure modes in plan/chart checks.
• Integrate recommendations of TG-275 in the clinic.
Snap Shot of East Orange VA Radiation Oncology

Radiation Oncologists:
- Chief of Service
- 1 FT + 3 PT

Medical Physicists:
- Chief (Agency Coverage)
- 1 FT Staff (vacant)

Medical Dosimetrists:
- 2 CMDs (1 vacant)

Radiation Therapists:
- Chief
- 1 FT Clinical Lead + 6 RTTs

Nursing Staff:
- 1 NP + 2 FT RNs
- 1 Health Tech
- 3 Nurse Navigators

Other:
- 1 PT Clinical Psychologist
- 1 PT Social Worker
- 1 PT Dietitian
- 1 FT Administrative Officer
- 1 FT Receptionist

Patient Load:
- 200 Consults/year
- 175 RT Patients/year
- 60% IMRT
- SBRT/SRS/HDR/Prostate LDR

Equipment:
- Elekta Infinity, Siemens, Philips Big Bore CT, Elekta/Nucletron HDR, Elekta seedSelectron, Varian Calypso, Philips TPS, Oncentra Brachy, Oncentra Prostate, MimVista, MOSAIQ, Monaco (nonclinical)
Challenges We Face . . .

STAFFING

Radiation Oncologists:
• Chief of Service (20% clinical)
• 1 FT + 3 PT

Medical Physicists:
• Chief (Agency Coverage)
• 1 FT Staff (vacant)

Medical Dosimetrist:
• 2 CMDs (1 vacant)

EQUIPMENT

• Elekta Infinity
• Siemens Impression Plus
• Philips Big Bore CT
• Elekta/Nucletron HDR
• Elekta seedSelectron
• Varian Calypso
• Philips Pinnacle TPS
• Oncentra Brachy
• Oncentra Prostate
• MimVista
• Elekta MOSAIQ
• Elekta Monaco (not clinical)
Challenges We Face . . .

Pinnacle ➔ MOSAIQ

In Pinnacle:
Approx 40 clicks to export DICOM data and Plan PDF and import into eScan
3D:
Approx 20 clicks to export into RadCalc and export report to eScan
IMRT/VMAT:
Approx 40 clicks to prep QA plan on phantom and export to QA folder

In MOSAIQ:
Approx 20 clicks to RTP import, complete Site setup, associate images &
complete & approve fields

Grand Total: 80-100 clicks (or steps)
Improvements...

- **Standardization** (Multiple MDs)
  - “**Standard patients**” in MOSAIQ
  - Standard Objective/Constraint Spreadsheets
- **Checklists**
  - MOSAIQ Assessments
    - Planner
    - Physics Plan/Chart Check
- **Physician Peer Review** (Weekly)
  - Contour Review (**before planning is completed**)
  - Plan Review (**prior to verification simulation/treatment**)
- **Mode of Communication**
  - MOSAIQ QCLs
  - iQScripts (**Evolving**)
Department Review Process

Weekly Rounds (MD/RN/RTT/MP)

On-Treatment Patients (and “Pending” Patients)

Treatment

Verification Simulation

Pre-Tx QA

Weekly Physician Peer Review (MD/CMD/MP)

Weekly Rounds (MD/CMD/RTT)

Daily Rounds (MD/CMD/RTT)

Simulation

Fusion & Contouring

Tx Planning

Plan Review

Contour Review

Weekly Rounds (MD/RN/RTT/MP)

New Consults

Consult
Physics Plan Review
Pinnacle/MOSAIQ

Targets and Expansions

Isodoses and Target Coverage

MOSAIQ Prescription
(adopted TG-263)

Rad Rx: PTV_6996: 6996 cGy / 33 fxs
Dose Spec: Calc Pt 97%
Rad Rx: PTV_5940cGy per Plan
Rad Rx: PTV_5412cGy per Plan

GTV = left tonsil slight extension left glossotonsillar sulcus and left level II-III LN

CTV_6996 = GTV + 5mm modified off muscle, air, and bone
CTV_5940 = GTV P + 8 margin covering soft palate, hemihard palate, retromolar trigone, parapharyngeal space, and valleculae + GTV LN IB, II, III modified off muscle, bone, and air
CTV_5412 = L LN level IV, V, R LN II-IV

PTV_6996 = CTV_6996 + 3mm: 6996cGy delivered to > 95% volume; minimum dose > 93%; 0.1cc volume < 107%
PTV_5940 = CTV_5940 + 3mm: 5940cGy delivered to > 95% volume; minimum dose > 93%
PTV_5412 = CTV_5412 + 3mm: 5412cGy delivered to > 95% volume; minimum dose > 93%
### Objectives and Constraints

<table>
<thead>
<tr>
<th>ROI</th>
<th>Type</th>
<th>Prescription</th>
<th>Composite Goal (cGy)</th>
<th>Plan Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTV_6996</td>
<td>ctv1 + 3mm</td>
<td>Rx (cGy)</td>
<td>Total Dose (cGy)</td>
<td>Vol (cc)</td>
</tr>
<tr>
<td>PTV_5940</td>
<td>ctv2 + 3mm</td>
<td>Rx (cGy)</td>
<td>Total Dose (cGy)</td>
<td>Vol (cc)</td>
</tr>
<tr>
<td>PTV_5412</td>
<td>ctv3 + 3mm</td>
<td>RX (cGy)</td>
<td>Total Dose (cGy)</td>
<td>Vol (cc)</td>
</tr>
<tr>
<td>CTV_6996</td>
<td></td>
<td></td>
<td></td>
<td>Vol (cc)</td>
</tr>
<tr>
<td>Min Dose to PTV_6996</td>
<td>99.9% volume</td>
<td></td>
<td></td>
<td>cGy</td>
</tr>
</tbody>
</table>

### Plan Results

<table>
<thead>
<tr>
<th>ROI</th>
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<th>Composite Goal (cGy)</th>
<th>Plan Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTV_6996</td>
<td></td>
<td></td>
<td>6996</td>
<td></td>
</tr>
<tr>
<td>PTV_5940</td>
<td></td>
<td></td>
<td>5940</td>
<td></td>
</tr>
<tr>
<td>PTV_5412</td>
<td></td>
<td></td>
<td>5412</td>
<td></td>
</tr>
<tr>
<td>CTV_6996</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### OAR’s

<table>
<thead>
<tr>
<th>Structure</th>
<th>Max Dose (0.1cc)</th>
<th>Max</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal Cord</td>
<td>5000</td>
<td>4559</td>
<td>4385</td>
</tr>
<tr>
<td>Brain Stem</td>
<td>5400</td>
<td>4395</td>
<td>4141</td>
</tr>
<tr>
<td>Mandible</td>
<td>7000</td>
<td>6952</td>
<td></td>
</tr>
<tr>
<td>Eyes (Rt &amp; Lt)</td>
<td>4500</td>
<td>258</td>
<td>320</td>
</tr>
<tr>
<td>Lens (Rt &amp; Lt)</td>
<td>800</td>
<td>170</td>
<td>205</td>
</tr>
<tr>
<td>Optic Nerve (Rt &amp; Lt)</td>
<td>5400</td>
<td>305</td>
<td>380</td>
</tr>
<tr>
<td>Spinal Cord</td>
<td>4500</td>
<td>358</td>
<td></td>
</tr>
<tr>
<td>Esophagus</td>
<td>3400</td>
<td>2776</td>
<td></td>
</tr>
<tr>
<td>Cochlea (Rt &amp; Lt)</td>
<td>4500</td>
<td>1976</td>
<td>3851</td>
</tr>
<tr>
<td>Lt Parotid</td>
<td>2600</td>
<td>2543</td>
<td></td>
</tr>
<tr>
<td>Rt Parotid</td>
<td>2600</td>
<td>2567</td>
<td></td>
</tr>
<tr>
<td>Larynx minus PTVs</td>
<td>3000</td>
<td>3055</td>
<td></td>
</tr>
<tr>
<td>Oral Cavity minus PTVs</td>
<td>3000</td>
<td>3966</td>
<td></td>
</tr>
</tbody>
</table>
Physics Plan Review
Pinnacle/MOSAIQ

MOSAIQ Assessment:
“Second Treatment Plan Review”

- Correct Patient and Site
- Plan agrees with script
- Imaging Correct
- Rad Rx approved by MD
- Tx Planning parameters correct
- Bolus & Beam modifier correct
- ROIs correct for Site
- Graphical Isodoses = Intent
- DVH appropriate for site
- DRRs associated to fields
- Independent Calc within +/- 5%

- Site Setup Accurate
- EMR field parameters match plan
- Pt specific QA within specs
- Plan signed by Planner
- Plan signed by MD
- Plan signed by Physicist
- Special Physics Consult Complete
- In Vivo Dosimetry form ready
- Charges Captured Correctly
- 2nd Tx Plan Review Initials
- 2nd Tx Plan Review Comments
Physics Plan/Chart Review
Pinnacle/MOSAIQ

Real Life Examples found during Physics Plan/Chart Reviews

All in ONE WEEK!!!!
Case #1

82 year old male with T1N0M0 SCC of the Right Bronchus (Stage 1A) planned to receive definitive radiation with a maximum of 2000cGy/10 fractions using a 3D plan then switch to an IMRT plan for a total of 6400cGy/32 fractions.
Case #1
What Happened?

- MD approves plan on Pinnacle
- Dosimetrist transfers plan to MOSAIQ
- **During dosimetrist plan/chart review, dosimetrist notices no MLC on AP field**
- In Pinnacle, Dosimetrist invokes MLC on AP field
- Exports plan from Pinnacle to MOSAIQ
- Physics Plan/Chart Review

<table>
<thead>
<tr>
<th></th>
<th>AP MU (wedge/open)</th>
<th>RPO MU (wedge/open)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>167.5 (49.24/118.26)</td>
<td>181.5 (73.04/108.46)</td>
</tr>
<tr>
<td>MOSAIQ</td>
<td>167.5 (49.24/118.26)</td>
<td>185.2 (74.53/110.67)</td>
</tr>
</tbody>
</table>

Dosimetrist imported only AP field & did not check RPO field.
# Case #1

## TG-275: Failure Modes/Causes

### High Risk Failure Modes for initial plan/chart review

<table>
<thead>
<tr>
<th>FM#</th>
<th>Process Step</th>
<th>Failure Mode</th>
<th>Cause</th>
<th>RPN</th>
<th>S</th>
<th>O</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>Tx Plan</td>
<td>Incorrect Field Parameters</td>
<td>MLC not invoked in one field; wrong MU</td>
<td>105.1</td>
<td>5.6</td>
<td>4.4</td>
<td>4.3</td>
</tr>
</tbody>
</table>

### EBRT Initial plan/chart review checks from AAPM all-member survey

<table>
<thead>
<tr>
<th>Physics Check Item</th>
<th>Corresponding FM</th>
<th>Highest RPN</th>
<th>Use Freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP-Q6-8: Beam modifiers (e.g. wedges, electron and photon blocks, tray, etc)</td>
<td>58,88,105,111</td>
<td>95.2</td>
<td>92%</td>
</tr>
<tr>
<td>TP-Q6-13: Field Aperture</td>
<td>41,43,58,70,72</td>
<td>105.2</td>
<td>96%</td>
</tr>
<tr>
<td>TP-Q7a-10: MU</td>
<td>37,43,81,94</td>
<td>107.6</td>
<td>68%</td>
</tr>
<tr>
<td>TP-Q7a-15: Field Aperture</td>
<td>41,43,94</td>
<td>105.2</td>
<td>56%</td>
</tr>
</tbody>
</table>
Case #2

81 year old male with Stage 4 carcinoma of the prostate metastatic to the bone. He was planned to receive palliative radiation with 2000cGy/5 fractions to two sites of the spine; T spine (4-9) and L spine (1-3). Each site uses AP/PA fields.
Case #2
What Happened?

- Setup notes and photos were exactly the same for both sites
- Longitudinal tolerance was too board

<table>
<thead>
<tr>
<th>Setup Notes And Photos</th>
<th>Original</th>
<th>Modified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt HFS large black mat, wingboard, U-bar A-1,2 #1 blue cushions under head, 2 #5 blue wedge under elbows, #2 knee wedge and tattoos. NOTE: 2 ISO, LINE UP TO L2 TATTOOS THEN SHIFT TO T2 ISO. TT=L2 13.8 / T5 10CM Sep = L2 22.2 / T5 23cm</td>
<td>2 ISO LINE UP TO L2 TATTOOS THEN SHIFT TO T2 ISO. TT=10cm; Sep = 23cm</td>
<td>TT=13.8; Sep = 22.2 Pt HFS large black mat, wingboard, U-bar A-1,2 #1 blue cushions under head, 2 #5 blue wedge under elbows, #2 knee wedge and tattoos.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tolerance Table</th>
<th>Original</th>
<th>Modified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photon 3D (Long = 10cm)</td>
<td>Long (Long = 3cm)</td>
<td>Long (Long = 3cm)</td>
</tr>
</tbody>
</table>
### Case #2
TG-275

#### High Risk Failure Modes for initial plan/chart review

<table>
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<tr>
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<th>S</th>
<th>O</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Simulation</td>
<td>Wrong setup instructions</td>
<td>Therapists inattention to workflow; Setup photos</td>
<td>124.4</td>
<td>3.7</td>
<td>6.2</td>
<td>5.5</td>
</tr>
</tbody>
</table>

#### EBRT Initial plan/chart review checks from AAPM all-member survey

<table>
<thead>
<tr>
<th>Physics Check Item</th>
<th>Corresponding FM</th>
<th>Highest RPN</th>
<th>Use Freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sim-Q1-5: Written or photographic documentation of patient positioning, immobilization and ancillary devices</td>
<td>24,33,47,63,78,80</td>
<td>124.4</td>
<td>70%</td>
</tr>
<tr>
<td>Sim-Q1-8: Patient setup and positioning</td>
<td>24,47,51,52</td>
<td>124.4</td>
<td>75%</td>
</tr>
<tr>
<td>Sim-Q1-9: Setup note</td>
<td>24,47,52</td>
<td>124.4</td>
<td>69%</td>
</tr>
<tr>
<td>TP-Q6-14: Tolerance Table</td>
<td>None</td>
<td>N/A</td>
<td>81%</td>
</tr>
</tbody>
</table>
Case #2

BUT ...  
Failure Mode during pre-treatment imaging:

L-Spine DRR

Pre-Treatment Image
63 year old male with nasal SCC status post nasal mass excision who now has a recurrence involving the entire nose and medial aspect of the right eye. The positive margin area (PTV1) was prescribed to 5600cGy/28 fractions and the adjacent probable area (PTV2) to 5040cGy/28 fractions using dose painting. A 1400cGy/7 fractions cone down would follow to PTV1 for a total dose of 7000cGy/35 fractions.
Physician Peer Review . . . Discussion . . . Patient “needs to start”

Pre-Tx QA for Initial Plan . . . QA passed

Physics Plan/Chart Review . . .

<table>
<thead>
<tr>
<th></th>
<th>Initial Plan (28 fx)</th>
<th>Cone Down Plan (7 fx)</th>
<th>Composite Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PTV1</td>
<td>PTV2</td>
<td>PTV1</td>
</tr>
<tr>
<td>Prescription</td>
<td>5600</td>
<td>5040</td>
<td>1400</td>
</tr>
<tr>
<td>Plan</td>
<td>5600</td>
<td>≈4600</td>
<td>1400</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Initial Plan (31 fx)</th>
<th>Cone Down Plan (4 fx)</th>
<th>Composite Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PTV1</td>
<td>PTV2</td>
<td>PTV1</td>
</tr>
<tr>
<td>Plan</td>
<td>6200</td>
<td>5084</td>
<td>800</td>
</tr>
</tbody>
</table>
## High Risk Failure Modes for initial plan/chart review

<table>
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<tr>
<th>FM#</th>
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<th>RPN</th>
<th>S</th>
<th>O</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Pre-Tx Review</td>
<td>Plan reviewed incorrectly by attending MD</td>
<td>Covering MD (not familiar with case details), <strong>MD rushed</strong></td>
<td>138.9</td>
<td>4.5</td>
<td>4.2</td>
<td>5.5</td>
</tr>
<tr>
<td>35</td>
<td>Tx Plan</td>
<td>Suboptimal plan</td>
<td>Beam or arc arrangement suboptimal, not enough flash, field matching incorrect, <strong>optimization objectives missing or wrong</strong>, suboptimal field weighting</td>
<td>108.3</td>
<td>3.8</td>
<td>6.4</td>
<td>4.5</td>
</tr>
<tr>
<td>40</td>
<td>Pre-Tx Review</td>
<td>Physician peer review (chart rounds) not performed or <strong>inadequate</strong></td>
<td>Standard procedure not followed (did not make it on list), not reviewed due to high-volume at chart rounds, <strong>policy for review is lacking</strong></td>
<td>106.2</td>
<td>3.9</td>
<td>4.8</td>
<td>5.6</td>
</tr>
</tbody>
</table>
**Case #3**

**TG-275**

### EBRT Initial plan/chart review checks from AAPM all-member survey

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<th>Use Freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA-Q1-12: Peer review of treatment decision (e.g. tumor board, peer-to-peer evaluation, etc)</td>
<td>8,13,26,28,34,40,77</td>
<td>160.2</td>
<td>17%</td>
</tr>
<tr>
<td>TP-Q4a-1: <strong>Target Planning Objectives</strong></td>
<td>35</td>
<td>108.3</td>
<td>82%</td>
</tr>
<tr>
<td>TP-Q5-2: Target Coverage</td>
<td>17,35,82</td>
<td>137.9</td>
<td>94%</td>
</tr>
</tbody>
</table>
THANK YOU

Elekta
Paul McGrew, Global Product Support Engineer