Optimizing the Treatment Planning Process

Systems Engineering Tools for Treatment Planning Process Optimization in Radiation Medicine

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Disclosures

None

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 6-σ approaches in treatment planning.

- *Lean approaches for reducing Overhead: Head & Neck Process Illustration*
- *6σ DMAIC in Treatment Process : Safety, Quality*

NSLIJHS QM TEAM

- Louis Potters, MD
- Beatrice Bloom, MD
- Lucille Lee, MD
- Brett Cox, MD
- Rajiv Sharma, MD
- Regina Stanzione (ADMIN)
- Carol Morgenstern, RN
- Elaine Montchal, RN
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- Petrina Zuvic, RTT
- Nilda Adair, RTT
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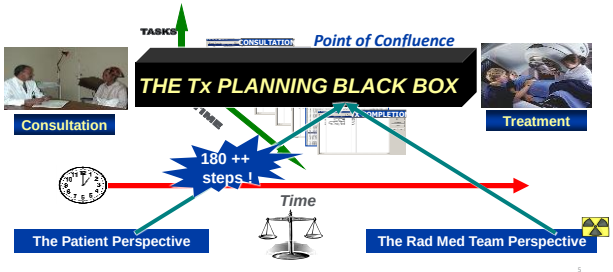
The Radiation Medicine System

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



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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.

"Radiotherapy is widely known to be one of the safest areas of modern medicine, yet, for some, this essential treatment can bring harm, personal tragedy and even death"

World Health Organization

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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
- Arose 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

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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

TREATMENT PLANNING

3) *Quality Indicators and Measures*

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Blumenthal, N Eng J Med, 2006

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QUALITY INDICATORS AND MEASURES

Donabedian, JAMA 1988

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

Assessing quality requires understanding causal links

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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

Deming, MIT 1986

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, Gamma Knife, Cyberknife, Tomotherapy, Zeiss, HDR, PSI, SIRT, ….*
- Paperless and Quality Checklist (QCL) Driven since 2007

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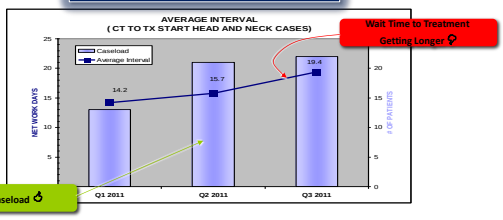
A Head and Neck Problem (2011)



- Can we reduce wait time while absorbing increased volume?
- Simple High Impact Solutions?

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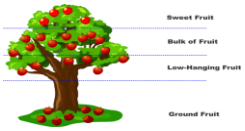
KAIZEN ILLUSTRATION

- 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

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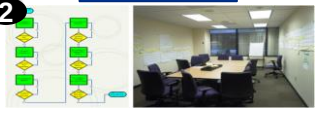
Kaizen H&N Project *(ASTRO 2016)*

1 GATHER THE TEAM

2 PROCESS MAPPING



3 DEFECT IDENTIFICATION

TIMWOOD

- Transportation.
- Inventory.
- Motion.
- Waiting.
- Overproduction.
- Overprocessing.
- Defects/Rework.
- Also include people (human capital).

4 DEFECT STRATIFICATION

Category	# of Cases
Repetitive Steps	10
Scheduling	13
Safety	4
Technical Workflow	12
Process Workflow	23
Systems Integration (Technical)	3
Total	65

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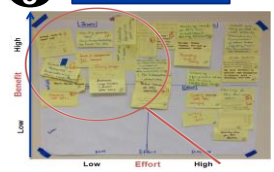
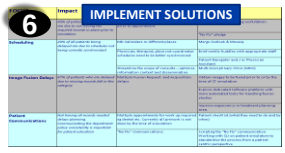
5 PRIORITIZATION MATRIX



6 IMPLEMENT SOLUTIONS



SOLUTIONS

Short Term

- ✓ Place scanner by nurse's WS
- ✓ Merge outlook/Mosaiq schedules
- ✓ Appointment Checklist
- ✓ Morning Huddles – SMART Rounds
- ✓ Recruitment of PA

Long Term

- ✓ Velocity Purchase [Contours, Fusion]
- ✓ Development of Whiteboard

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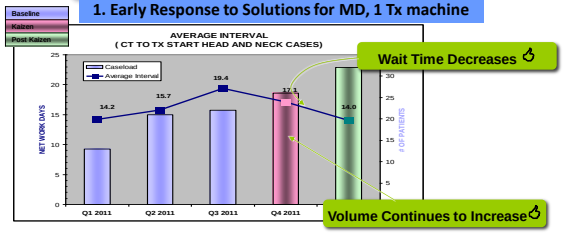
Quick Results .. Sustained…

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



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

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Original Report

Six sigma tools for a patient safety-oriented, quality-checklist driven radiation medicine department

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SIX SIGMA DMAIC INITIATIVES

Enhance Safety, Quality
In Treatment Planning Workflow

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NSLIJHS : The beginnings: 2007-2009

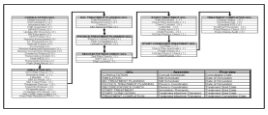
Tasks Accomplished

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

•Training	•QC
•Staffing	•Documentation
•P&P	•PMI
•Incident Learning	•Dosimetric Audits
•Communication	•Accreditation
•Checklists	•Safety Culture

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



A 6 sigma opportunity!

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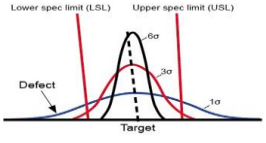
Shifting Focus to 6σ

Focuses on quality by identifying & mitigating causes of defects and minimizing variability in processes.

- **D**efine, **M**easure, **A**nalyze, **I**mprove and **C**ontrol Quality [**DMAIC**]



SIGMA LEVEL σ	DEFECTS PER MILLION OPPORTUNITIES	EXAMPLES
2	308,538	Restaurant Bills
		Airline Baggage
		Doctor's Prescription
3	66,807	Average Company
4	6,210	
5	233	
6	3.4	Best Companies
		Airline Safety

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On 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.

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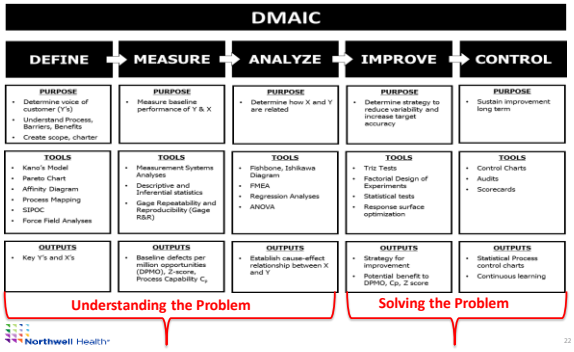
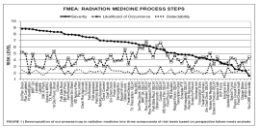


DEFINE: High Risk Steps

What are the high risk steps?

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 used combined approach, neither is independently sufficient



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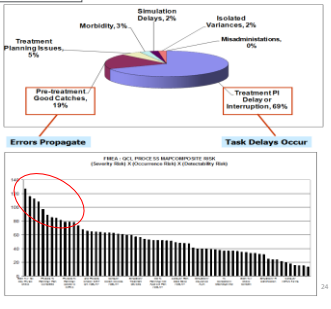
DEFINE: High Risk Steps

Combined Procedures
TX:Prescription
Tx:Consent
Path Reviewed (Before Sim)
Contour
Plan Completed
2nd Plan Check
IMRT QA
Laterality (start Tx)
1st Day Physic Check



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MEASURE

Baseline High Risk Tasks

Metadata for QCL^H at baseline:

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

We were at higher risk than perceived

ANALYZE
Why defects?

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^H 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

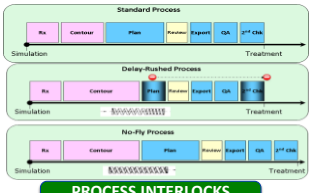
Call for Better Standards, process interlocks, peer review, coordination

IMPROVE

PEER REVIEW INTERLOCKS BEFORE TX PLANNING

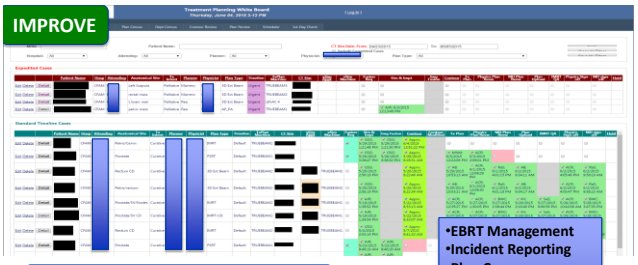
Common Terminology Criteria for Adverse Events (CTCAE)
Version 4.02

REDUCE VARIABILITY



PROCESS INTERLOCKS BEFORE TREATMENT

IMPROVE



WHITEBOARD: COORDINATION & TRANSPARENCY IN WORKFLOW

- EBRT Management
- Incident Reporting
- Plan Census
- SMART Rounds
- HDR Management
- 1st Day Physics Check

IMPROVE

Risk Mitigation Strategies

INITIATIVE	SEVERITY	LIKELIHOOD	DETECTABILITY	METRIC
Care Pathway Standardization	X		X	Compliance Rate
Toxicity Scale Standardization	X		X	Inter-rater reliability kappa
Pre Tx Planning Peer Review [SMART Rounds]	X	X	X	MD GPA on Peer Review
No Fly Policy	X	X	X	Delay Rates
Electronic Whiteboard		X	X	Incident Reporting Rates
Monitoring High Risk Task Operation			X	Z-scores

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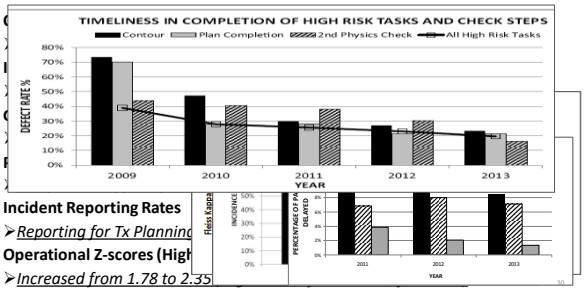
CONTROL

SUSTAINED OUTCOMES



Incident Reporting Rates

➢ *Reporting for Tx Planning*

Operational Z-scores (High

➢ *Increased from 1.78 to 2.35*

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