Using Data to Improve Safety and Quality in Radiation Oncology

A Systems Approach

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Consulting - Varian
Grants - Varian, ViewRay, Siemens
Licensing – Varian, ViewRay, Modus, MedLever
Ownership – Radialogica, TreatSafely

Conflict of Interest Statement

Outline

• Systems approach?
• Data in management of safety and quality
• Examples
• Sources of data
Systems Approach

A strategy, philosophy, process and leadership approach for operating in a superior way, coupled with a belief that individual components of an organization are dependent on each other.

- Applicable to systems with the following attributes:
  - Complex
  - Engineered
  - Advanced technology
  - High risk
  - High cost

RT

Systems Engineering

- Systems Design
  - Quality systems
  - Human factors
  - FMEA

- Systems Analysis
  - Modeling and simulation
  - Enterprise management
  - Financial engineering and risk analysis
  - Knowledge discovery

- Systems Control
  - SPC
  - Scheduling
An outline for use of Systems Engineering for improvement of national health care system

"We often call this arrangement a "health care system" even though it was never created as a system and has never performed as a system."

Data in management of safety and quality

System Performance

a) The demands on our operations continually change
   - Patient numbers
   - Available staff
   - Available machines
   - Expertise/aptitude

b) Well-designed systems maintain constant performance

c) Poorly designed systems cannot cope with these changes
Early analysis of ILS data

- WashU electronic ILS
  - Launched July 2007
  - ~18,500 events through July 2019

Data Collection

- Error, near-miss, and corrective action data
- Individual equipment performance data and trends
- Individual process performance data
- Clinical area performance data
- Individual staff performance data

- Clinically supportable
  - User independent
  - Minimally intrusive
  - Demonstrable Value

Outcomes of the Big Data Workshop

- Opportunities
  - Detection
  - Diagnosis/staging
  - Imaging
  - Treatment
  - Safety/quality
  - Outcome response
  - Efficiencies

- Obstacles
  - Access to data
DMAIC Cycle – Continuous Improvement

Define
Step 0
Select a Project

Measure
Step 1
Establish Performance Parameters
Step 2
Validate Measurement System for Y

Analyze
Step 3
Establish Process Baseline
Step 4
Define Performance Goals – Identify Variation Sources
Step 5
Exposure Potential Causes
Step 6
Establish Variable Relationship
Step 7
Design Operating Limits

Improve
Step 8
Validate Measurement System for Y
Step 9
Verify Process Improvement
Step 10
Implement Process Controls
Step 11
Control

MD Simulation/Treatment Planning Orders

- During 19 months ~600 Events submitted through ILS for MD Simulation/Treatment Planning Orders
- ~70% of reported events related directly to the order entry process (MS Word template in MOSAIQ)
  - 28% Incorrect/incomplete simulation instructions
  - 33% Incorrect/incomplete treatment planning orders
  - 6% Scheduling issues
- Solution – Web-based order entry system with business logic and error checking
- Designed to specifically address the data contained in the 500 events

MD Simulation/Treatment Planning Orders

- Development team (physicians, dosimetrists, therapists, IT, physics, nursing)
- Design based on:
  - ILS Data
  - Standardization
  - Automation
  - Compliance (performance and ACR)
  - Future data mining (control)

- 4 Physicians in the pilot group (clinical validation)
  - 203 events in 19 months with the old system
  - New system
    - 22 events in 4 months
    - 3 events in month 4

- Significant and sustainable reduction in incomplete/incorrect orders
- Automation allowed order entry in minutes
- Next gen system being deployed in 2020

WashU Rad Onc ILS database ~ 18,500 events since July 2007
Example: QA/QC Check Effectiveness

- An analysis of the effectiveness of common QA/QC checks
- Between Johns Hopkins University & Washington University
- Both institutions started incident learning systems (ILS) at the same time
- Data:
  - Incident reports: 2007-2011
  - 4,407 reports
  - 292 (7%) “high potential severity”
Pre-treatment IMRT QA

*Online CT: check by physician

SSD check

*Online CT: check by therapist

*Port film check by therapist

In vivo diode measurements

*Port film check by physician

*EPID dosimetry

*Physician chart review

*Physics weekly chart check

*Therapist chart review

*Physician chart review

*Checklist

*Chart rounds

*Online CT check by therapist

*3D check

*Online CT check by physician

*Pre-treatment IMRT QA

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**Literature Search**

- pubmed.org search on:
  - (Quality Assurance) AND (Radiation Therapy) AND (IMRT)
    - Results: 403 (2013); 808 (2018)
  - (Chart Checks) Results: 7 (2013); 7 (2018)
  - (Chart Review) Results: 34 (2013); 48 (2018)

- An order of magnitude difference

- 2013 to 2018
  - IMRT QA: 345 manuscripts
  - Chart Checks: 0 manuscripts
  - Chart Review: 15 manuscripts

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**Sources of Data**
Is there a benefit in every size facility?

- Relatively good communications
- Streamlined processes
- Great collective memory
- Perhaps a limited benefit

Single Machine Facility

Is there a benefit in every size facility?

- Non-uniform communications
- Complex processes
- Pockets of reliable memory
- Potentially significant benefits

Large Facilities
WashU – 350 Faculty and Staff

Is there a benefit in every size facility?

- Still silos
- Non-uniform processes
- Unawareness
- Potentially significant benefits

Networks
Thank you!