GETTING IT RIGHT THE FIRST TIME: MOVING CHECKS UPSTREAM IN THE TREATMENT PLANNING PROCESS

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ANONYMOUS SESSION SURVEY (<5 MINUTES)

https://bit.ly/TxPlan1
CONFLICTS OF INTEREST

• None
• Member of AAPM WGPE
• Member of TG275
LEARNING OBJECTIVES

Gain insight into the most common error origination and detection workflow steps in the treatment planning process.

Learn about applicable concepts from manufacturing quality management.

Be introduced to the concept of Time Driven Activity Based Costing (TDABC).

Lean about current recommendations related to upstream plan checks.
TRADITIONAL PLAN CHECK PROCESS
TRADITIONAL PLAN CHECK PROCESS

Patient Assessment → Imaging for RT Planning → Treatment Planning → Pre-Tx Review and Verification → Treatment Delivery → On-Treatment Quality Management → Post-Treatment Completion

TRADITIONAL PLAN CHECK PROCESS

Treatment Planning

Re-Work

Pre-Tx Review and Verification

Detected Error Information
TRADITIONAL PLAN CHECK PROCESS

Treatment Planning → Pre-Tx Review and Verification
RO-ILS
RADIATION ONCOLOGY
INCIDENT LEARNING SYSTEM
Sponsored by ASTRO and AAPM

AGGREGATE DATA REPORT
Quarter 4, 2021
October 1 - December 31, 2021

Patient Safety Work Product
CLARITY PSO, a Division of Clarity Group, Inc.
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**TREATMENT PLANNING ERROR ORIGINATION AND DETECTION LOCATIONS**

<table>
<thead>
<tr>
<th>METRIC</th>
<th>AGGREGATE HISTORICAL SUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number Of Events</td>
<td>21108</td>
</tr>
<tr>
<td>Therapeutic Radiation Incident</td>
<td>2700</td>
</tr>
<tr>
<td>Other Safety Incident</td>
<td>2573</td>
</tr>
<tr>
<td>Near Miss</td>
<td>4097</td>
</tr>
<tr>
<td>Unsafe Condition</td>
<td>3458</td>
</tr>
<tr>
<td>Operational/Process Improvement</td>
<td>8280</td>
</tr>
</tbody>
</table>

**Most Commonly Identified Workflow Step Where Event Occurred**

- Treatment Planning: 30% (6371/21108)

**Most Commonly Identified Workflow Step Where Event was Discovered**

- Treatment Delivery Including Imaging: 30% (6271/21108)
TREATMENT PLANNING ERROR ORIGINATION AND DETECTION LOCATIONS

RO-ILS Data Shows:

Large separation between error origination and detection

Missed opportunities to detect errors before treatment delivery
MANUFACTURING QUALITY MANAGEMENT
TREATMENT PLANNING AS MANUFACTURING PROCESS

Inputs → Process → Output → Inspection → Customer

Simulation Dataset → Treatment Planning → Treatment Plan → Physics Plan Check → Patients
• Scientific Management (Taylorism)
• Late 1800’s

Frederick W. Taylor
### Manufacturing Quality Management

#### Scientific Management (Taylorism)

<table>
<thead>
<tr>
<th>Focus on Efficiency</th>
<th>Dramatically Increased Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality in Hands of Inspectors</td>
<td>Quality Eroded</td>
</tr>
<tr>
<td>Employed hundreds of inspectors</td>
<td>Excess Scrap</td>
</tr>
</tbody>
</table>
• 1950’s - Post WWII Japan
  • Deming’s 14 Points
  • Point 3: Understand Inspection
    • Does not add value
    • Rework expensive
    • Encourages Defects by Passing the Buck
  • Quality should be in the hands of the workers

W. Edwards Deming

MANUFACTURING QUALITY MANAGEMENT

• 1960’s – Japanese Industrial Engineer
• Zero Quality Control (ZQC)
  • Stop Errors at or Very Close to Source
  • Simple & Inexpensive Processes
• Successive Checking
  • Checking prior work before continuing
• Self Checking
  • Operators assess own work

Shigeo Shingo

http://www.shingoprize.org/about
1. Source Inspection to catch errors before they become defects
2. 100% inspection to check all products, not just a sample
3. Provides immediate feedback, which shortens time for corrective action
4. Because smart people do make mistakes, uses Poka-Yoke (mistake-proofing) devices for checking process steps
COST OF QUALITY
QUALITY COST CLASSIFICATION

- **Prevention Costs**
  - Doing it Right the First Time
    - Quality Planning
    - Process Control
    - Information Systems
    - Training

- **Appraisal Costs**
  - Checking that it was Done Right
    - Inspection
    - Process Measurement

- **Internal Failure Costs**
  - Errors that are Caught During Appraisal
    - Scrap and Rework
    - Corrective Action

- **External Failure Costs**
  - Errors that Reach the Customer
    - Customer Dissatisfaction
    - Administrative
    - Liability
PREVENTIVE COSTS

- Not really a cost, but an investment in the future
- Sometimes referred to as “cost-avoidance investment”
- Preventive activities:
  - Have a positive effect on ability to do the job right every time
  - Improve first-time yield
- Prevention costs early in product cycle
  - Biggest payback
  - Least expensive to correct problems
POTENTIAL FINANCIAL AFFECTS

Time Driven Activity Based Costing (TDABC)
TIME DRIVEN ACTIVITY BASED COSTING (TDABC)

A “methodology that calculates the costs of healthcare resources consumed as a patient moves along a care process.”

<table>
<thead>
<tr>
<th>Process Step</th>
<th>Responsible Personnel</th>
<th>Estimated Time to Complete Step (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import CT</td>
<td>CMD</td>
<td>10</td>
</tr>
<tr>
<td>Import Secondary Datasets</td>
<td>CMD</td>
<td>20</td>
</tr>
<tr>
<td>Complete Image Fusions</td>
<td>MP</td>
<td>20</td>
</tr>
<tr>
<td>Review Images &amp; Fusion</td>
<td>RO</td>
<td>10</td>
</tr>
<tr>
<td>Contour Target Volumes</td>
<td>RO</td>
<td>20</td>
</tr>
<tr>
<td>Modify Target Volumes</td>
<td>CMD</td>
<td>10</td>
</tr>
<tr>
<td>Contour OAR’s</td>
<td>CMD</td>
<td>45</td>
</tr>
<tr>
<td>Set Plan Parameters</td>
<td>CMD</td>
<td>15</td>
</tr>
<tr>
<td>Optimize Plan</td>
<td>CMD</td>
<td>15</td>
</tr>
<tr>
<td>Finalize Plan</td>
<td>CMD</td>
<td>15</td>
</tr>
<tr>
<td>Plan Review</td>
<td>RO</td>
<td>15</td>
</tr>
<tr>
<td>Secondary Calcs</td>
<td>CMD</td>
<td>15</td>
</tr>
<tr>
<td>Plan Preparation and Documentation</td>
<td>CMD</td>
<td>20</td>
</tr>
<tr>
<td>Physics Plan Check</td>
<td>MP</td>
<td>40</td>
</tr>
</tbody>
</table>
TIME DRIVEN ACTIVITY BASED COSTING (TDABC)

Import CT
Import Secondary Datasets
Complete Image Fusions
Review Images & Fusion
Modify Target Volumes
Contour Target Volumes
Set Plan Parameters
Contour OAR's
Optimize Plan
Finalize Plan
Plan Review
Secondary Calcs
Plan Preparation and Documentation
Physics Plan Check

TDABC Analysis of Treatment Planning Process

Cost/Step
Cumulative Cost If No Errors
Cost per Error Origination Step

$1,000.00
$900.00
$800.00
$700.00
$600.00
$500.00
$400.00
$300.00
$200.00
$100.00
$-

$100.00
$200.00
$300.00
$400.00
$500.00
$600.00
$700.00
$800.00
$900.00
$1,000.00
TIME DRIVEN ACTIVITY BASED COSTING (TDABC)

TDABC Analysis of Treatment Planning Process

- Cost/Step
- Cumulative Cost If No Errors
- Cost per Error Origination Step with Safety Barriers Placed after Each Step

Activities:
- Import CT
- Import Secondary Datasets
- Confirm correct CT's imported
- Complete Image Fusions
- Contour Target Volumes
- Modify Target Volumes
- Contour Peer Review
- Set Plan OAR's
- Optimize Plan
- Finalize Plan
- Physics Plan Review
- Plan Review
- Secondary Calcs
- Plan Preparation and Documentation
- Physics Plan Check
CURRENT RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS
RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS

The report of Task Group 100 of the AAPM: Application of risk analysis methods to radiation therapy quality management


2016

Quality Contol (QC) vs. Quality Assurance (QA)
QUALITY CONTROL (QC) EFFORTS

• Goal: Assures inputs are correct
• Detected errors result in less wasted effort

QUALITY ASSURANCE (QA) EFFORTS

• Goal: Assures outputs are correct
• Detected errors:
  • Determine cause
  • Correction of error
  • Repeat process with corrected input

RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS TG100
Key Recommendation:

“Practices should work to incorporate physics reviews as early in the workflow as possible and not rely solely on review at the end-of-treatment planning”
Advantages:

• “issues may be more easily identified
• changes may be more easily executed if the work is not yet complete
• wasted effort and rework may be avoided (which translates into time and cost savings)
• early review may allow for several shorter, more focused checklists rather than one very long checklist late in the workflow”
RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS

2021 Medical Physics Practice Guideline (MPPG) 11.a: Plan and chart review in external beam radiotherapy and brachytherapy

“recommend that the planner conduct a self-check during planning or after the plan is completed”

RECOMMENDATIONS FOR UPSTREAM PLAN CHECKS

2021 Medical Physics Practice Guideline (MPPG) 11.a: Plan and chart review in external beam radiotherapy and brachytherapy

“each institution should perform independent assessments of the best methods to catch errors upstream and to avoid treatment delays. Medical physicists should participate in designing an optimal workflow that can catch errors as early as possible in the treatment planning process.”

WHERE DO WE GO FROM HERE?
QUALITY MANAGEMENT IN RADIATION ONCOLOGY

• Standardization
• Automation
• Safety Barriers Placement Optimization
STANDARDIZATION

• Reduces Variation and Random Error
• Pre-requisite to Automation
Standardizing dose prescriptions: An ASTRO white paper

Suzanne B. Evans MD, MPH a,*, Benedick A. Fraass PhD b, Paula Berner CMD, FAAMD c, Kevin S. Collins PhD, RT(R)(T), CMD d, Teamour Nurushev PhD e, Michael J. O’Neill MD f, Jing Zeng MD g, Lawrence B. Marks MD h

AAPM Task Group 263: Tackling Standardization of Nomenclature for Radiation Therapy


Volume 93, Issue 3, Supplement, Pages E383–E384
Driven by a need to increase efficiency

Time is valuable

Some items simply more effective to check using automated methods
SAFETY BARRIERS PLACEMENT OPTIMIZATION

- Need to pay attention to location of automated safety barriers
- Design safety into the process
- Put barrier within or immediately following error prone process step
- Put safety into the hands of the planner
- Reduce “scrap” or re-work
- Evaluate barrier types for efficiency and effectiveness
HOW DO I IMPLEMENT THESE CONCEPTS IN MY CLINIC?
THREE EXAMPLES OF EXPERIENCE WITH UPSTREAM QA STEPS

- Scripting and Automation for Efficient and Effective Chart Checks in a Pinnacle/Mosaiq Environment
  - Dr. Badal Juneja
  - MD Anderson Cancer Center at Cooper

- Lessons Learned From Upstream Physics Peer Review of Plan Quality With the Eclipse Treatment Planning System
  - Dr. Grace Kim
  - University of California at San Diego

- Experience With Upstream Plan Quality Checks Using the Raystation Treatment Planning System
  - Dr. Leigh Rankine
  - University of North Carolina at Chapel Hill
WHAT IF I DON'T HAVE THE RESOURCES TO ESTABLISH THESE METHODS?

• Not a current option for all treatment planning systems
• Encourage vendors to include your TPS

Some vendor solutions are available

• Use methods discussed in this talk
• Justify need to support training for clinical physicists
• Justify need for vendor solutions if available

Justify need to administration
THE END
REFERENCES & RECOMMENDED READING

• ACR–AAPM TECHNICAL STANDARD FOR THE PERFORMANCE OF RADIATION ONCOLOGY PHYSICS FOR EXTERNAL BEAM THERAPY


REFERENCES & RECOMMENDED READING


• Ford, E. et al, Quality Control Quantification (QCQ): A Tool to Measure the Value of Quality Control Checks in Radiation Oncology., International Journal of Radiation Oncology Biology Physics.,(2012), 84 (3), e263-e269.


• Gopan, O. et al, The effectiveness of pretreatment physics plan review for detecting errors in radiation therapy, Med. Phys. 43 (9), September 2016


**Safety is no accident: A Framework for Quality Radiation Oncology and Care**, American Society for Radiation Oncology. 2012.


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