Improving Patient Safety and Quality in Radiation Oncology

Bhisham Chera, MD
Assistant Professor
Director of Patient Safety and Quality
Dept. of Radiation Oncology
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“Primum non nocere” First, do no Harm
Disclosures

• UNC Health Care System; financial support

• Departmental grants: Elekta, Siemens, Accuray, NIH, CDC
Key Take Home Points

- Focus on systems and processes
  - “It’s the system not the person”

- Leadership buy in is essential (physicians)
  - Changing organizational culture is difficult

- Empower the front-line staff
  - “No blame culture”
What We are Doing

- **Leadership**
  - Changing organizational culture is difficult
  - Success = f (leadership)

- **Process Engineering**
  - Lean (Toyota Production System)
  - Human Factors Engineering
  - Workload ↔ Performance
  - Good Catch, A3 initiatives
  - Patient Care Pathways
  - Daily Metrics & e-Whiteboard
  - Safety Rounds

Continuous Quality Improvement at UNC

- **Peer Review**
UNC Approach/Paradigm

• **Lean** = to remove waste via work on process while focusing on developing employees
  – Streamline processes
  – Remove ambiguity
  – Improve communication

• **Focus on upstream/latent failures**
  – “It’s the process not the person”

• **Empower frontline staff**
  – Emphasize no blame
Reason’s Swiss Cheese Model of Organizational Error Prevention

- Latent Failures
  - Organizational Influence
  - Inadequate Supervision
  - Policy & Procedure Violations
  - Precondition for Unsafe Act
  - Adverse mental & physiological state/limitations
  - Workload/Stress

- Active Failures
  - Near miss (knowledge, skill, or rule-based)
  - Violation

We need to focus here

We tend to focus here
Strategy for Problem Solving

Soviet Style Planning/Problem Solving – a few minds telling the workers what to do and how to do it.

Strategy Deployment – 1,000 minds identifying and solving problems.

Empowering the Front Lines

Courtesy of Lukasz Mazur, PhD
Hierarchical Model

Isolated "bad" event or complaint → Departmental Leadership, QA Committee (reactive)

- Dictums
- Policies

Clinic

Chera Semin Radiat Oncol 22:77-85
Integrated Model

Clinic

Integrating facilitators of quality/safety into routine workflow; e.g. peer review, checklists, standardization, Lean assessments

Continuous monitoring of process measurements

Supports/celebrates quality/safety initiatives

Nurseries Culture of Safety

Empowers others to improve processes

Departmental Leadership, QA Committee (proactive)
What We are Doing

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The Problem with Physician Culture

- Powerful emphasis on perfection
- Mistakes are unacceptable
- **Infallibility** (expected to function without error)
  - Errors are not reported/covered up
  - Blame culture
  - Lessons learned are private (work-arounds)
- **Fear**
  - Embarrassment by colleagues
  - Patient reaction
  - Litigation

Leape JAMA 1994
Societal Perception of Physicians

- Esteem and Respect
- Responsibility
- Trust
- Honor
- Societal Servant
- Leader
<table>
<thead>
<tr>
<th>Rank</th>
<th>2005</th>
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<th>2007</th>
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<td>2</td>
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<td>Druggists/Pharmacists</td>
<td>Grade-school teachers</td>
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<td>Veterinarians</td>
<td>Druggists/Pharmacists</td>
<td>High school teachers</td>
<td><strong>Medical doctors</strong></td>
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<td><strong>Medical doctors</strong></td>
<td>Police officers</td>
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<tr>
<td>5</td>
<td>Policemen</td>
<td>Dentists</td>
<td><strong>Medical doctors</strong></td>
<td>Policemen</td>
<td>Engineers</td>
</tr>
</tbody>
</table>
Physicians

Unique Knowledge and Clinical Perspectives
Leadership

↓

Safety Culture

* e.g. electrical grounding procedures, spark-free hand-tools; movement in horizontal and vertical access zones without crossing designated paths

Zohar and Luria (2003) J
Leadership ↓ ? Safety Culture

* e.g. electrical grounding procedures, spark-free hand-tools; movement in horizontal and vertical access zones without crossing designated paths

** e.g. protective gear; housekeeping (e.g., cleaning oil spills appropriately)

Leadership is Key

Strong commitment of senior leadership to a culture that encourages efficiency/quality/safety is essential!
Engaging Physicians in Quality and Safety

- Involve physicians from the beginning
- Discover common purpose
  - Improve patient outcomes
  - Reduce hassles and wasted time
- Make physicians partners, not customers
- Make physician involvement visible
- Identify and activate champions
- Use “Engaging” Improvement Methods
  - Standardize what is standardizable
  - Generate light, not heat, with data
  - Make the right thing easy to try & do

Adopted from IHI: *Engaging Physicians in a Shared Quality Agenda*
What We are Doing

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Continuous Quality Improvement at UNC

• Peer Review
Lean Management Philosophy

- **Mantra:** Preserving value with less work
  - Identify and eliminate waste
  - Standardization of work and communication
- **Goal:** To create highly reliable systems
- **Tools:**
  - Kaizen
  - Value Stream Maps
  - Root Cause Analysis
  - Gemba Walk, “Safety Rounds®”
  - A3
  - “Forcing Functions” “Error-proofing”
  - Computerization
  - Checklist
Lean is just another “Tool”
Transitioning to electronic chart

Impaired clinical workflow

Patients, clinicians, staff frustrated
Sequestered Information
Nurse Path Before: Wasted Motion
> Visual Indications of Demand, Location, Available Rooms
> Clinic Unit Coordinator Position
Nurse Path After

Nurses see the patient chart sleeve, know the empty room from the white board, invite the patient to the room, write the room on the board, flag the clinician, page if necessary
Average waiting time reduced from 29 to 13 minutes

Average total status check visit drops from 83 to 45 minutes
Nursing Time for New Patients

- Pre Pilots: 28 minutes
- Post Pilot#1: 20 minutes
- Post Kaizen: 9.5 minutes

Minutes

- New Patient Nursing Time
CT simulator Delays Kaizen 2010

1. Identified stake holders
2. Gemba
3. Root cause analysis
4. Value stream map
## Causes of Delays at CT sim

<table>
<thead>
<tr>
<th>Number of Delays = 84</th>
<th>Reasons</th>
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<tbody>
<tr>
<td><strong>35 Attributed to Physicians</strong></td>
<td>→ No simulation orders</td>
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<tr>
<td></td>
<td>→ Consent not obtained</td>
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<tr>
<td></td>
<td>→ Order for contrast administration, pregnancy test was not communicated</td>
</tr>
<tr>
<td><strong>32 Attributed to Patients</strong></td>
<td>→ Late to appointment</td>
</tr>
<tr>
<td></td>
<td>→ Questions about insurance</td>
</tr>
<tr>
<td></td>
<td>→ Claustrophobia</td>
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<tr>
<td><strong>21 Attributed to Nurses</strong></td>
<td>→ Incomplete Consent Forms</td>
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<td></td>
<td>→ Not informing Simulator therapist that patient is ready</td>
</tr>
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<td></td>
<td>→ Starting IV for contrast administration</td>
</tr>
<tr>
<td><strong>20 Miscellaneous</strong></td>
<td>→ Waiting on Spanish interpreter</td>
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<tr>
<td></td>
<td>→ Transportation from inpatient unit</td>
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<tr>
<td></td>
<td>→ Front desk not informing simulator therapist that patient is ready</td>
</tr>
<tr>
<td></td>
<td>→ Schedulers not telling patient to come 1 hour prior to simulation if patient is receiving contrast</td>
</tr>
</tbody>
</table>
Delays 40% to < 5%
Continuous Quality Improvement

- Patient education
- Point of care pregnancy test
What We are Doing

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Continuous Quality Improvement at UNC

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Human Factors Engineering

- How humans and technology relate to one another
- Assessing the environment’s impact on human performance
- Purpose is to improve user satisfaction and system performance reliability while reducing operation errors and operator stress
Radiation Oncology has many human-computer and human-machine interactions/interfaces.
Quantitative Assessment of Workload and Stressors in Clinical Radiation Oncology

Association Between Workload and Error
Reducing Workload for HDR Nurses

- Observed 46 hours, 15 brachytherapy procedures
- Hierarchical Task Analysis
- Measured Workload (NASA-TLX)
- Systematic Human Error Reduction and Prediction Approach (SHERPA)
  - Identifies potential errors related to high workload tasks
Reducing Workload for HDR Nurses

• Tasks with highest workload (NASA-TLX)
  – CT scan and radiation delivery preparation
  – Patient identification and preparation
  – Cervix preparation
  – Physician assistance

• SHERPA found human errors
  – Information miscommunication
  – Inappropriately conducted or missed tasks
<table>
<thead>
<tr>
<th>Human Factors Improvement</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication table was moved bedside</td>
<td>Improved efficiency/workflow</td>
</tr>
<tr>
<td>Additional instruments were purchased</td>
<td>Prior to this only one set was available and had to be cleaned prior to each HDR procedure, causing significant delays and interruptions.</td>
</tr>
<tr>
<td>Moved glove box to bedside</td>
<td>Improved efficiency/workflow</td>
</tr>
<tr>
<td>Sterile gowns and caps were moved to provide more direct access</td>
<td>Improved efficiency/workflow</td>
</tr>
<tr>
<td>Additional portable examination light</td>
<td>Improved efficiency. Previously one light was shared between multiple providers limiting productivity.</td>
</tr>
<tr>
<td>Phone numbers in HDR suite and patient’s beside were changed to have same number</td>
<td>Reduced re-work. Prior to this change the nurse had to tend to two phones.</td>
</tr>
<tr>
<td>All HDR cables are now tethered together</td>
<td>Improved efficiency and safety. Nurse no longer looks for missing catheter. Reduced inadvertent disconnection</td>
</tr>
</tbody>
</table>

*Leadership worked with HDR nurse over 16 months to improve workflow and treatment room layout*
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• Peer Review
- Make better systems (it’s the process, not the person)
- Get more people involved in improving systems
- Team-work, cohesiveness, respect, job satisfaction
What is “A3”?  

A3 is a paper size – an International/European paper size established by the International Standards Organization (ISO)

It measures 297 x 420 millimeters, or equivalent to 11.69 x 16.54 inches
<table>
<thead>
<tr>
<th>WHAT IS THE PROBLEM?</th>
<th>DIAGRAM OF THE CURRENT CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIAGRAM OF THE TARGET CONDITION</td>
<td>WHAT CHANGES WILL YOU MAKE?</td>
</tr>
<tr>
<td>WHAT ARE THE ROOT CAUSES (5 WHYS)?</td>
<td>IMPLEMENTATION PLAN WHO/WHAT/WHEN?</td>
</tr>
<tr>
<td>HOW WILL YOU MEASURE SUCCESS?</td>
<td></td>
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</tbody>
</table>
Eiji Toyoda, Promoter of the Toyota Way and Engineer of Its Growth, Dies at 100

NYTimes Sept 18, 2013
“Japanese workers use their brains and hands …… providing 1.5 million suggestions a year, and 95 percent of them are put to practical use. There is an almost tangible concern for improvement in the air at Toyota”
Near Miss = “Good Catch”

- Electronic self reporting system
- Reviewed weekly at Operational Meeting
- ~400 “Good Catches” since June 2012
- Integration with Process Maps
- Lead to Quality Initiatives (A3’s, Kaizen’s etc.)
Good Catch App
For Clayton, Smithfield & Wakefield clinics

1. What would you like to do?
   I want to submit a new Good Catch

2. Where do you work?
   choose a site

Password (site-wide)

Sign-in  Forgot password?

Purpose
Rad Onc staff use this form to describe a new Good Catch to the review committee. If in doubt, report.

"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."

-AAPM Volume 39 / Issue 12 / SPECIAL REPORT

Courtesy of Greg Tracton, PhD
# Good Catch App

**For Clayton, Smithfield & Wakefield clinics**

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## Purpose

Email a Good Catch to a Champion

## Instructions

1. Click any description to edit it
2. Select a Good Catch champion
3. Sends emails the Good Catch to the chosen champion. Removes the Good Catch from the list.
4. Repeat as desired

## Unassigned

[Sorted by GC # in descending order]

<table>
<thead>
<tr>
<th>GC #</th>
<th>Description</th>
<th>Assign a Champion</th>
<th>Actions</th>
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</table>
| 14   | GST submitted this Good Catch on Mon May 13 18:13:49 EDT 2013: TEST1  
Assigned to: tracton@unc.edu  
[Tx Delivery Error]  
[Assigned to: tracton@unc.edu] | GoodCatch Admin (tracton@unc.edu) | Send | Ignore |
| 13   | GST submitted this Good Catch on Mon May 13 18:13:34 EDT 2013: TEST1  
Assigned to: tracton@unc.edu  
[Tx Delivery Error]  
[Assigned to: tracton@unc.edu] | GoodCatch Admin (tracton@unc.edu) | Send | Ignore |
| 12   | GST submitted this Good Catch on Mon May 13 18:12:53 EDT 2013: TEST1  
Assigned to: tracton@unc.edu  
[Tx Delivery Error]  
[Assigned to: tracton@unc.edu] | GoodCatch Admin (tracton@unc.edu) | Send | Ignore |
Celebrating people and their ideas leads to greater participation and higher reliability

- “It’s the system not the person”
- Review learning from “Good catches” monthly with department
- Part of how we manage
- Part of our education programs
More reporting → safer

\[ p < 0.001 \]

"Number reports"

"Number safety events"

Courtesy of Eric Ford PhD  
Mardon et al. AHRQ, J Patient Saf, 6, 226-232, 2010
Process maps/charts

- Encapsulate all steps
- Can be complex
- Time consuming

Modeling and dialogue connected with mapping processes create knowledge and better understanding of the process and its boundaries

*The process of creating the map is more important than the map itself*

Courtesy of Stephen L. Breen, PhD, MCCPM
Princess Margaret Hospital
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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<th>I</th>
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<th>K</th>
<th>L</th>
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<td>30</td>
<td><strong>Workflow (patient care path)</strong></td>
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<td>Dosimetrist notes any changes or &quot;OK to plan&quot;</td>
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<td>-4...-3d</td>
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<td>Fix Dosimetry QCL for IMRT QA bus</td>
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<td>42</td>
<td><strong>EVERYTHING ABOVE THIS LINE IS COMMON TO ALL EXTBM PATIENTS (3D, IMRT, Tomo, CK)</strong></td>
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<td>10</td>
<td>-3...-2d</td>
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<td>Verbally review plan, dvhs w/attending (D+A)</td>
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<td>Obtain attending approval of plan (A)</td>
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<td>54</td>
<td>MU &quot;gut-check&quot; (reasonable MUs?)</td>
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<td><strong>poss hard stop: indep second MU ck by physicists</strong></td>
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<td>57</td>
<td>Complete IMRT QA paperwork as applicable.</td>
<td>e</td>
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<tr>
<td>58</td>
<td>Printouts to block room as applicable</td>
<td>f</td>
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<tr>
<td>59</td>
<td><strong>Workflow (patient care path)</strong></td>
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<tr>
<td>60</td>
<td>Dosimetrist enters MOSAIQ (MQ) information</td>
<td>11</td>
<td>-3...-2d</td>
<td></td>
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<td></td>
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<tr>
<td>61</td>
<td>Amend Rx: technique</td>
<td>a</td>
<td></td>
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<tr>
<td>62</td>
<td>dose specification</td>
<td>b</td>
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</tr>
</tbody>
</table>
3P’s: Pregnancy, Pacemaker, Prior radiation

- 8 Good catches were submitted
  - Analyzed by Quality Committee
- A3 was completed
  - Checklist completed by nurses & verified by doctors
  - Hard stop – must be verified prior to simulation
- Sustainability
  - 100% of 3Ps completed & approved prior to simulation
    - 92% of 3Ps entered prior to simulation
    - 85% of 3Ps approved prior to simulation
Trending Quality Metrics: Daily Metric

• Metrics for all divisions
  – Physicians
  – Nurses
  – Physics
  – Dosimetry
  – Administration

• Supervisors enter metrics daily
• Broadcasted on monitors located in high traffic areas
• Reviewed at dept. meetings

“e-Whiteboard”
### RadOnc Daily Metrics

For Lean Process Improvement

**Purpose**
Rad Onc supervisors record Daily Metrics for their group. Colors indicate **good** or **bad** status.

Note: visible to computers inside the UNCH firewall (Skynet OK)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Who</th>
<th>Description</th>
<th>Unit</th>
<th>Color Code</th>
<th>Aug 12 Mon</th>
<th>Aug 13 Tue</th>
<th>Aug 14 Wed</th>
<th>Aug 15 Thu</th>
<th>Aug 16 Fri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic Team Huddles</td>
<td>Nursing</td>
<td>#102: Did all the MDs in clinic on the prior day huddle with their nurses?</td>
<td>y/n</td>
<td>Yes/No</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Accurate &amp; Timely QRx Notes</td>
<td>Therapist</td>
<td>#103: % of pts scanned yesterday where the therapist had the information &amp; materials needed to scan in a timely fashion</td>
<td>Numerator / Denominator</td>
<td>Perfect Defects</td>
<td>5/8</td>
<td>4/4</td>
<td>3/5</td>
<td>1/1</td>
<td>4/6</td>
</tr>
<tr>
<td>Output</td>
<td>Physicist</td>
<td>#115: Primus Output (POD) within 3%</td>
<td>y/n</td>
<td>Yes/No</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Output</td>
<td>Physicist</td>
<td>#116: Artiste Output (POD) within 3%</td>
<td>y/n</td>
<td>Yes/No</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Output</td>
<td>Physicist</td>
<td>#117: Oncor Output (POD) within 3%</td>
<td>y/n</td>
<td>Yes/No</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>n</td>
<td>Y</td>
</tr>
<tr>
<td>Output</td>
<td>Physicist</td>
<td>#118: Tomo Output (POD) within 3%</td>
<td>y/n</td>
<td>Yes/No</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>1000 Rad Checks</td>
<td>Physicist</td>
<td>#121: 1000 Rad Checks completed on time</td>
<td>Numerator / Denominator</td>
<td>Perfect Defects</td>
<td>6/6</td>
<td>4/4</td>
<td>0/0</td>
<td>14/14</td>
<td>3/3</td>
</tr>
<tr>
<td>Chart Checks</td>
<td>Physicist</td>
<td>#120: Weekly Chart Checks completed on time</td>
<td>Numerator / Denominator</td>
<td>Perfect Defects</td>
<td>13/13</td>
<td>3/3</td>
<td>2/2</td>
<td>25/32</td>
<td>16/16</td>
</tr>
</tbody>
</table>

Courtesy of Greg Tracton, PhD
What We are Doing

• Leadership
  – Changing organizational culture is difficult
  – Success = f (leadership)

• Process Engineering
  – Lean (Toyota Production System)
  – Human Factors Engineering
  – Workload ↔ Performance
  – Good Catch, A3 initiatives
  – Patient Care Pathways
  – Daily Metrics & e-Whiteboard
  – Safety Rounds

Continuous Quality Improvement at UNC

• Peer Review
Safety Rounds/WalkRounds™

- Chair and 1-2 departmental leaders
  - Go to work areas to meet with staff members

- Discuss safety and/or workplace concerns for 15-45 minutes

- > 100 suggestions
Why?
• Demonstrates commitment to safety
• Fuels culture to change
• Establishes lines of communication
• Rapid safety-based improvements
• Go to where the work is done
• Educational for managers

How?
• Senior Leaders
• Quarterly
• Go to front line staff
• Conversation at worksite
  • Linac
  • Simulator
  • Dosimetry
  • Clinic
Interruptions Per Patient Treatment

Mean = 4.1

Mean = 0.83
A change in the physical workplace reduced interruptions on the treatment machine
What We are Doing

• Leadership
  – Changing organizational culture is difficult
  – Success = f (leadership)

• Process Engineering
  – Lean (Toyota Production System)
  – Human Factors Engineering
  – Workload ↔ Performance
  – Good Catch, A3 initiatives
  – Patient Care Pathways
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• Peer Review

Continuous Quality Improvement at UNC
Peer Review

- Evaluating each other’s clinical performance: *to improve quality and safety*
Pre-treatment and During 1\textsuperscript{st} week of Treatment
Consultation → Planning CT → Treatment Planning → Treatment

Daily Pre-Treatment Peer Review
- 51% Major Change: > 1 cm change to gross target volume
- 26% Minor Change: < 1 cm change to gross target volume
- 23% No change

Weekley During-Treatment Peer Review
- 1% Major Change: > 1 cm change to gross target volume
- 5% Minor Change: < 1 cm change to gross target volume
- 94% No change

977 Cases Reviewed

1050 Cases Reviewed

Courtesy of Robert Adams Ed D.
# of Re-plans 2010 to 2013

- 5 re-plans per month (3%)
- Jan 2012 to July 2013: 56% preventable (43/77)
Quality of Radiotherapy

Seriously non-compliant (12% of plans)

Peters et al. JCO, 28(18), 2996, 2010
Quality of Radiotherapy

Trial
- RTOG 73-01
- SWOG 7628
- POG 9031
- SIOP/UKCCSG PNET-3
- TROG 02.02
- RTOG 97-04
- COMBINED

Hazard ratio associated with radiotherapy deviations

p < 0.001

HR = 1.74
95% CI = 1.28 to 2.35
Measuring Changes in our Patient Safety Culture at UNC

- Agency for Health care Research and Quality (AHRQ) Patient Safety Survey
- 42 items measure 12 dimensions of safety culture
- Administered to all staff members
- Compare data 2009 vs. 2011
  - Improvements in every category

http://www.ahrq.gov/qual/patientsafetyculture/
N=20
• 7 Providers
• 4 Managers
• 3 Administrators
• 2 Nurses
• 3 Therapist/dosimetrists
Should Radiation Oncology *Aspire* To Be a High Reliability Organization?

1. Operate in unforgiving political and social environments.

2. Have risky technologies with the potential for error.

3. Do not allow for learning through experimentation.

4. Use complex processes to manage complex technologies and complex work to avoid failures.

YES!
5 Characteristics of HRO

- Preoccupation with failure
- Reluctance to simplify interpretations
- Sensitivity to operations
- Commitment to resilience
- Deference to expertise

Not there yet!

Weick K et al. Managing the Unexpected - Assuring High Performance in an Age of Complexity. 2001. San Francisco, CA, USA; Jossey-Bass
How do we prioritize high reliability in healthcare?

• Competing Interests in Healthcare
  – Patients (Customers)
  – Government/Insurance (Payers)
  – Healthcare Providers (Healers)

• Airline Industry
  – Many bags go missing every day
  – Yet aviation accidents are rare
Reason’s Swiss Cheese Model of Organizational Error Prevention

- **Latent Failures**
  - Organizational Influence
  - Inadequate supervision
  - Policy & Procedure violations

- **Active Failures**
  - Near miss (knowledge, skill, or rule-based)
  - Violation

- **Unsafe Act**
  - Precondition for Unsafe Act

- **Unsafe Supervision**

- **Latent Failures**
  - Policies & Procedures

We need to focus here

We tend to focus here
Focus on systems and processes
- "It’s the system not the person"

Leadership buy in is essential (physicians)
- Changing organizational culture is difficult

Empower the front-line staff
- "No blame culture"
Acknowledgements

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- John Rockwell, M.S., M.B.A.
- Jessica Church, MPH, RT(R)(T)

http://www.ihi.org/
http://www.ahrq.gov/