Plan Review Through Benchmarking

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Definition

• "Benchmark" originates from the practice of a surveyor chiseling a horizontal groove in a stone structure, and then inserting a bar of angle iron.
Angle Iron (Bench Mark)
Less Literally

• A standard or point of reference against which things may be compared or assessed.
Benchmarking Today

• Although an old concept, benchmarking is just as applicable and important as ever.
What is Benchmarking in Treatment Planning?

• Benchmarking is recording the normal organs and target doses we were able to achieve for a given plan.

• Use this data, as a reference when planning future patients, whenever the patients have similar disease type and location.
Similar Anatomy
What Are We Currently Doing?

- Benchmarking might sound obvious, but technically it often isn’t utilized.
Current Best Practice

• In Radiation Oncology, we typically use RTOG protocols, TD 5/5’s and the NCCN guidelines as the framework for our treatment planning goals.

• These are just as the name implies...Guidelines.
Current Best Practice

• We drive the optimizer or configure beam arrangements which best achieve these predetermined reference RTOG,TD 5/5 and NCCN guidelines.
Current Best Practice

• Some plans, while using these guidelines as our reference, may approach the absolute optimal holy grail dose distribution for a given patient.

• However, many approved plans may meet our guidelines, but fall short of being optimal.
Why do some plans fall short of being optimal when using RTOG,NCCN,TD 5/5 guidelines?

• 1) RTOG guidelines and Protocols may not be stringent enough for a specific patient.
RTOG 0815

<table>
<thead>
<tr>
<th>Normal Organs</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bladder</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15% volume</td>
<td>receives no more than</td>
<td>60 Gy</td>
</tr>
<tr>
<td>25% volume</td>
<td>receives no more than</td>
<td>75 Gy</td>
</tr>
<tr>
<td>35% volume</td>
<td>receives no more than</td>
<td>70 Gy</td>
</tr>
<tr>
<td>50% volume</td>
<td>receives no more than</td>
<td>65 Gy</td>
</tr>
<tr>
<td><strong>Rectum</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15% volume</td>
<td>receives no more than</td>
<td>75 Gy</td>
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</tr>
<tr>
<td>50% volume</td>
<td>receives no more than</td>
<td>60 Gy</td>
</tr>
<tr>
<td><strong>Right Femoral Head - Maximum Dose</strong></td>
<td>is less than</td>
<td>50 Gy</td>
</tr>
<tr>
<td><strong>Left Femoral Head - Maximum Dose</strong></td>
<td>is less than</td>
<td>50 Gy</td>
</tr>
<tr>
<td><strong>Bowel Space - V45 Gy</strong></td>
<td>is less than</td>
<td>150 cc</td>
</tr>
<tr>
<td><strong>Targets</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% PTV receiving Rx dose</td>
<td>is at least</td>
<td>98%</td>
</tr>
<tr>
<td>Maximum target dose (to 0.03cc)</td>
<td>is less than</td>
<td>107%</td>
</tr>
</tbody>
</table>
RTOG 0815 vs Actual Optimization

Bladder Dose

Rectum Dose

RTOG Rectum

RTOG Bladder

Level Hold
Why do some plans fall short of being optimal?

• 2) We can stop optimizing when normal organs meet constraints, but we could have spared them
Why Do Some Plans Fall Short of Being Optimal?

• We can stop optimizing when normal organs meet constraints, but we could have spared them much further.
Why Do Some Plans Fall Short of Being Optimal?

- 3. Difficult to achieve

<table>
<thead>
<tr>
<th>Critical Structures (5/31/07)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTOG 0529 (Anal)</td>
</tr>
</tbody>
</table>

The dose constraints are listed in order from most to least important.

**Small bowel:**
- No more than 200 cc above 30 Gy
- No more than 150 cc above 35 Gy
- No more than 20 cc above 45 Gy
- None above 50 Gy

**Femoral heads:**
- No more than 50% above 30 Gy
- No more than 35% above 40 Gy
- No more than 5% above 44 Gy

**Iliac crests:**
- No more than 50% above 30 Gy
- No more than 35% above 40 Gy
- No more than 5% above 50 Gy

**External genitalia:**
- No more than 50% above 20 Gy
- No more than 35% above 30 Gy
- No more than 5% above 40 Gy

**Bladder:**
- No more than 50% above 35 Gy
- No more than 35% above 40 Gy
- No more than 5% above 50 Gy

**Large bowel:**
- No more than 200 cc above 30 Gy
- No more than 150 cc above 35 Gy
- No more than 20 cc above 45 Gy
Why Do Some Plans Fall Short of Being Optimal?

- Genitalia Actual Dose
- Genitalia RTOG limit
- Bladder Actual Dose
- Bladder RTOG limit
Why Do Some Plans Fall Short of Being Optimal?

• #4) We can sacrifice target coverage unnecessarily. Perhaps, prioritize an OAR we don’t need to prioritize.
Why Do Some Plans Fall Short of Being Optimal?

• 5) We waste a lot of time trying to decide.
Why Do Some Plans Fall Short of Being Optimal?

WHAT IS IS GOING ON HERE?
Why Do Some Plans Fall Short of Being Optimal?

• Unless we start recording our Treatment plan results, to evaluate in the future, we will continue to plan in the dark.
Your Average Dosimetrist
More Control, More Responsibility

- With advances in technology, namely IMRT/VMAT/IGRT we are able to hypo fractionate and dose escalate like never before.
- This new technology places more of the decisions and control in our hands.
- We really need to know what to do with it, and what we are capable of.
Stevie Wonder

- Might not have been a great Dosimetrist.
• But even he said “if you don’t ask, you don’t get.”
Advantages?

• 1) Through Benchmarking of our treatment plans, we can more specifically and reproducibly plan and cater to similar patient cohorts and disease sites.
Advantages?

• 2) Satellite clinics can more effectively and efficiently plan like the mothership.
Advantages?

- 3) Access and uniformity to a consistent framework throughout our entire population.
Advantages?

• 4) Great way to show how new modalities work or don’t work.
Advantages

• 5) Know what your neighbor is doing.
Great Way to Satisfy Accrediting Agencies

- ASTRO’s
- ACR
- ACRO
- JCERT
- All ask for quality indicators, and a way to establish performance goals for each quality indicator.
- Use results to improve.
How is Roswell Park Moving Toward This?

- Installed and commissioned treatment plan evaluation software which allows for benchmarking of treatment plans as well as DVH metric evaluation.
Historical Benchmarks
## DVH Metric Example

### Metric Values

#### 45 PTV (PTV - Initial):
- **DMin (> 95.00 % Rx1)**: 97.55 % Rx1, 43.90 Gy
- **V100% Rx1 (> 98.00 %)**: 99.80 %
- **D0.03cc (< 107.00 % Rx1)**: 105.17 % Rx1, 47.33 Gy

#### 45 CTV (CTV - Initial):
- **DMin (> 95.00 % Rx1)**: 100.04 % Rx1, 45.02 Gy
- **V100% Rx1 (> 98.00 %)**: 100.00 %, 310.55 cc

#### Bladder:
- **D15% (< 60.00 Gy)**: 42.63 Gy
- **D25% (< 75.00 Gy)**: 39.46 Gy
- **D35% (< 70.00 Gy)**: 37.14 Gy
- **D50% (< 65.00 Gy)**: 33.38 Gy

#### Rectum:
- **D15% (< 75.00 Gy)**: 43.20 Gy
- **D25% (< 70.00 Gy)**: 39.10 Gy
- **D35% (< 65.00 Gy)**: 34.72 Gy
- **D50% (< 60.00 Gy)**: 29.19 Gy

#### Fem H+N R:
- **V50Gy (< 10.00 %)**: 0.00 %, 0.00 cc
How is Roswell Park moving toward Benchmarking?

• Combine treatment plan benchmarked data, with a more discreet and comprehensive evaluation of our patients during OTV’s and follow ups.
• More acute and detailed insight into how a given radiation dose effects survival and side effects.
• We work in a very technical field. One which allows us to micro manage many of the details.