10 Years Human Factors Engineering: UNC

Program Director, Radiation Therapy and Medical Dosimetry Programs
Department of Radiation Oncology
UNC Hospitals
June 2019

The Truth

Vs.

The real truth
You may think we are successful because of the star physicists on our team....
Or, the engineers…

But in reality, it all begins with ordinary people meeting together.
Disclosures

UNC Health Care System: financial support
UNC Institute of Healthcare Quality Improvement

Today’s Talk

1) 2008
2) 2009
3) 2010
4) 2011
5) 2012
6) 2013
7) 2014
8) 2015
NC Cancer Hospital – University of North Carolina, Chapel Hill, NC

Facts about the NC Cancer Hospital

- Built in September 2009
- 50 inpatient beds
- Dedicated clinical trials unit
- State-of-the-art diagnostic imaging equipment
- 1 HDR room for treating localized tumors with radioactive implants
- 3 Linear Accelerators for Radiation Therapy, including IMRT, an alteration of radiation beams to better accommodate the radiation dose to the shape of the cancer. These machines also have IGRT to better aim the beam at the cancer.

https://unclineberger.org/about/nc-cancer-hospital/
Important events in 2008

• Presidential election

• Walmart was America’s biggest company

• 2008 Summer Olympics happened in Beijing, China

Dr. Lawrence Marks
2008 - Lean Methodology

Administrative
Latent Failures: e.g. policies, supervision

Workplace
Latent Failures: e.g. lighting, noise, workflows

Therapists/Dosimetrists
Active Failures: e.g. error

Patient Harm

We need to focus here
Our workplace often predisposes us to make errors!

We tend to focus here

2008 - Lean Basics

• Automate whenever possible
• Foster teamwork and respect; Empower the masses
• Consider causes of errors on multiple levels (Organizational, workplace, workers)
• In reality, many errors result from “upstream” latent failures that predispose workers to make errors
Entropic Chaos

- **Entropy** is a strong driving force in nature.
- With Suboptimal processes, well-meaning providers and staff do what it takes to "get the job done," resulting in numerous work-arounds, variations in process, and often chaos.
- **GRAPH**: As more reliable systems are created, the need for work-arounds decreases. There are fewer surprises in the clinic, the staff gain confidence in the systems and happiness increases.

2008 - UNC Health System Invests in Lean Initiative

- Weekly Operations Meetings Begin
- First exposure to lean: clinic load leveling
- Visual management of clinic schedules
- Good news and recognition board
- Implementations of “Doctor of the Day”
- Standardization of inpatient coverage
2008 - NCSU engagement for lean activities

- UNC Health System engages Industrial Extension Service for North Carolina State University to aid with lean improvements initiatives

Dr. Lukasz Mazur, PhD  
Dr. Prithima Reddy-Mosaly, PhD

Important events in 2009

- The price of a gallon of gas was $2.40
- Presidential Inauguration
- UNC-Chapel Hill wins NCAA basketball tournament

2009 - First Kaizen Event: Patient Treatment Flow

• Problem: Delays and errors in clinical flow
• Improvements:
  – Schedule lab/IV/prep nursing visits prior to SIM
  – Queue patients to SIM and treatment machines
  – Barcode patients card prior to first treatment day
  – Use QCL to notify therapists of patients on break
  – Use Mosaiq for patient tracking (“Code Q”)

2009 - Improvements in Clinical Flow

• Simulator: Patient Flow Analysis
• Gong in the lobby for patients
• Automated self-check in for daily treatment
Important events in 2010

• 2010 Winter Olympics in Vancouver, Canada
• On January 27, 2010, Apple Computer unveils the iPad tablet computer.
• 3 New York Times Articles Published Blasting Radiation Therapy Safety Practices

2010 - Assessing Improvement Activities

<table>
<thead>
<tr>
<th>Metric</th>
<th>Pre and Post</th>
<th>% Improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time from patient registration to being placed in a clinic room (mean)</td>
<td>31 vs 17 min</td>
<td>45%</td>
</tr>
<tr>
<td>Time from patients leaving the lobby to being ready to see the provider (mean)</td>
<td>28 vs 20 min</td>
<td>29%</td>
</tr>
<tr>
<td>Percent of patients experiencing delays on the simulator</td>
<td>&gt;50% vs &lt;10%</td>
<td>47%</td>
</tr>
<tr>
<td>Reduced waiting times for new patient consults</td>
<td>30 vs 16 min</td>
<td>26%</td>
</tr>
<tr>
<td>Reduced waiting times for patient status checks</td>
<td>23 vs 17 min</td>
<td>26%</td>
</tr>
<tr>
<td>Reduced waiting times for follow-up appointments</td>
<td>22 vs 17 min</td>
<td>23%</td>
</tr>
<tr>
<td>Reduced waiting time for running visits</td>
<td>28 vs 10 min</td>
<td>64%</td>
</tr>
</tbody>
</table>
2010 - Kaizen Event: Nursing’s Role with New Patients

• Problem: Redundancy in history taking, excessive time to prepare patients for exams, and wasted clinician time

• Improvement: Redundant review of systems and ill-timed patient education

2010 - Kaizen Events Increase Efficiency

• First quarterly safety walk rounds

• Improvement from safety walk rounds
2010 - Kaizen Event: Scheduling Patients

- Problem: Gaps in appointments, unprepared simulator appointments, delays, late cancellations
- Improvements:
  - Defined flow for appointments
  - Coordinated with front desk reception
  - Revised lab and x-ray requisitions/check-out sheet
  - Standardized central simulator scheduling

2010 - Kaizen Event: CyberKnife Coordination

- Problem: Incomplete treatment plans resulted in delays
- Improvements:
  - Order sets by anatomic sites
  - CyberKnife Coordinator role
  - No new starts before 9:00AM
2010 - Kaizen Event: Patient Transport

- Problem: The absence of a trigger to alert staff that had a patient had arrived made patients late for treatment and left unidentified patients and waiting in the clinic
- Improvements:
  - Central location for transporters
  - Mobile phones and pager assigned to staff members
  - White board centrally located to monitor patients need transport

2010 - Reducing Errors and Improving Safety

- To reduce re-plans and improve safety the PLUNC treatment planning software was updated to automatically name plans
- Objective goal sheets were created to facilitate plan review
### 2010 - Hierarchy of Effectiveness to Prevent Error

<table>
<thead>
<tr>
<th>Forcing function and constraints</th>
<th><strong>Technology</strong></th>
<th>Automation naming within planning systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated computerization</td>
<td><strong>Features</strong></td>
<td></td>
</tr>
<tr>
<td>Simplification/Standardization</td>
<td><strong>People Focused</strong></td>
<td>Reminder signs on walls</td>
</tr>
<tr>
<td>Reminders, checklists, double checks</td>
<td>Easy, Cheap</td>
<td>“You must do this”</td>
</tr>
<tr>
<td>Rules and policies</td>
<td>Less Effective</td>
<td>“We should do this”</td>
</tr>
<tr>
<td>Training and education</td>
<td>Most often used</td>
<td></td>
</tr>
</tbody>
</table>

### 2010 - Improving Workflow and Safety

- Reduced Interruptions for radiation therapists during patient treatments
- 2nd Quarterly Safety Rounds
2010 - Kaizen Event: Treatment Planning

- Problem: late plans, re-plans, and ambiguous goals
- Improvements: increased use of standard plans, checklists, and reference sheets
- Measurement: percent of treatment re-plans per month

2010 - Kaizen Event: Employee Orientation

- Problem:
  - Ad-hoc Orientation
  - Wasted effort
  - Dissatisfaction
- Improvements:
  - Comprehensive polished and adaptable package of department and hospital maps
  - Reference materials
  - Photos
2010 - Employee of the Month

- Their photo for award is announced in an email, and placed on the department’s Good News Board monthly.

- We appreciate all of these employees for their efforts in the department.
2011 – Important events

- Prince William and Kate Middleton are married.
- *Harry Potter* film series ends.
- Steve Jobs passed away, aged 56.

2011 - Staff Recognition

Shelves in the entrance of department highlights awards of our faculty and staff.
2011- Improved Safety

• Morning Huddle - the long-standing departmental daily simulation (SIM) review expanded to include elements of a daily departmental huddle with broader participation.

• SIM Review - interprofessional education aims to foster improved communication among team members.
2011 - Improving Interprofessional Communication

Inter-professional Communication is a Challenge!

Survey of Radiation Therapists (n=600)

<table>
<thead>
<tr>
<th>My communication with my:</th>
<th>Bad</th>
<th>Neutral</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>radiation oncologists is...</td>
<td>8%</td>
<td>11%</td>
<td>27%</td>
<td>54%</td>
</tr>
<tr>
<td>physicists is</td>
<td>6%</td>
<td>6%</td>
<td>23%</td>
<td>66%</td>
</tr>
<tr>
<td>departmental administrators is...</td>
<td>19%</td>
<td>13%</td>
<td>30%</td>
<td>38%</td>
</tr>
<tr>
<td>My comfort level reporting errors is...</td>
<td>10%</td>
<td>8%</td>
<td>16%</td>
<td>66%</td>
</tr>
</tbody>
</table>

RTTs personally reprimanded for reporting errors: 16%

≈ 18%

39

2011 - Improving Interprofessional Communication

- Interprofessional collaborations- Medical Dosimetry and Radiation Therapy students attend daily morning conferences, SIM reviews, and huddles as part of their educational learning experience

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2011 - Expansion of Lean Improvement Methodology

- Human Factors
- Engineering Laboratory Opens
- Grants received from IMPAC and Accuray and CDC
- Spread of Lean Activities to multi-disciplinary clinic

2012 – Important events

- In October, Facebook announced that it had one billion active users.
  
- Smartphones became popular.
  
- Another presidential election.

2012- Improving Patient Safety

- Treatment Room Monitors
- Implementation of First A3
- More Formalized Machine Timeouts
- Implementation of Physicist of the Day
- Industrial engineer faculty

2012 – Good Catch Pilot Program Initiated

- Definition of a “GOOD CATCH”
  - “An event or situation that could have resulted in an accident, injury or illness but did not either by chance or through timely intervention. Also known as a close call, good catch or near hit.”
- Lean Training: 'Good Catch' and A3
- Introduction of the ‘Swiss Cheese’ model for each error classification and analysis
- First Good Catch Submitted
2012 – Improvement flow software in use

- This is how the department would submit a Good Catch.

- It will eventually be reviewed by the QSC meeting for further discussion.

2019 - ImprovementFlow software in use, what it looks like today
2012 - Improvement Flow can show us Good Catches per month

• This data is presented at the Departmental QA meeting monthly

2013 - Important events

• A gallon of gas cost $3.80

• Twitter goes public on September 12th.

• Birth of Prince George. Kate and William welcomed their first son.

2013- Quality Assurance Goals and Improvements

- Quality Assurance goals – department-created metrics for daily, weekly, and monthly review

- Yellow Sheets – updated to ensure patient accuracy during checkout, treatment-related scans, follow-up appointments, etc.

Patient Safety Survey Results: 2009-2013
2013 - Quality Assurance Goals and Improvements

Dr. Chera is the Director of Quality and Safety

Dr. Bhishamjit Chera

2013 - National and International Recognition as Leaders in Quality, Safety, and Lean Healthcare

• Assessment tool for patients with head, neck and breast cancer
2014 – Important events

• Had the highest job growth rate since 1999.

• *How I Met Your Mother* aired its final episode.

• Apple introduced the Apple Watch product.

2014- Utilizing “Cycle of Improvement”
Tools to Increase Safety and Efficiency

• Patient Care Pathways
• eWhite Boards
2014- Harmonization of Information Technology and Machine Systems

“Cycle of improvement” tools largely in place

- Define Standard Work
- Consistent use
- Reliability
- Outcomes
- Identify targets for improvement
- Monitor process performance
- Good catches
- Daily metrics
- Statistics
- Discipline
- Workers

- Make better systems (it's the process, not the person)
- Get more people involved in improving systems
- Team-work, cohesiveness, respect, job satisfaction

2014 - QSC Committee

Quality & Safety Committee
2014 - Symptom Management Clinic

Focus: high-risk head, neck, and lung cancer patients receiving outpatient radiation with or without concurrent chemotherapy
AIM: a 50% relative reduction in unplanned hospital admissions
August 20, 2014: Inception of the Institute of Healthcare Quality Improvement (IHQI) grant-funded Symptom Management Clinic (SxMC): a weekly (non-billable) nurse-led clinic visit for on-treatment patients. This visit, scheduled +/- 2 days from the patient’s weekly physician appointment, is managed by an Oncology nurse who independently evaluates a patient and involves higher level providers (Nurse Practitioners, Physicians) only when medically necessary (e.g., prescription needed).

Symptom Management Clinic Team

2014 - Symptom Management Clinic

The historic 16% (approximate) unplanned hospital admission rate. The Symptom Management Clinic appears to reduce the rate of unplanned admissions in patients with head and neck cancer.
2014 - Division of Healthcare Engineering

- Permanent positions added: Process Improvement Analysts, Research Associate, and Good Catch Leader
- Written A3s shift front line staff from identifying problems (2010-2013) to empowering them to solve the identified problems (2011+)
- Completed 5 years of Quarterly Safety Rounds; approximately 250 departmental improvements
- New Human Factors Engineering laboratory
- Grants (1) Simulation-based Research to Enhance Patient Safety in Radiation Oncology. Agency: AHRQ. Advances in Patient Safety through Simulation Research (1 R18 HS023458-01). (2) Enhancing Providers' Ability to Follow-up on Abnormal Test Results. Agency: AHRQ Exploratory and Developmental Grant to Improve Health Care Quality through Health Information Technology (IT) (R21 HS024062-01)

2014 - Division of Healthcare Engineering – Steering Committee

Dr. Lawrence Marks, MD

Dr. Robert Adams, EdD

Patty Saponaro, MS, MBA

Dr. Bhisham Chera, MD
2015 – Important events

- *Star Wars: The Force Awakens* film was released.
- NASA confirms water on Mars.
- Pope Francis visits the USA.

2015 - Engineering Patient Safety in Radiation Oncology

- Book published in April 2015
- Reviews the barriers in radiation oncology, and how to effectively enhance quality & safety in this setting.
- Overall goal of improvement in the workplace and on an individual level.
Book Recognitions

Dr. Bhisham Chera, MD

Dr. Robert Adams

Dr. Lukasz Mazur, PhD

Dr. Lawrence Marks

2015 - Engineering Patient Safety in Radiation Oncology

"We dedicate this book to the concept of interprofessional collaborations. The practice of radiation oncology relies on the fusion of multiple fields (e.g. clinical medicine, physics, dosimetry, radiation therapy, engineering). The improvement work described in this book resulted from the infusion of industrial engineers into the clinical arena. Advances in the sciences often result from the concerted and interactive efforts of people from diverse professions/disciplines and the same is true for our clinical and research activities. The world would be a better place if we were better able to leverage each other’s expertise in a synergistic and productive manner. This book is also dedicated to the many patients who suffer with cancer, whose outcomes we hope to improve through our efforts. We especially dedicate this book to patients and families harmed by the healthcare delivery system." - Authors: Lawrence Marks, MD; Lukasz Mazur, PhD; Bhisham Chera, MD; Robert Adams, PhD
2015 - Clinic Awards and Recognition

- Many faculty members have received recognition for their quality improvement systems in place.
- Faculty in the department are on ASTRO’s committee for this reason.

Dr. Robert Adams

- Dosimetrypractice.com
- A web-based interactive tool designed to enhance the students’ learning through modules – organized by degrees of difficulty, and a self-assessment.
Conclusion

The Truth: The Real Truth