Using Data to Improve Safety and Quality in Radiation Oncology

A Systems Approach

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Conflict of Interest Statement

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

Outline

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

Systems Approach

Systems Engineering

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

Systems Engineering in Health Care

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

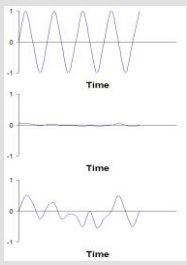
"We often call this arrangement a "health care system" even though it was never created as a system and has never performed as a system."

National Academy of Engineering and Institute of Medicine, 2005

Data in management of safety and quality

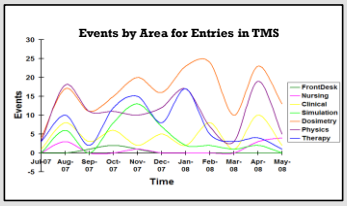
System Performance

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 though 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

BIG DATA

A Systems Approach Using Big Data to Improve Safety and Quality in Radiation Oncology

Louis Potters, MD, FACR, FASTRO,* Eric Ford, PhD,† Suzanne Evans, MD,‡ Todd Pawlicki, PhD,§ and Sasa Mutic, PhD‖

Big Data Use

Fig. 1. A paradigm for quality and safety research that requires big data.

Potters et al, Int J Radiation Oncol Biol Phys, Vol. 95, No. 3, pp. 885e889, 2016

Examples

DMAIC Cycle – Continuous Improvement

DMAIC Cycle – Continuous Improvement

Define	Step 0	Select a Project
Measure	Step 1 Step 2	Establish Performance Parameters Validate Measurement System for 'Y'
Analyze	Step 3 Step 4 Step 5	Establish Process Baseline Define Performance Goals Identify Variation Sources
Improve	Step 6 Step 7 Step 8	Explore Potential Causes Establish Variable Relationship Design Operating Limits
Control	Step 9 Step 10 Step 11	Validate Measurement System for 'X' Verify Process Improvement Implement Process Controls

MD Simulation/Treatment Planning Orders

- During 19 months - ~500 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

Fig. 1. Events reported using the electronic event reporting system for simulation and treatment planning order entry deviations from 2008-2010.

Santanam et al Eliminating inconsistencies in simulation and treatment planning orders in radiation therapy. Int J Radiat Oncol Biol Phys. 2013 Feb 1;85(2):484-91.

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)

MD Simulation/Treatment Planning Orders

MD Simulation/Treatment Planning Orders

- 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

MD Simulation/Treatment Planning Orders


Physics Contribution

Eliminating Inconsistencies in Simulation and Treatment Planning Orders in Radiation Therapy

MD Simulation/Treatment Planning Orders

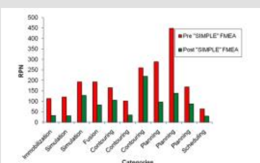


Fig. 3. Graph showing the pre- and postmitigation failure modes and effects analysis (FMEA) for the design of the SIMulation and treatment PLanning Electronic (SIMPLE) order form. RPN = risk priority number.

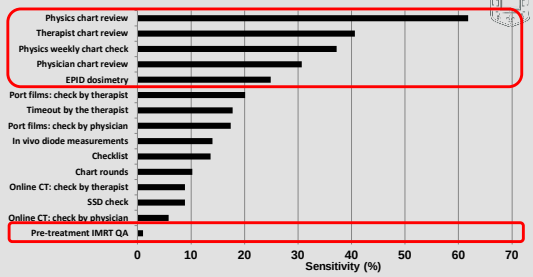
Santanam et al Eliminating inconsistencies in simulation and treatment planning orders in radiation therapy. Int J Radiat Oncol Biol Phys. 2013 Feb 1;85(2):484-91.

Example: QA\QC Check Effectiveness

- An analysis of the effectiveness of common QA/QC checks
- IRB 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"

E.C. Ford, S. Terezakis, A. Souranis, K. Harris, MD, H. Gay, S. Mutic, Quality Control Quantification (QCQ): A tool to measure the value of quality control checks in radiation oncology, Int. J. Radiat. Oncol. Biol. Phys., 84(3), 263-269, (2012).

QA\QC Check Effectiveness



Literature Search

- pubmed.org search on:
  - (Quality Assurance) AND (Radiation Therapy) AND
    - (IMRT) Results: 463 (2013); 808 (2018)
    - (Chart Checks) Results: 7 (2013); 7 (2018)
    - (Chart Review) - Results: 34 (2013); 49 (2018)
- An order of magnitude difference
- 2013 to 2018
  - IMRT QA – 345 manuscripts
  - Chart Checks – 0 manuscripts
  - Chart Review – 15 manuscripts


Improving patient safety and workflow efficiency with standardized pretreatment radiation therapist chart reviews

Kelly Cooper Younge PhD [a,*], Katherine Woch Naheedy MS [a], Joel Wilkinson CMD [a], Joumana Dekmak MS [a], Elizabeth Covington PhD [b], Bonnie Durbin BS RT(T) [a], Eric Nelson BS RT(T) [a], Stephanie Filpansick BS RT(T) [a], Jean M. Moran PhD [a]

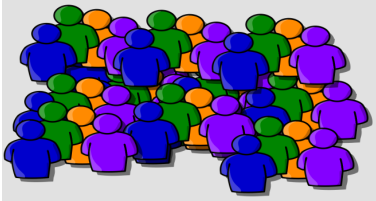
Sources of Data

Is there a benefit in every size facility?

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

Single Machine Facility

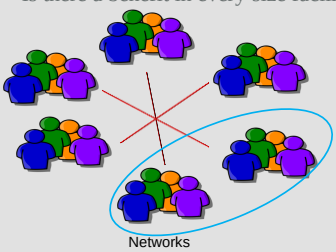
Is there a benefit in every size facility?



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

Large Facilities
WashU – 350 Faculty and Staff

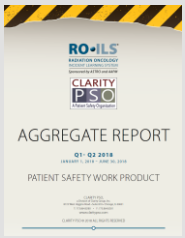
Is there a benefit in every size facility?



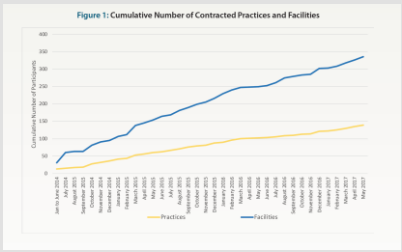
- Still silos
- Non-uniform processes
- Unawareness
- Potentially significant benefits

Networks

RO-ILS



RO-ILS



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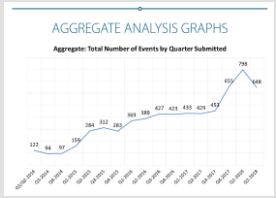
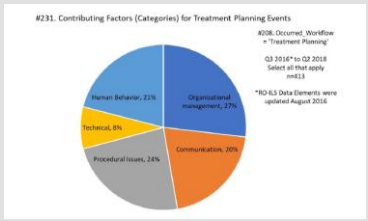


RO-ILS: Participant Education

Figure 11: 2016-2017 Tips of the Month

June 2016	Reporting Unsafe Conditions
July 2016	New Data Elements
August 2016	HHS Guidance on Patient Safety Work Product
September 2016	Document Upload Within the Portal
October 2016	Standard Prescription White Paper
November 2016	Debriefing After a Safety Event
December 2016	Contributing Factors
January 2017	MIPS Improvement Activity
February 2017	Report All Safety Events to the PSO
March 2017	CME Credit Available for Quarterly Reports
April 2017	Portal Bookmarking and Desktop Shortcuts
May 2017	Save Between "Reviewer" Tabs

RO-ILS



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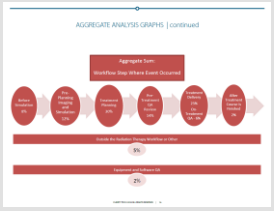

RO-ILS

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Basic Original Report

Common error pathways seen in the RO-ILS data that demonstrate opportunities for improving treatment safety

Gary Ezzell PhD[1,*], Brinkon Chera MD[2], Adam Dicker MD, PhD[3], Eric Ford PhD[4], Louis Potters MD[5], Lakshmi Santanam PhD[6], Sherri Wahrmund MS[3]

Thank you!