Planning Comparisons with Difficult Cases
Idea for Today’s Conversation

Following are 2 Case Studies followed by a few points to consider.

The idea is to develop a community awareness of the value of Medical Dosimetrists and to share a little of what we do.
“The best thing you can give as a leader is a reason to trust. People want to trust. They’re hungry for it. But they’re selective. They’ll only give it to a motivator, a communicator, a teacher, a real person. Someone who in good times and bad always does the right thing.”

-- Jeffrey Immelt
CEO GE
Thoughts to Consider:

**Conformality Index:**

RTOG Definition – volume of reference or Rx Isodose divided by the Target Volume

\[ CI \text{ (RTOG)} = \frac{V(\text{RI})}{TV} \]

For Example:

PTV 4500cGy Volume = 1450cc’s
4500cGy Isodose Cloud = 1600cc’s
CI = 1600cc’s/1450cc’s
= 1.103

Indicating a 10.3% greater Isodose Cloud over the PTV per volume. (excess volume)
Thoughts to Consider:

Conformality Index:

The RTOG Guidelines define a ratio of 1.0-2.0 as per protocol and ratios in the range of 0.9-1.0 or 2.0-2.5 as minor variations.

This value is heavily dependent upon target size and shape complexity ... complex target shapes are often higher than those for simple target shapes.

--Journal of Applied Clinical Medical Physics, Vol 4, #4 Fall 2003; “Quality of Coverage: Conformity measures for stereotactic radiosurgery”
For Example:
Thoughts to Consider:

**Homogeneity Index:**
RTOG Definition – The Maximum Isodose in the Target divided by the Reference Isodose.

\[ HI = \frac{I(\text{max})}{RI} \]

For Example:
Reference Isodose (Rx dose) = 4500cGy
Maximum Isodose (>0.03cc’s) = 5000cGy

\[ HI = \frac{5000\text{cGy}}{4500\text{cGy}} \]
\[ = 1.11 \]

Indicating an 11% Isodose point above Rx request.

(RTOG 0534 : Max Dose Acceptable Variation >7% - <12%)
Thoughts to Consider:

Homogeneity Index:
It’s worth noting that there is also a “Quality of Coverage” definition from RTOG

- Minimum Isodose around the target divided by the Reference Isodose

\[
\text{Quality} = \frac{I(\text{min})}{\text{RI}}
\]

.... If the 90% Isodose covers all of the clinical and pathologic target, tx is considered to comply with protocol.

“Conformity Index : A Review”
For Example:
Thoughts to Consider:

**Integral Dose:**

AAPM Definition – the volume integral of the dose deposited in the patient and is equal to the mean dose times the volume..... “Total Energy Adsorbed by the Body”

ID = average dose received by the entire volume excluding the PTV

Medial Physics Vol 41(1) Jan 2014   Nguyen et al.
Thoughts to Consider:

Integral Dose:

“As a general rule, one should keep the integral dose to a minimum, provided the adequacy of tumor irradiation and the sparing of critical organs are not compromised.”
For Example:

AP/PA (not treated)

VMAT (treated)
Thoughts to Consider:

All of these criteria can be utilized to “Quantify three dimensional dose distributions”

However:

“Which goals are achievable? Which will be challenging? Which are actually impossible?”

-- Ben Nelms “Icarus Tx Planning 2013”

Law of Diminishing Returns – “a point at which the level of benefits gained is less than the energy invested”
Robert Adams in his lecture:
“The Future of Medical Dosimetry” – 2015
Asked this question –

“If you were asked: How would you prove that what you do as a Medical Dosimetrist adds value?”

Ben Nelms in his lecture:
“Icarus Treatment Planning: Flying High [or too close to the sun?]” – 2013

“You are already “Radiation Oncology Engineers”. There are many tasks that can be or should be automated. But there are many tasks that likely cannot or should not ever by automated. Everyone needs to embrace and integrate Quality Philosophies.”
Thoughts to Consider:

“We are just going to have to use our Brains!”
MEDICAL DOSIMETRIST

- Treatment Planning
- Participating in Simulation
- Research
- Assisting Physicist
- Consulting during Treatment
- Performing QA
- Fabrication of Devices
- Teaching

Courtesy of Ms. Anne Greener
ASTRO-Papers; RTOG-Protocols; NCCN-Guidelines; Accreditation Standards; QUANTEC-NTCP
Courtesy of Dr. Sam Hancock
“Try not to become a man of success, but rather try to become a man of value.”
-- Albert Einstein
Tumor Markers:

- Helps to determine treatment and prognosis
- Assist in determining stage and response
- For Dosimetry ....
- “Gives a better understanding of the treatment plan design and physician intent.”
- Could this lead to better set up? More efficient treatment delivery? Opportunity for teaching/training?
### Figure 3. Leading Sites of New Cancer Cases and Deaths – 2016 Estimates

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<thead>
<tr>
<th></th>
<th>Estimated New Cases</th>
<th></th>
<th>Estimated Deaths</th>
<th></th>
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<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
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<tr>
<td></td>
<td>Prostate</td>
<td>Breast</td>
<td>Lung &amp; bronchus</td>
<td>Lung &amp; bronchus</td>
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<tr>
<td></td>
<td>180,890 (21%)</td>
<td>246,660 (29%)</td>
<td>85,920 (27%)</td>
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<td>Prostate</td>
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<td>117,920 (14%)</td>
<td>106,470 (13%)</td>
<td>26,120 (8%)</td>
<td>40,450 (14%)</td>
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<td>Colon &amp; rectum</td>
<td>Colon &amp; rectum</td>
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<tr>
<td></td>
<td>70,820 (8%)</td>
<td>63,670 (8%)</td>
<td>26,020 (8%)</td>
<td>23,170 (8%)</td>
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<td>Urinary bladder</td>
<td>Uterine corpus</td>
<td>Pancreas</td>
<td>Pancreas</td>
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<tr>
<td></td>
<td>58,950 (7%)</td>
<td>60,050 (7%)</td>
<td>21,450 (7%)</td>
<td>20,330 (7%)</td>
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<td>Melanoma of the skin</td>
<td>Thyroid</td>
<td>Liver &amp; intrahepatic bile duct</td>
<td>Ovary</td>
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<td>46,870 (6%)</td>
<td>49,350 (6%)</td>
<td>18,280 (6%)</td>
<td>14,240 (5%)</td>
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<td>Non-Hodgkin lymphoma</td>
<td>Non-Hodgkin lymphoma</td>
<td>Leukemia</td>
<td>Leukemia</td>
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<tr>
<td></td>
<td>40,170 (5%)</td>
<td>32,410 (4%)</td>
<td>14,130 (4%)</td>
<td>12,720 (4%)</td>
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<tr>
<td></td>
<td>Kidney &amp; renal pelvis</td>
<td>Melanoma of the skin</td>
<td>Esophagus</td>
<td>Leukemia</td>
</tr>
<tr>
<td></td>
<td>39,650 (5%)</td>
<td>29,510 (3%)</td>
<td>12,720 (4%)</td>
<td>10,270 (4%)</td>
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<tr>
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<td>Oral cavity &amp; pharynx</td>
<td>Leukemia</td>
<td>Urinary bladder</td>
<td>Liver &amp; intrahepatic bile duct</td>
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<td></td>
<td>34,780 (4%)</td>
<td>26,050 (3%)</td>
<td>11,820 (4%)</td>
<td>11,520 (4%)</td>
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<tr>
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<td>Pancreas</td>
<td>Non-Hodgkin lymphoma</td>
<td>Non-Hodgkin lymphoma</td>
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<tr>
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<td>34,090 (4%)</td>
<td>25,400 (3%)</td>
<td>11,520 (4%)</td>
<td>8,630 (3%)</td>
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<td>Liver &amp; intrahepatic bile duct</td>
<td>Kidney &amp; renal pelvis</td>
<td>Brain &amp; other nervous system</td>
<td>Brain &amp; other nervous system</td>
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<tr>
<td></td>
<td>28,410 (3%)</td>
<td>23,050 (3%)</td>
<td>9,440 (3%)</td>
<td>6,610 (2%)</td>
</tr>
<tr>
<td></td>
<td>All sites</td>
<td>All sites</td>
<td>All sites</td>
<td>All sites</td>
</tr>
<tr>
<td></td>
<td>841,390 (100%)</td>
<td>843,820 (100%)</td>
<td>314,290 (100%)</td>
<td>281,400 (100%)</td>
</tr>
</tbody>
</table>

Estimates are rounded to the nearest 10, and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder.

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## Table 6. Probability (%) of Developing Invasive Cancer during Selected Age Intervals by Sex, US, 2010-2012*

<table>
<thead>
<tr>
<th></th>
<th>Birth to 49</th>
<th>50 to 59</th>
<th>60 to 69</th>
<th>70 and older</th>
<th>Birth to death</th>
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<tr>
<td><strong>All sites†</strong></td>
<td>Male</td>
<td>3.4 (1 in 29)</td>
<td>6.5 (1 in 15)</td>
<td>14.5 (1 in 7)</td>
<td>34.6 (1 in 3)</td>
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<tr>
<td></td>
<td>Female</td>
<td>5.4 (1 in 19)</td>
<td>6.0 (1 in 17)</td>
<td>10.0 (1 in 10)</td>
<td>26.1 (1 in 4)</td>
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<tr>
<td><strong>Breast</strong></td>
<td>Male</td>
<td>1.9 (1 in 53)</td>
<td>2.3 (1 in 44)</td>
<td>3.5 (1 in 29)</td>
<td>6.7 (1 in 15)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.3 (1 in 318)</td>
<td>0.5 (1 in 195)</td>
<td>0.9 (1 in 117)</td>
<td>3.4 (1 in 30)</td>
</tr>
<tr>
<td><strong>Colon &amp; rectum</strong></td>
<td>Male</td>
<td>0.3 (1 in 300)</td>
<td>0.7 (1 in 149)</td>
<td>1.2 (1 in 82)</td>
<td>3.7 (1 in 27)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.3 (1 in 318)</td>
<td>0.5 (1 in 195)</td>
<td>0.9 (1 in 117)</td>
<td>3.4 (1 in 30)</td>
</tr>
<tr>
<td><strong>Kidney &amp; renal pelvis</strong></td>
<td>Male</td>
<td>0.2 (1 in 467)</td>
<td>0.3 (1 in 295)</td>
<td>0.6 (1 in 158)</td>
<td>1.3 (1 in 76)</td>
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<tr>
<td></td>
<td>Female</td>
<td>0.1 (1 in 748)</td>
<td>0.2 (1 in 576)</td>
<td>0.3 (1 in 317)</td>
<td>0.7 (1 in 136)</td>
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<tr>
<td><strong>Leukemia</strong></td>
<td>Male</td>
<td>0.2 (1 in 415)</td>
<td>0.2 (1 in 591)</td>
<td>0.4 (1 in 261)</td>
<td>1.4 (1 in 72)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.2 (1 in 508)</td>
<td>0.1 (1 in 939)</td>
<td>0.2 (1 in 458)</td>
<td>0.9 (1 in 115)</td>
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<tr>
<td><strong>Lung &amp; bronchus</strong></td>
<td>Male</td>
<td>0.2 (1 in 608)</td>
<td>0.7 (1 in 145)</td>
<td>2.0 (1 in 51)</td>
<td>6.4 (1 in 16)</td>
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<tr>
<td></td>
<td>Female</td>
<td>0.2 (1 in 572)</td>
<td>0.6 (1 in 177)</td>
<td>1.5 (1 in 67)</td>
<td>4.8 (1 in 21)</td>
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<tr>
<td><strong>Melanoma of the skin†</strong></td>
<td>Male</td>
<td>0.3 (1 in 297)</td>
<td>0.4 (1 in 238)</td>
<td>0.8 (1 in 127)</td>
<td>2.2 (1 in 45)</td>
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<tr>
<td></td>
<td>Female</td>
<td>0.5 (1 in 206)</td>
<td>0.3 (1 in 321)</td>
<td>0.4 (1 in 242)</td>
<td>0.9 (1 in 107)</td>
</tr>
<tr>
<td><strong>Non-Hodgkin lymphoma</strong></td>
<td>Male</td>
<td>0.3 (1 in 376)</td>
<td>0.3 (1 in 347)</td>
<td>0.6 (1 in 174)</td>
<td>1.8 (1 in 55)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.2 (1 in 546)</td>
<td>0.2 (1 in 477)</td>
<td>0.4 (1 in 237)</td>
<td>1.4 (1 in 73)</td>
</tr>
<tr>
<td><strong>Thyroid</strong></td>
<td>Male</td>
<td>0.2 (1 in 560)</td>
<td>0.1 (1 in 821)</td>
<td>0.2 (1 in 635)</td>
<td>0.2 (1 in 451)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.8 (1 in 131)</td>
<td>0.4 (1 in 281)</td>
<td>0.3 (1 in 306)</td>
<td>0.4 (1 in 258)</td>
</tr>
<tr>
<td><strong>Prostate</strong></td>
<td>Male</td>
<td>0.3 (1 in 325)</td>
<td>2.1 (1 in 48)</td>
<td>5.8 (1 in 17)</td>
<td>10.0 (1 in 10)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.3 (1 in 364)</td>
<td>0.1 (1 in 850)</td>
<td>0.1 (1 in 871)</td>
<td>0.2 (1 in 576)</td>
</tr>
<tr>
<td><strong>Uterine cervix</strong></td>
<td>Female</td>
<td>0.3 (1 in 355)</td>
<td>0.6 (1 in 170)</td>
<td>0.9 (1 in 107)</td>
<td>1.3 (1 in 76)</td>
</tr>
</tbody>
</table>

*For those who are free of cancer at the beginning of each age interval. †All sites excludes basal cell and squamous cell skin cancers and in situ cancers except urinary bladder. ‡Statistic is for whites.


Please note: The probability of developing cancer for additional sites, as well as the probability of cancer death, can be found in Supplemental Data at cancer.org/statistics.

Table 7. Trends in 5-year Relative Survival Rates* (%) by Race, US, 1975-2011

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All sites</td>
<td>49</td>
<td>55</td>
<td>69†</td>
<td>50</td>
<td>57</td>
<td>70†</td>
<td>39</td>
<td>43</td>
<td>62†</td>
</tr>
<tr>
<td>Brain &amp; other nervous system</td>
<td>22</td>
<td>29</td>
<td>35†</td>
<td>22</td>
<td>28</td>
<td>33†</td>
<td>25</td>
<td>32</td>
<td>40†</td>
</tr>
<tr>
<td>Breast (female)</td>
<td>75</td>
<td>84</td>
<td>91†</td>
<td>76</td>
<td>85</td>
<td>92†</td>
<td>62</td>
<td>71</td>
<td>81†</td>
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<td>Colon &amp; rectum</td>
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<td>66†</td>
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<td>60</td>
<td>67†</td>
<td>45</td>
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<td>59†</td>
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<td>Esophagus</td>
<td>5</td>
<td>10</td>
<td>20†</td>
<td>6</td>
<td>11</td>
<td>21†</td>
<td>4</td>
<td>7</td>
<td>14†</td>
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<td>Hodgkin lymphoma</td>
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<td>79</td>
<td>88†</td>
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<td>89†</td>
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<td>55†</td>
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<td>18†</td>
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<td>6</td>
<td>18†</td>
<td>2</td>
<td>3</td>
<td>13†</td>
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<td>88</td>
<td>84</td>
<td>85†</td>
<td>60</td>
<td>57</td>
<td>66†</td>
</tr>
</tbody>
</table>

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 9 areas from 1975 to 1977, 1987 to 1989, and 2005 to 2011, all followed through 2012. †The difference between the 1975-1977 and 2005-2011 rates is statistically significant (p<0.05). ‡The standard error is between 5 and 10 percentage points. §Survival rate is for cases diagnosed from 1978 to 1980.


THEY’VE DONE STUDIES, YOU KNOW.

60 PERCENT OF THE TIME, IT WORKS EVERY TIME
For our Case Studies .... Assume that it needs to be treated tomorrow morning, it’s 3:00pm and the Doctor is tied up for the next however long.
Case Study #1

- 55 Year Old Female

- Initial clinical presentation: Rectal Bleeding with increasing discomfort; Colonoscopy revealed ulcerated and necrotic appearing mass distal rectum with possible vaginal involvement.

- Biopsy Pathology Revealed Infiltrating Poorly Differentiated Squamous Cell Carcinoma

- Immunoperoxidase Stain for Pancytokeratin: CK7, CK5/6, P63 – highly indicative of Squamous Cell Origin
Current Stage for this case:

Stage II, T3, NO, MO
Elective Clinical Target Volumes in Anorectal Cancer: An RTOG Consensus Panel Contouring Atlas

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6.1 Dose Specifications (5/31/07)
6.1.1 The treatment plan used for each patient will be based on an analysis of the volumetric dose, including dose-volume histogram (DVH) analyses of the PTV and critical normal structures. An “inverse” planning method using dose-objective-based computerized optimization shall be used. The treatment aim will be the delivery of dose to the PTVs and the exclusion of noninvolved tissue.

6.1.2 Target prescription dose: The prescription dose scheme shall depend on staging as follows:

6.1.2.1 For T2N0 disease: The primary tumor PTV (PTVA) will receive 50.4 Gy in 28 fractions at 1.8 Gy per fraction. The nodal PTVs will receive 42 Gy in 28 fractions at 1.5 Gy per fraction.
- PTVA will receive 50.4 Gy in 28 fractions at 1.8 Gy per fraction.
- PTV42 will receive 42 Gy in 28 fractions at 1.5 Gy per fraction and will include all nodal regions (see section 6.4.2.3 below).

6.1.2.2 For T3N0 or T4N0 disease: The primary tumor PTV (PTVA) will receive 54 Gy in 30 fractions at 1.8 Gy per fraction. The nodal PTVs will receive 45 Gy in 30 fractions at 1.5 Gy per fraction.
- PTVA will receive 54 Gy in 30 fractions at 1.80 Gy per fraction.
- PTV45 will receive 45 Gy in 30 fractions electively at 1.5 Gy per fraction and will include all nodal regions (see section 6.4.2.4 below).

6.1.2.3 For N+ disease: The primary tumor PTV (PTVA) will receive 54 Gy in 30 fractions at 1.8 Gy per fraction. For involved nodes ≤ 3 cm in maximum dimension, the involved nodal PTV will receive 50.4 Gy in 30 fractions at 1.68 Gy per fraction. For involved nodes > 3 cm in maximum dimension, the involved nodal PTV will receive 54 Gy in 30 fractions at 1.80 Gy per fraction.
Case Study #1

Anal Carcinoma

PRINCIPLES OF RADIATION THERAPY

- Multifield techniques with supervoltage radiation (photon energy of >6 mV) should be used to deliver a minimum dose of 45 Gy in 1.8 Gy-fractions (25 fractions over 5 weeks) to the primary cancer.
- PET-CT should be considered for treatment planning.
- The inguinal nodes and the pelvis, anus, and perineum should be included in the initial radiation fields. The superior field border should be at L5-S1, and the inferior border should include the anus with a minimum 2.5-cm margin around the anus and tumor. The lateral border should include the lateral inguinal nodes (as determined from imaging or bony landmarks). There should be attempts to reduce the dose to the femoral heads.
- After 17 fractions (30.6 Gy), an additional 14.4 Gy should be given in 8 fractions with the superior field reduced to the bottom of the sacroiliac joints. Additional field reduction off inguinal nodes should occur after 36 Gy for node-negative lesions. This protocol brings the total dose to 45 Gy in 25 fractions over 5 weeks.
- For patients treated using an AP-PA technique, rather than the recommended multifield technique, the dose to the lateral inguinal region should be brought to the minimum dose of 36 Gy using an anterior electron boost matched to the PA exit field.
- For T2 lesions, T3/4 lesions, or N1 lesions, an additional boost of 9–14 Gy in 1.8–2 Gy fractions to the original primary tumor volume and involved nodes plus a 2–2.5 cm margin is usually delivered. This boost brings the total dose to 54–59 Gy in 30–32 fractions over 6–7.5 weeks. A direct perineal boost using photons or electrons with the patient in lithotomy position or a multifield photon approach (AP-PA plus paired laterals, PA + laterals, or other) can be used.
- The consensus of the panel is that intensity-modulated radiation therapy (IMRT) is preferred over 3-D conformal RT in the treatment of anal carcinoma. IMRT requires expertise and careful target design to avoid reduction in local control by so-called “marginal-miss.” The clinical target volumes for anal cancer used in the RTOG-0529 trial have been described in detail. The outcome results of RTOG-0529 have been reported.

Also see http://atc.wustl.edu/protocols/rtog-closed/0529/ANAL_Ca_CTVs_5-21-07_Final.pdf for more details of the contouring atlas defined by RTOG.

- Side effect management:
  Female patients should be considered for vaginal dilators and instructed on the symptoms of vaginal stenosis.
  Male patients should be counseled on infertility risks and given information regarding sperm banking.
  Female patients should be counseled on infertility risks and given information regarding oocyte, egg, or ovarian tissue banking prior to treatment.
Case Study #1
Case Study #1

Initial Planning for Traditional Anal Case T3 NO MO:

PTV_A = 5400cGy in 30fx @ 180cGy/fx
PTV_45 LN = 4500cGy in 30fx @ 150cGy/fx
Case Study #1

Traditional Anal Case T3 NO MO
Case Study #1

Traditional Anal Case T3 NO MO
Case Study #1

Traditional Anal Case T3 NO MO
However!

“Previous Medical History significant for Stage II Hodgkin’s Lymphoma presenting in the mediastinum and found to have bone, splenic and periaortic lymph node involvement.”

Previous TX = Chemotherapy + XRT to Mantle and Inverted Y with Cobalt circa 1980-81 (35 years ago)

“Assumed dose of 4500cGy .... No Records Available”
Can you treat a previously irradiated site?

Treated with extended SSD
Case Study #1

Prone Position on Belly Board
VMAT IMRT
CTV = 2.5cm
PTV = 1.0cm
Rx = 5400cGy (180cGy/fx @ 98%)

Request:
Limit dose to prior treatment area (integral dose)
Avoid all overlap with loops of bowel.

Poor Coverage
If PTV is the Target:
Conformality Index = 0.9
Less than 1 – not covering target .... Avoid LN Region and Bowel Space
Homogeneity Index = 1.09 .... 9% Hot Spot
3 Month Follow Up Post: XRT (5400cGy) and concurrent systemic chemotherapy continuous infusion 5-FU and Mitomycin.

Development of fluid in her lungs; pneumonia treated with antibiotics; continues to have shortness of breath despite oxygen use; notice of mild extremity swelling – will follow up...concerning that this may be cardiac related vs radiation related.

No obvious evidence of recurrence with resolution of distal rectal mass noting continued firmness at the 11 to 1 o’clock position.
Consulted 3 days ago..... Simulated 1 hour ago .... Treatment time is tomorrow?

What would happen if thought bubbles really existed?

Remember our Assumption .....
Case Study #2

Presentation: (April 2014)
- 56 year old female
- patient noticed right breast dimpling; mammogram showed a lesion in proximity to the dimpled area
- Cord Needle Bx: Moderately Differentiated Adenocarcinoma
- ER(+) / PR(-); HER2/neu(-); Ki67 12% (borderline)
- Oncotype Dx score of 39 corresponding to an average rate of distant recurrence of 27%
- Breast Conservation Lumpectomy and Node Bx
  Margins Clear with 0/1 LN(+)
- T1c, No, MO Stage IA – moderately differentiated ductal right breast adenocarcinoma
Case Study #2

ER-Estrogen Receptor = slightly lower chance of cancer recurrence (favorable)

PR-Progesterone Receptor = possibly an indicator of the functionality of the ER performance (favorable)

HER2-Human Epidermal Growth Factor Receptor = important part of the pathway for cell growth and survival - positivity may indicate the use of anti-HER2 drugs such as Herceptin

Ki-67-Proliferation Marker = rate of cell growth with a high rate a poorer prognosis (<15%, 15-30%, >30%)
Case Study #2

Oncotype Dx = predicts chemotherapy benefit and the likelihood of distant breast cancer recurrence
“Recurrence Score” : <17% (low), 18-30 (unclear), >30 (high)
Case Study #2

Here’s a thought:
“As the distinguishing cellular make up of the “cancer cell” moves further away from the cellular make up of the host, the prognosis decreases.”

So:
Favorable - ER(+) / PR(+) ; HER-2(-)
Next - ER(+) / PR(-) ; HER-2(-)
Next – ER(-) / PR(+) ; HER-2(-)
Next – ER(-) / PR(-) ; HER-2(+)
Least Favorable – ER(-) / PR(-) ; HER-2(-) [Triple Negative]

(positive nodal status can negatively effect prognosis)
Case Study #2

Survival Rates :  (For Patient Education)

“Survival rates tell you what portion of people with the same type and stage of cancer are still alive a certain amount of time (usually 5 years) after they were diagnosed. They can’t tell you how long you will live, but they may help give you a better understanding about how likely it is that your treatment will be successful.” -- American Cancer Society

“Relative Survival Rate may be a more accurate way to estimate the effect of cancer on survival. These rates compare women with breast cancer to women in the overall population. For example : 90% relative survival means that people who have cancer are about 90% as likely to live 5 years as someone that doesn’t.” – ACS
5-year relative survival rates for breast cancer by stage

The outlook for women with breast cancer varies by the stage (extent) of the cancer. In general, the survival rates are higher for women with earlier stage cancers. But remember, the outlook for each woman is specific to her circumstances.

- The 5-year relative survival rate for women with stage 0 or stage I breast cancer is close to 100%.
- For women with stage II breast cancer, the 5-year relative survival rate is about 93%.
- The 5-year relative survival rate for stage III breast cancers is about 72%. But often, women with these breast cancers can be successfully treated.
- Breast cancers that have spread to other parts of the body are more difficult to treat and tend to have a poorer outlook. Metastatic, or stage IV breast cancers, have a 5-year relative survival rate of about 22%. Still, there are often many treatment options available for women with this stage of breast cancer.

Remember, these survival rates are only estimates – they can’t predict what will happen to any individual person. We understand that these statistics can be confusing and may lead you to have more questions. Talk to your doctor to better understand your specific situation.

Please note that these statistics come from the National Cancer Institute’s SEER database. They are based on the previous version of AJCC staging. In that version stage II also included patients that would now be considered stage IB.

ACS – www.cancer.org
Case Study #2

Patient Workup would favor radiation treatment to the intact breast followed by a boost to the incision site.
Case Study #2

Right Breast Tangents – “Field in Field” Technique

Calculate “Open Field” Tangents ... Convert Isodose Cloud to Structure ...
Design Segments to exclude Isodose Cloud
(note: I try to not use more than 2 or 3 segments per open field)
Case Study #2

Each segment is designed independently (not mirrored or parallel opposed)

Also: Mixed Energy is utilized for wider separation fields but lower energy (6x) is preferred.
Case Study #2

Rx = 180cGy/fx x 25fx’s @ 95%

Note: Max Isodose Localized to Seroma Site.
Case Study #2

FinF

Wedge

FinF

Wedge
Case Study #2

Contralateral Breast Dose is significantly less with “FinF” vs “Wedge” planning.
Case Study #2

However ..... 

Presentation: (January 2013)
- 55-year-old female
- Diagnostic mammogram revealing 1.5cm nodular density in the Left Breast (6 o’clock position)
- Biopsy revealing moderately differentiated ductal breast adenocarcinoma
- ER Positive 92%, PR Positive 94%, HER-2Neu Negative
  Ki-67 was 23 (Oncotype DX pending)
- Wide local excision with sentinel node biopsy
  Margins Negative with 0/1 nodes positive
- Pathologically staged pT1c, pN0
Case Study #2
Case Study #2

Cumulative Dose Volume Histogram

Mean Heart Dose = 268.0 cGy

Whole Lung V20 = 12.3%

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</tr>
</thead>
<tbody>
<tr>
<td>4.30 Rt Lung</td>
<td>Approved</td>
<td>100 / 100.0</td>
<td>1215.7</td>
<td>31.8 cGy</td>
<td>4723.3 cGy</td>
<td>8817 cGy</td>
<td>1223 cGy</td>
<td>2457 cGy</td>
<td>13284 cGy</td>
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<tr>
<td>4.30 Lt Lung</td>
<td>Approved</td>
<td>100 / 100.0</td>
<td>1102.4</td>
<td>24.6 cGy</td>
<td>4541.9 cGy</td>
<td>5618 cGy</td>
<td>89.9 cGy</td>
<td>169.0 cGy</td>
<td>988.2 cGy</td>
</tr>
<tr>
<td>4.30 Whole Lung</td>
<td>Approved</td>
<td>100 / 100.0</td>
<td>2317.0</td>
<td>24.6 cGy</td>
<td>4743.3 cGy</td>
<td>7294 cGy</td>
<td>107.7 cGy</td>
<td>264.6 cGy</td>
<td>1189.4 cGy</td>
</tr>
<tr>
<td>4.30 Heart</td>
<td>Approved</td>
<td>100 / 100.0</td>
<td>656.3</td>
<td>67.2 cGy</td>
<td>4462.5 cGy</td>
<td>268.0 cGy</td>
<td>186.0 cGy</td>
<td>166.7 cGy</td>
<td>408.8 cGy</td>
</tr>
<tr>
<td>4.30 Cord</td>
<td>Approved</td>
<td>100 / 99.7</td>
<td>97.5</td>
<td>0.0 cGy</td>
<td>89.3 cGy</td>
<td>38.3 cGy</td>
<td>0.4 cGy</td>
<td>34.6 cGy</td>
<td>22.5 cGy</td>
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<tr>
<td>4.30 Seroma</td>
<td>Approved</td>
<td>100 / 100.1</td>
<td>10.7</td>
<td>4736.7 cGy</td>
<td>5115.4 cGy</td>
<td>4985.2 cGy</td>
<td>4982.1 cGy</td>
<td>4988.1 cGy</td>
<td>65.4 cGy</td>
</tr>
</tbody>
</table>
Case Study #2

“FinF” sets up well with Mono-Isocentric Planning
Case Study #2

Utilize “FinF” Technique
Case Study #2

IMRT Breast:

“IMRT is proven and medically necessary for treating the primary site of the following diagnoses:
-Breast Cancer when the patient has a separation of 25.5cm or more in the intra-thoracic distance from the midpoint of the posterior light field border of the medial tangential field to the midpoint of the posterior light field of the lateral tangential field.” – United Health Care IMRT – 2/1/2016

“Greater target dose homogeneity and sparing of normal tissues can be accomplished using compensators such as wedges, forward planning using segments and IMRT.” --NCCN
49-year-old male
T4a, No, MO, Stage IVA
Poorly Differentiated
Squamous Cell Carcinoma
Left Maxillary Sinus
# For Consideration #1:

<table>
<thead>
<tr>
<th><strong>DEFINITIVE:</strong></th>
<th><strong>POSTOPERATIVE:</strong></th>
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<tbody>
<tr>
<td>RT Alone</td>
<td>RT</td>
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<tr>
<td>• PTV</td>
<td>• Preferred interval between resection and postoperative RT is ≤6 weeks</td>
</tr>
<tr>
<td>♦ High risk: Primary tumor and involved lymph nodes (this includes possible local subclinical infiltration at the primary site and at the high-risk level lymph node(s))</td>
<td>♦ High risk: Adverse features such as positive margins (See footnote m on MAXI-3)</td>
</tr>
<tr>
<td></td>
<td>◦ 60–66 Gy (1.8–2.0 Gy/fraction); daily Monday–Friday in 6–6.5 weeks²</td>
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<td>◦ Concomitant boost accelerated RT: 72 Gy/6 weeks (2 Gy once daily and then 1.8 Gy/fraction, large field; 1.5 Gy boost as second daily fraction during last 12 treatment days)</td>
</tr>
<tr>
<td></td>
<td>◦ Low to intermediate risk: sites of suspected subclinical spread</td>
</tr>
<tr>
<td></td>
<td>◦ 44–50 Gy (2.0 Gy/fraction) to 54–63 Gy (1.6–1.8 Gy/fraction)⁴,⁵</td>
</tr>
<tr>
<td>♦ Fractionation:</td>
<td>POSTOPERATIVE CHEMORADIATION</td>
</tr>
<tr>
<td></td>
<td>• Concurrent single-agent cisplatin</td>
</tr>
<tr>
<td>◦ 66 Gy (2.2 Gy/fraction) to 70–70.2 Gy (1.8–2.0 Gy/fraction) daily Monday–Friday in 6–7 weeks²,³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>◦ Hyperfractionation: 81.6 Gy/7 weeks (1.2 Gy/fraction, twice daily)</td>
</tr>
<tr>
<td>♦ Low to intermediate risk: Sites of suspected subclinical spread</td>
<td></td>
</tr>
<tr>
<td>◦ 44–50 Gy (2.0 Gy/fraction) to 54–63 Gy (1.6–1.8 Gy/fraction)⁴,⁵</td>
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</tbody>
</table>

| CONCURRENT CHEMORADIATION:⁶ | |
|----------------------------| |
| • PTV                      | |
| ♦ High-risk: typically 70–70.2 Gy | |
| (1.8–2.0 Gy/fraction); daily Monday–Friday in 7 weeks² | |
| ♦ Low to intermediate risk: | |
| ◦ 44–50 Gy (2.0 Gy/fraction) to 54–63 Gy (1.6–1.8 Gy/fraction)⁴,⁵ |

IMRT is preferred over 3D conformal RT for maxillary sinus or paranasal/ethmoid sinus tumors to minimize dose to critical structures. The role of proton therapy is being investigated.
For Consideration #1:
For Consideration #1:
For Consideration #2:

Lymph Node or Prostate/SV Only?
For Consideration #2:

Partin Tables –
Use clinical feature of prostate cancer (Gleason Score, PSA, clinical stage) to predict whether the tumor will be confined to the prostate.

Roach Formula –
Derived in 1993 during the early PSA screening era...used to predict the risk of pelvic lymph node involvement.

\[
\left[ \frac{2}{3} \times PSA + (Gleason \ Score - 6) \times 10 \right]
\]

Remember .... Need to treat tomorrow and the Doc may not be available for a while.....
Final Thoughts

Farts are just the ghosts of the things we ate.

Today I feel like putting an "out of order" sticker on my head and going back to bed!
"Education is not the learning of facts, but the training of the mind to think."
- Albert Einstein
Thank you for your Time!