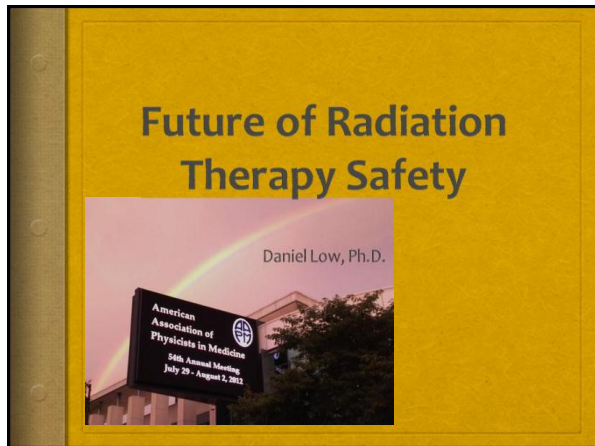
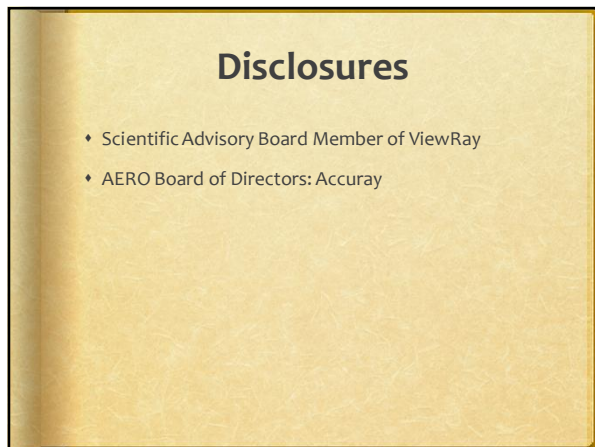
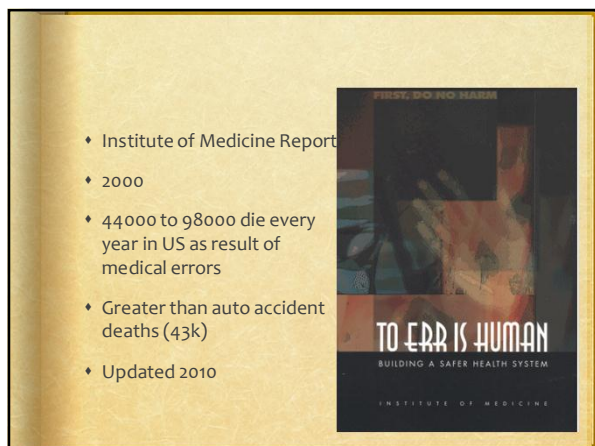


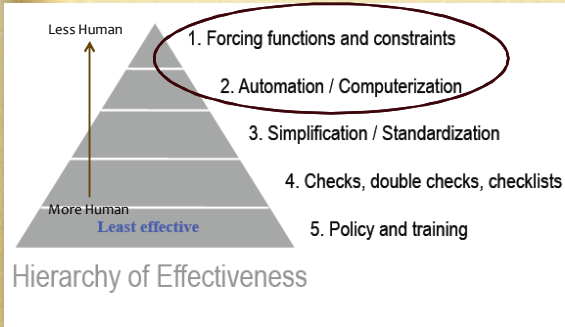




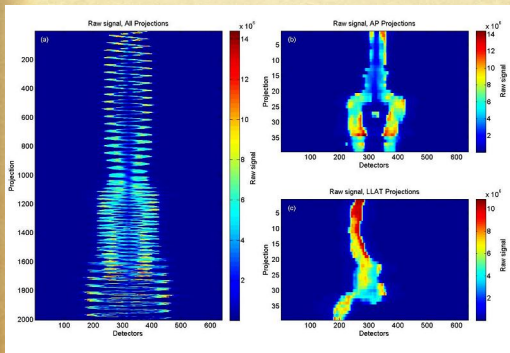


What To Do?

- 5 Elements
 - Automation and Redundancy
 - Monitoring
 - Standardization and Rationalization (procedures)
 - Training, Retraining, and Testing
 - Quality QA: Accreditation
- 2 Strategies
 - Coordination and Cooperation
 - Culture



Automation and Redundancy

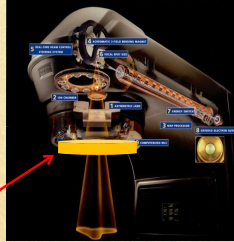


RTD Checksum System

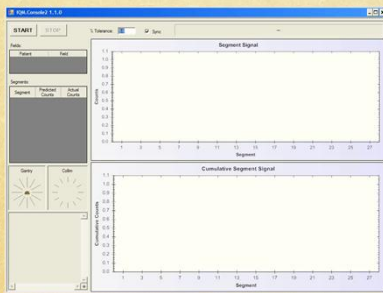
Integrated into the beam delivery path

Automatically integrates dose with spatially sensitive detector

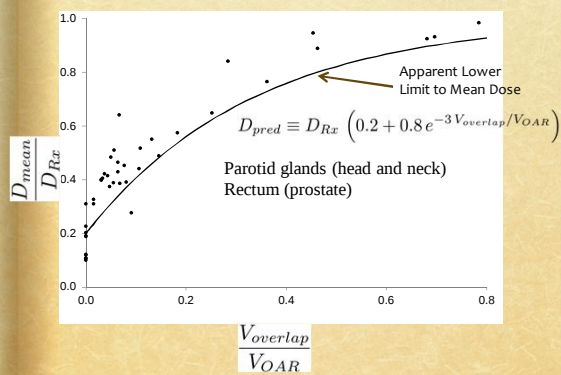
Automated workflow, provides both automation and redundancy



RTD Checksum Example



Planning Automation



Monitoring

- How well do we do?
 - Error Reporting
 - Results
- In-room monitoring

Error Reporting: Grass Roots

- ♦ UCLA - Wash U. Collaboration Electronic Whiteboard to Enhance Safety
- ♦ Electronic whiteboard for reporting and analysis
- ♦ All errors and near misses are tracked
- ♦ Creates data
- ♦ Promotes zero mistake culture with all stakeholders (if implemented correctly)

Department of Radiation Oncology

Process Improvement Logs

Therapy # 05110701 Name: Test Wrong Energy Patient, Date, Physician Demographics

Physician: DBM Event Date: 5/11/2007

Area of Event: ☐ Administration ☐ Clinical ☒ Dosimetry ☐ Maintenance ☐ Nursing ☐ Physics ☐ Technical

Type of Event: Prescription Interpretation / Delivery Problems

Therapy # 05110701 Name: Test Wrong Energy

Physician: DBM Event Date: 5/11/2007

Severity: Medium ?

Narrative: Patient treated with 6MV instead of 18MV.

National Error Registry

- ♦ We need to know what is happening
 - ♦ Where are we making mistakes?
 - ♦ How often do the mistakes happen?
 - ♦ What are the consequences of the mistakes?
- ♦ National Radiation Oncology Registry (NROR)



Proposal: Black Box

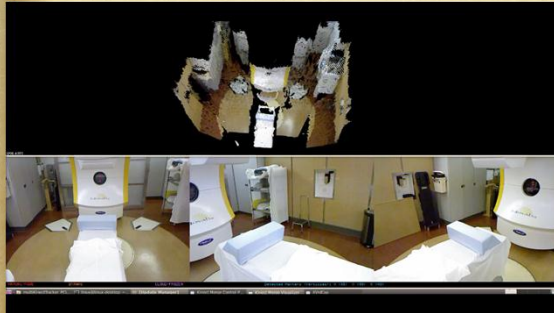
- ♦ Develop retrospective recording system
 - ♦ Records actions in the treatment room
 - ♦ Policies that maintain worker's and patient's privacy



Monitoring to Avoid Errors

- ♦ Primarily human-based errors
 - ♦ Wrong patient
 - ♦ Wrong site
 - ♦ Missing or wrong accessory
- ♦ How?
 - ♦ 3D cameras positioned in the room
 - ♦ Monitor the patient, accessories, accelerator
 - ♦ Compare against programmed values
 - ♦ Compare against similar patients
- ♦ Automated feature recognition
- ♦ Expert-system: Big Brother Covert Patient Surveillance

Get Movie for Big Brother



Standardize and Rationalize

- Treatment Directives
- Standardized procedures
 - Allows the development of FMEA and FTA to be developed by national organizations
- Standardized QC/QA
- Risk-based QA
- Standardized interfaces, data management, measurement techniques, commissioning, interfaces (human factors)

Standardize

ASTRO QA White Papers	• Provide an overview of QA issues and	Literature review and consensus
ASTRO Best Practices	• Recommendations about "how" to deliver radiation therapy, including the best treatment methods and patient care processes • Basis for measure development for PQRS, MOC, and ROPA • Basis for educational content (webinars, educational sessions)	RAND appropriateness methodology (systematic literature review and formal consensus process); moving toward compliance with IOM recommendations for "guidelines"

FMEA

- For each subprocess, enumerate the possible scenarios, i.e., Failure Modes (FM), that could lead an unsuccessful treatment
- Identify causes and effect on process outcome
- Assess risk to successful outcome posed by each FM assuming no QA

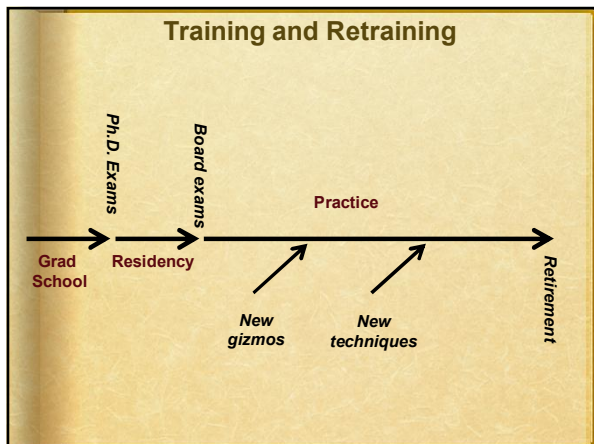
$$\text{Risk} = \left\{ \begin{matrix} \text{Probability of} \\ \text{occurrence} \end{matrix} \right\} \times \left\{ \begin{matrix} \text{Severity of} \\ \text{consequences} \end{matrix} \right\} \times \left\{ 1 - \frac{\text{probability Error Detected}}{P} \right\}$$

Risk Probability Number = RPN = O × S × P

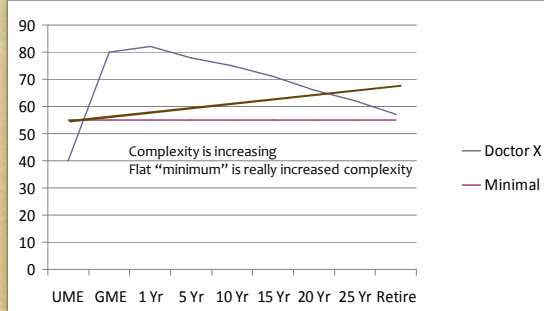
- Assign O, S, and P a value from 1-10
- 4 Observers: Ibbott, Mutic, Williamson, Thomadsen
- Significant additions/modifications by JFW
- Reorder list in terms of descending RPN

Alternative Method

- Nancy Leveson of MIT
- Evaluated modern accidents (FMEA is more than 30 years old)
- FMEA doesn't manage software or "migration"
- Changed emphasis: from "prevent errors" to
 - Enforce safety constraints on system behavior
 - ID safety constraints
 - Design control structure to enforce constraints on system behavior and adaptation



Competence



Training and Retraining

- Re
- Sin
- Per
- rev
- Fre



QA

• Accreditation

California

Center for Radiation Therapy of Beverly Hills, Expiration 2/28/14
Scripps Health, Green Hospital, Expiration 5/31/13
VA Long Beach Healthcare System, Expiration 5/31/14
VA Greater Los Angeles Healthcare System, Expiration 9/30/13
Queen of the Valley Medical Center, Expiration 8/31/14
Redlands Community Hospital, Expiration 5/31/13
John Muir Cancer Institute-Walnut Creek, Expiration 03/31/15
John Muir Cancer Institute (Concord), Expiration 5/31/15
UC Davis Cancer Center, Expiration 4/30/15
Presbyterian InterCommunity Hospital, Expiration 6/30/15

37,691,912

Connecticut

Hartford Hospital - The Helen and Harry Gray Cancer Center, Expiration 8/31/14
St. Vincent's Medical Center, Expiration 7/31/14
Community Cancer Care (Northeast Regional Radiation Oncology Network, Inc.), Expiration 8/31/14
Hartford Hospital, Expiration 8/31/14
Northeast Regional Radiation Oncology Network Inc., Expiration 8/31/14
Middlesex Hospital Cancer Center, Expiration 12/31/13
The Hospital of Central Connecticut, Expiration 9/31/14
New Milford Hospital, Expiration 7/31/14
Hemlock Regional Cancer Center, Expiration 1/31/14

3,580,709



Coordination and Cooperation

- Informal collaboration with MITA and vendors on a Radiation Oncology Stakeholders group that is working on a series of white papers
 - Error Messages
 - Standard prescription format

Culture

- Culture of Safety is key ingredient
 - Create the culture that strives to learn what happened
 - Commitment by all personnel
- Current medical culture: “be perfect”
 - Mistake... not what you did was bad, but you are bad
 - You are always supposed to have the right answer
 - Self doubt vs. culture of improvement
 - Errors are ubiquitous
 - Medical events vs. process mistakes
 - Mistakes are inevitable ... if we weed out the mistake makers there won't be anyone left
- Blameless culture



M. Workman, 2009

Radiation Therapy Safety is Now More Challenging Because

21%	1.	Investigative reporters are looking over our shoulders
20%	2.	Computers entered the picture
20%	3.	The number of parameters being defined, transported and used has grown tremendously
19%	4.	IMRT is easier to plan than 2D
20%	5.	CT scanning makes target definition harder

Correct Answer: 3

- The number of parameters being defined, transported and used has grown tremendously

FMEA is

20%	1.	A quantitative way to determine relative risk
20%	2.	A way to prioritize risk management according to a combination of occurrence, severity, and detectability
21%	3.	A way to prioritize risk management according to severity
21%	4.	Only useful for designing factory assembly lines
18%	5.	Framed Management Engagement Assurance

Correct Answer: 2

- A way to prioritize risk management according to a combination of occurrence, severity, and detectability

Automation is Important in RT Because

- | | | |
|-----|----|---|
| 22% | 1. | It reduces the reliance on expensive employees |
| 21% | 2. | It allows us to spend less time at the console |
| 21% | 3. | Therapists are too scarce and need to be replaced by automation |
| 18% | 4. | The number and speed of parameters we use are too numerous for humans to effectively manage |
| 18% | 5. | There are no redundant systems in radiation therapy |

Correct Answer: 4

- The number and speed of parameters we use are too numerous for humans to effectively manage
