Optimizing the Treatment Planning Process

Systems Engineering Tools for Treatment Planning Process Optimization in Radiation Medicine

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SESSION LEARNING OBJECTIVES

1. Gain familiarity with the workflow of modern treatment planning process.

2. Understand the scope and challenges of managing modern treatment planning processes.

3. Gain familiarity with lean and 6σ approaches in treatment planning.
   - Lean approaches for reducing Overhead: Head & Neck Process Illustration
   - 6σ DMAIC in Treatment Process: Safety Quality

Disclosures

None
The Radiation Medicine System

The value added by the system depends on how well the parts are interconnected (Rechtin, 2000)

Point of Confluence

Consultation

THE Tx PLANNING BLACK BOX

Treatment

180 ++ steps

Time

The Patient Perspective

The Rad Med Team Perspective

COMPLEXITY AND THE NEED FOR SYSTEMS THINKING

• Injuries due to errors are as old as the field of radiation medicine

• Complex systems: substantial diversity of components, hierarchical structures, processes, handoffs and non-linear interactions

• As complexity evolves so do opportunities for error

• Workflow optimization efforts should embrace complexity & a systems approach towards understanding interactions.
TO ENGINEER IS HUMAN

Systems Engineering (1930’s) concentrates on the whole system not just parts with particular emphasis on communication, uncertainty and complexity in all interactions.

- Examples: International space station and Apollo program
- Arise when traditional quality frameworks did not improve reliability (aerospace and defense)
- 6 sigma methods are similar but emerged from fierce market competition calling for aggressive reduction of defects and variability
- Both approaches resulted in substantial improvements in quality

INSTITUTE OF MEDICINE FRAMEWORK FOR QUALITY

1) Health Care Quality
   - “The degree to which health care services for individuals & populations increase the likelihood of desired health outcomes & are consistent with current professional knowledge”

2) 6 Aims to Achieve Quality
   - Effective
   - Safe
   - Timely
   - Efficient
   - Equitable
   - Patient Centered

3) Quality Indicators and Measures

QUALITY INDICATORS AND MEASURES

- Core Set up
- Technical, interpersonal encounters in care specification & delivery
- Net effect on health status, Quality of Life

Assessing quality requires understanding causal links
QUALITY INDICATORS AND MEASURES

• Structure measures
  ➢ relatively easy to glean, typically deployed by accreditation agencies
  ➢ Some e.g. volumes are linked with outcomes

• Process measures
  ➢ easier for caregivers to relate to, proximal to errors, less follow up
  ➢ No single process represents totality of care, multiple measures needed
  ➢ Deviations from protocols built on firm structure, process foundations – poor outcomes

• Outcomes measures
  ➢ Outcomes may not be realized immediately
  ➢ Cofactors – patient characteristics, multi-disciplinary care

Consider all dimensions, and seek causes for deviations and variations

FRAMEWORK FOR QUALITY IMPROVEMENT

PLAN
• Setting objectives, processes to meet outcomes

DO
• Execute and Measure

SEE
• Analyze data for variability & deviations from expected

ACT
• Replan if fails to meet plan

4 separate phases to minimize build up of interactions, rooted in scientific principles

Radiation Medicine at North Shore-LIJ

• 2800 consults/yr; 200 patients/day, 8 locations

• A blend of Academic, Private and Community Based Practice

• Various treatment platforms
  - Truebeams, EX series, GammaKnife, CyberKnife, Tomotherapy, Zevix, HDR, PSI, SIRT, ...

• Paperless and Quality Checklist (QCL) Driven since 2007
• Can we reduce wait time while absorbing increased volume?
• Simple High Impact Solutions?

A Head and Neck Problem (2011)

AVERAGE INTERVAL (CT TO TX START HEAD AND NECK CASES)

<table>
<thead>
<tr>
<th>Q1 2011</th>
<th>Q2 2011</th>
<th>Q3 2011</th>
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<tbody>
<tr>
<td>19.4</td>
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KAIZEN ILLUSTRATION

• Wasteful, defective or non-value adding steps in a workflow are identified.
• Relatively low-effort solutions are sought through upfront discovery, learning, diagnosis and dialog by a multidisciplinary team.
• Turnaround is relatively quick.
• The culture of continual small improvements by engaged staff members potentially culminates in greater productivity long term as well as innovation.

http://mgbs.com/apple-tree

Kaizen H&N Project (ASTRO 2016)

1. Gather the Team
2. Process Mapping
3. Defect Identification
4. Defect Stratification
PRIORITIZATION MATRIX

IMPLEMENT SOLUTIONS

SOLUTIONS

**Short Term**
- Place scanner by nurse’s WS
- Merge outlook/Mosaik schedules
- Appointment Checklist
- Morning Huddles – SMART Rounds
- Recruitment of PA

**Long Term**
- Velocity Purchase [Contours, Fusion]
- Development of Whiteboard

**Quick Results .. Sustained...**

1. Early Response to Solutions for MD, 1 Tx machine

- Wait Time Decreases 
- Volume Continues to Increase

16 --> 14 day turnaround despite 2.5X increase in volume for MD

SIX SIGMA DMAIC INITIATIVES

Enhance Safety, Quality
In Treatment Planning Workflow

Tasks Accomplished
- Incorporated many recommendations
- Paperless EMR across Health System
- Quality Checklist Process (QCL) Driven

Opportunity to become evidence/outcome driven
- Performance metrics on process steps
  - mean, standard deviation
- Measurable, analyzable, potentially controllable
- Amenable to 6σ process control
- All sites, locations

Shifting Focus to 6σ
Focuses on quality by identifying & mitigating causes of defects and minimizing variability in processes.

- Define, Measure, Analyze, Improve and Control Quality (DMAIC)
- DMAIC (Design-Measure-Analyze-Improve-Control) is a data-driven six sigma approach used to improve existing processes using various tools in five sequential phases.
- The first three phases concentrate on understanding the problem, while the last two on solving it.
- A key requirement for DMAIC is that relevant performance characteristics must be measurable.
- The scope of the problem must be well defined and narrow.
- The phases must be completed in the correct order and all necessary steps within must be completed.
- DMAIC may be potentially used to address process related problems for all six aims identified in the IOM framework.
Moving toward safer radiotherapy requires active surveillance of associated failures, causes and effects, & evidence-based mitigation.

- Surveillance may be reactive (incident learning) or proactive (FMEA etc)
- Assumption: every effect has cause(s), every cause may have an effect(s)
- Must use combined approach, neither is independently sufficient
Baseline High Risk Tasks

Metadata for QCL at baseline:

• 40% of QCL were delayed
• 70% of contours and plan tasks were delayed
• Majority of patients had some QCL delayed, yet staff rushed to ‘get it done’
• Large variability in staff performance on QCL

We were at higher risk than perceived

Three Main Causes for Failures

1. Timeliness & accuracy of high-risk-process steps
   - 40% variances germinated from issues clustered around tasks
   - Requisite information at the right time from the right source
   - Ineffective handoffs/communications, coordination
   - Not just staff delinquencies

2. Cultural pathogens
   - Delay/Rushed Processes (>75% of pts with QCL delays not delayed)
   - Experience based rather than evidence based directives

3. Variability
   • Handful of staff: ++ high-risk task delays/issues >> pt volume/complexity
   • More patient effects –delays, safety events

Call for Better Standards, process interlocks, peer review, coordination

Common Terminology Criteria for Adverse Events (CTCAE)
### Risk Mitigation Strategies

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<tr>
<th>INITIATIVE</th>
<th>SEVERITY</th>
<th>LIKELIHOOD</th>
<th>DETECTABILITY</th>
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<td>Monitoring-High Risk Task Operation</td>
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<td>Z-scores</td>
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### SUSTAINED OUTCOMES

- Incident Reporting Rates
  - Reporting for Tx Planning
  - Operational Z-scores (High)
  - Increased from 1.78 to 2.73

- Timelessness in Completion of High Risk Tasks and Check Steps

SUMMARY

6σ tools led to workflow and safety culture improvements
- Provided a structured framework to guide quality management & report regularly
- Sustained improvements over the past 5 years of implementation in our department.

Driving initiatives has challenged traditional norms of operations
- such as expediting treatment initiation in delay-rushed environments
- sustaining care pathways that are more experience based than evidence-based

Implementation has met with substantial cultural barriers
- Working practices evolve over decades, and changing them creates uncertainty
- The inertia of sustaining past cultures and arguments for not changing tend to perseverate
- Direct persuasion only goes so far.

Other centers could institute these initiatives without replicating formative effort, yet for others there may be value in validating this work

REFERENCES