Improving Patient Safety and Quality in Radiation Oncology

Bhisham Chera, MD
Assistant Professor
Director of Patient Safety and Quality
Dept. of Radiation Oncology
November 16th, 2013

“Primum non nocere” First, do no Harm
Disclosures

• UNC Health Care System; financial support

• Departmental grants: Elekta, Siemens, Accuray, NIH, CDC
Public Awareness:

- 44,000 – 98,000 deaths/yr
- 8th leading cause of death in US
- National Costs: $17 to $29 billion
- $2 billion Adverse Rx event costs alone

Healthcare must be:

1) Safe
2) Effective
3) Patient-centered
4) Timely
5) Efficient
6) Equitable
Culture of Medical Practice

- **Lack of awareness** of the severity of the problem
  - Most errors do not harm the patient
  - Occur in isolated events at many different hospitals
- **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

Culture of Medical Practice

- **Error Prevention Strategy:** “If I study and train hard enough, I won’t make mistakes.”

- **Motivation:** Blame Culture
  - Social/Peer disapproval and criticism
  - Blame is used to encourage proper performance
  - Errors are someone’s fault

- **Error prevention is reactive**
  - Preventing *that* individual from making a repeat error
  - Underlying “root” causes are not explored

All Humans Err Frequently!

Systems that rely on error-free performance are doomed to fail!

Key Take Home Points

➢ Focus on systems and processes
  ▶ It’s the system not the person
  ▶ Focus on root causes

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

➢ Empower the front-line staff
  ▶ No blame culture
  ▶ Sustainable solutions come from those who do the work
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*

Errors are inevitable

Errors are evidence of system flaws not character flaws

*Improve Operational Efficiency* → Quality Safety
Reason’s Swiss Cheese Model of Organizational Error Prevention

Latent Failures

- Policies & Procedures
- Inadequate supervision
- Policy & Procedure violations
- Organizational Influence
- Unsafe Supervision
- Precondition for Unsafe Act

Active Failures

- Near miss (knowledge, skill, or rule-based)
- Violation
- Adverse mental & physiological state/limitations
- Workload/Stress

We need to focus here

We tend to focus here
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

Nurtures Culture of Safety

Empowers others to improve processes

Departmental Leadership, QA Committee (proactive)
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
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

  *Continuous Quality Improvement at UNC*

• **Peer Review**
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

  *Continuous Quality Improvement at UNC*

• **Peer Review**
Societal Perception of Physicians

- Esteem and Respect
- Responsibility
- Trust
- Honor
- Societal Servant
- Leader
<table>
<thead>
<tr>
<th>Rank</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nurses</td>
<td>Nurses</td>
<td>Nurses</td>
<td>Nurses</td>
<td>Nurses</td>
</tr>
<tr>
<td>2</td>
<td>Druggists/Pharmacists</td>
<td>Druggists/Pharmacists</td>
<td>Grade-school teachers</td>
<td>Druggists/Pharmacists</td>
<td>Druggists/Pharmacists</td>
</tr>
<tr>
<td>3</td>
<td><strong>Medical doctors</strong></td>
<td>Veterinarians</td>
<td>Druggists/Pharmacists</td>
<td>High school teachers</td>
<td><strong>Medical doctors</strong></td>
</tr>
<tr>
<td>4</td>
<td>High school teachers</td>
<td><strong>Medical doctors</strong></td>
<td>Military officers</td>
<td><strong>Medical doctors</strong></td>
<td>Police officers</td>
</tr>
<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 \( \downarrow \) ?
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)
Strong commitment of leadership (esp. physician) to a culture that encourages 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 physician involvement visible

- Make physicians partners, not customers

- Use “Engaging” Improvement Methods
  - Standardize what is standardizable
  - Generate light, not heat, with data
  - Make the right thing easy to try & do

- Identify and activate champions

Adopted from IHI: Engaging Physicians in a Shared Quality Agenda
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

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”
Clinic Work Flow
Kaizen 2008

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
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

• **Peer Review**
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 a many human-computer and human-machine interactions/interfaces
Quantitative Assessment of Workload and Stressors in Clinical Radiation Oncology

- **Radiation Therapists**
  - Treatment Admin
  - Contouring, Beam & Dose Calculations

- **Dosimetrist**
  - Documentation & Quality Assurance
  - Verification & Positioning

- **Simulation Therapists**
  - Immobilization
  - Mark Isocenter
  - Documentation

- **Physicists**
  - 1000 Rad Check
  - Weekly Chart Check
  - Image Registration
  - Cone Beam CT
  - CT on Rails

- **Radiation Oncologists**
  - Pre-Clinical Review
  - Clinical Evaluation
  - Quick Rx
  - Contouring
  - Set Isocenter
  - Plan Approval
  - Signing the Plan
  - Port Film Approval
  - Chart Rounds
  - SIM Review

NASA TLX Score
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

No harm but Re-work and Frustration
<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*
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

Continuous Quality Improvement at UNC

• 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
A3 Report

WHAT IS THE PROBLEM?

DIAGRAM OF THE CURRENT CONDITION

WHAT ARE THE ROOT CAUSES (5 WHYS)?

DIAGRAM OF THE TARGET CONDITION

WHAT CHANGES WILL YOU MAKE?

IMPLEMENTATION PLAN
WHO/WHAT/WHEN?

HOW WILL YOU MEASURE SUCCESS?
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
- 391 “Good Catches” since June 2012
- Integration with Process Maps
- Lead to Quality Initiatives (A3’s, Kaizen’s etc.)
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
National Incident Learning System

Patient Safety Organization (PSO)
- Supported by Federal Law
- Allows for sharing of sensitive info related to patient safety events without fear of liability

Clarity Group Inc.

Currently beta testing

Go live ➔ 2\(^{nd}\) quarter 2014
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
### Workflow (patient care path)

<table>
<thead>
<tr>
<th>Step #</th>
<th>Time w/r/t tx</th>
<th>Clerk (C)</th>
<th>Nurse (N)</th>
<th>Resident MD (R)</th>
<th>Attending MD (A)</th>
<th>CT sim Therap (CT)</th>
<th>Dosim (D)</th>
<th>Linac Therap (T)</th>
<th>Physicist (P)</th>
<th>QA cks Oct 2012</th>
<th>QA cks to add</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>7</td>
<td></td>
<td></td>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>a</td>
<td></td>
<td></td>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>b</td>
<td></td>
<td></td>
<td>c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>c</td>
<td></td>
<td></td>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-37</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

### Simulation review (CONTOURS) by (A)

- **6d**
- **4d**

**Dosimetrist notes any changes or "OK to plan"**

**Dosimetrist starts planning:**

- **4 to 3d**

**Pre-planning (as applicable)**

- Fix Dosimetry QCL for IMRT QA bus
- Contour appropriate structures

---

### EVERYTHING ABOVE THIS LINE IS COMMON TO ALL EXTERNAL PATIENTS (3D, IMRT, Tomo, CK)

**Dosimetrist planning (cont’d):**

- **9**
- **4 to 3d**

**Plan Review in PLUNC by Dosimetrist**

- **10**
- **3 to 2d**

**Verbally review plan, dvhs w/attending (D+A)**

- **a**

**Obtain attending approval of plan (A)**

- **b**

**MU "gut-check" (reasonable MUs)?**

- **c**

***Poss hard stop: indep second MU ck by physicists***

**Export plan, DRRs, documents to MQ**

- **d**

**Complete IMRT QA paperwork as applicable**

- **e**

**Printouts to block room as applicable**

- **f**

---

### Workflow (patient care path)

**Dosimetrist enters MOSAIQ (MQ) information**

- **11**
- **3 to 2d**

**Amend Rx: technique**

- **a**

**Dose specification**

- **b**
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”
### Daily Metric: How was yesterday? (Mon Nov/04)

**Green: Great!**

**Orange: Could improve...**

**White: ungraded**

<table>
<thead>
<tr>
<th>Add-on consults</th>
<th>Add-on Medical Checks</th>
<th># of Tx Pts Scheduled</th>
<th># of Tx Pt Treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>115</td>
<td>109</td>
</tr>
<tr>
<td>mean=0/0 since Oct 07</td>
<td>mean=31/292 since Oct 07</td>
<td>mean=124 since Oct 07</td>
<td>mean=112 since Oct 07</td>
</tr>
</tbody>
</table>

**Machine End Time**

**15 min late**

mean=39 min late since Oct 07

**Last Machine**

**P2**

mean=0% since Oct 07

### Hours Down

<table>
<thead>
<tr>
<th>P2 Hours Down</th>
<th>Artiste Hours Down</th>
<th>Oncor Hours Down</th>
<th>Tomo Hours Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>mean=0 since Oct 07</td>
<td>mean=2 since Oct 07</td>
<td>mean=0 since Oct 07</td>
<td>mean=0 since Oct 07</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

- Peer Review
Peer Review

• Evaluating each other’s clinical performance: to improve quality and safety
Pre-treatment and During 1st 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

977 Cases Reviewed

Weekly 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

1005 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)

 Courtesy of Kathy Burkhardt, MS
Quality of Radiotherapy Impacts Cancer Control

Trial (outcome)
- POG 8346 (LC)
- SFOP 93/94 (Relapse)
- POG 9031 (EFS)
- SIOP/UKCCSG PNET-3 (EFS)
- TROG 02.02 (LRC)
- RTOG 97-04 (Failure)
- COMBINED

Hazard ratio associated with radiotherapy deviations

HR = 1.79
95% CI = 1.15 to 2.78

Quality of Radiotherapy Impacts Survival

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
Improving Safety Culture Reduces Errors

179 Hospitals, 56,480 staff respondents

(J Patient Saf 2010;6: 226–232)
How do we prioritize high reliability in healthcare?

- Competing Interests
  - Patients (Customers)
  - Government/Insurance (Payers)
  - Healthcare Providers (Healers)

- Airline Industry
  - Many bags go missing every day
  - Yet aviation accidents are rare
Key Take Home Points

➢ Focus on systems and processes
  ➢ *It’s the system not the person*
  ➢ *Focus on root causes*

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

➢ Empower the front-line staff
  ➢ *No blame culture*
  ➢ *Sustainable solutions come from those who do the work*
Acknowledgements

- Lawrence B. Marks, M.D.
- Lukasz M. Mazur, Ph.D.
- Robert Adams, Ed. D.
- Katharin Deschesne, M.S.
- Sha X. Chang, Ph.D.
- Dana Lunsford, RT
- Mosley Prithima, Ph.D.
- Marianne Jackson, M.D., M.P.H.
- Kinley Taylor, MS
- Therapists, staff, faculty, residents, nurses, physicists, dosimetrists, computer scientists

- Rebecca Green, M.S.W.
- Lori Stravers, MPH
- Ellen L. Jones, M.D., Ph.D.
- Jing Xu, M.S
- John Rockwell, M.S., M.B.A
- Jessica Church, MPH, RT(R)(T)

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