Patient Safety and Treatment Quality Improvement

JOHNS HOPKINS MEDICINE
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AAPM 2011, Vancouver, BC
SAMS session

Disclosures

Ford:
- Pilot grant: Elekta Inc.
- Chair AAPM Working Group on Prevention of Errors

Mutic:
- Grant on patient safety: Varian Medical
- Partner: AQUSI,LLC

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EDITORIAL

HOW SAFE IS SAFE? RISK IN RADIOTHERAPY

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Departments of Radiation Oncology and Molecular Radiation Sciences, Johns Hopkins University, Baltimore, MD

Estimates for US patients

- 1200 mistreatments per year
- 1 in 600 patients affected

Error spectrum

- Publicized - One side of the spectrum, usually large dosimetric errors – NY Times Articles
- Semi-publicized – RPC data
  - Approximately 30% of *participating* institutions fail to deliver IMRT dose indicated in their treatment plans to within 7% or 4mm to an anthropomorphic phantom (IJROBP. 2008;71(1 Suppl):S71-5).
- Unpublicized/unnoted – everyday occurrences
  - "Small" dosimetric errors and geographic misses
  - Suboptimal treatment plans (contouring and dose distributions)
  - Care coordination issues
  - Unnecessary treatment delays

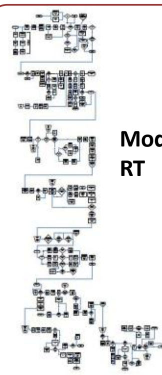
Increasing Complexity of Radiation Treatments

Control Console
circa 1970

Console *2010*

Increasing Complexity

Process Map
circa 1970



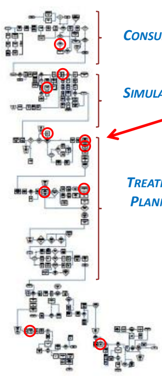
Modern RT

Step	Rate
1	99.9%
2	99.9%
.	
.	
.	
.	
.	
n	99.9%

***n*=76:**

$(99.9\%)^{76} =$ 93%

Where do errors originate?



CONSULT

SIMULATION

High-risk areas
- Scattered throughout process
- Traditional QA does not address these
- How to find them?

TREATMENT PLANNING

TREATMENT

Ford et al. Int J Radiat Oncol Biol Phys, 74(3), 852-858, 2009

7

Improving Quality and Safety in Radiotherapy

- Difficult problem
- Often only partial understood
- Methods are available


CNN Travel

Justice Entertainment Tech Health Living Travel Opinion iReport Money Sports

NTSB: Air traffic controller fell asleep, leaving planes on their own

March 24, 2011 | By the CNN Wire Staff

The air traffic controller suspended for failing to respond to two planes heading into Ronald Reagan Washington National Airport has told investigators that he had fallen asleep, according to the National Transportation Safety Board.

The controller, a 20-year veteran, "indicated that he had fallen asleep for a period of time while on duty," according to a statement released Thursday by the safety board. "He had been working his fourth consecutive overnight shift (10:00 p.m. to 6:00 a.m.)."

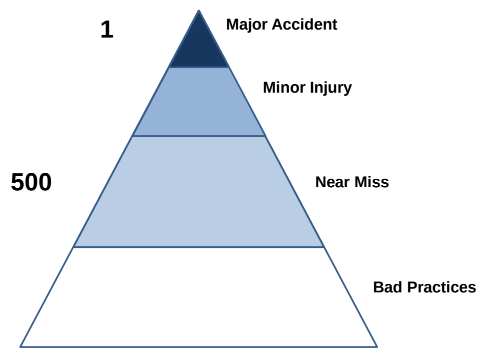
This is a 2009 file photo of a jetliner at Reagan National Airport in Washington.

"Human fatigue issues are one of the areas being investigated," the statement read.

… vs. Radiation Oncology

- "… I am personally outraged …" – Randy Babbitt, the FAA administrator. ***A Spokesman***
- Babbitt, who suspended the unidentified 20-year veteran, is reviewing the incident. ***Sanction*** ***Anonymized***
- The controller told the NTSB it was his fourth straight overnight shi ***Investigative body*** he tower. ***Root-Cause***
- The FAA is looking at overnight staffing issues nationwide. About 30 towers operate with just one controller after midnight.
- Suspected controller errors in 2010 hit 1,887 up from 1,233 the previous year. ***Statistics***

- Source: Reuters, March 25, 2011



Heinrich's Triangle

Heinrich, HW. Industrial accident prevention: a scientific approach, 1st Ed., 1931

Research in industrial engineering indicates that for every serious error there are approximately how many near-misses?

20%	1. 2
20%	2. 10
20%	3. 50
20%	4. 500
20%	5. 5000

10
Countdown

Research in industrial engineering indicates that for every serious error there are approximately how many near-misses?

1. 2
2. 10
3. 50
4. **<u>500</u>**
5. 5000

As a safety improvement measure, the nuclear industry requires on:

20%	1. Licensure of operators
20%	2. Board certification
20%	3. In-plant incident reporting system
20%	4. National voluntary reporting system
20%	5. All of the above

10
Countdown

As a safety improvement measure, the nuclear industry requires on:

1. Licensure of operators
2. Board certification
3. **<u>In-plant incident reporting system</u>**
4. National voluntary reporting system
5. All of the above

Patient Safety and Treatment Quality Improvement

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Overview

(I)Discovering errors and weak points …… Mutic

FMEA
Incident reporting

(II)Preventing errors ……………………………… Ford

Error-proofing approaches
Checklists, portal dosimetry, QC checks
Culture of safety

Failure Modes and Effects Analysis

- **Objectives:**
- To motivate the use of FMEA and to provide an introduction to the application of FMEA in RT
- To illustrate the dependence of the results of an FMEA on the approach used and on the individuals performing the analysis
- **FMEA is a tool**

Failure Modes and Effects Analysis

- **Failure Modes and Effects Analysis (FMEA)**
- Identifies ways that a sub-process or product can fail and develops plans to prevent those failures. FMEA is especially useful with high-risk projects.
- The FMEA process is a **dynamic**, structured approach that has the goal of linking the FAILURE MODES to an EFFECT over time for the purpose of prevention.

http://www.webpages.uidaho.edu/~redgeman/Generic%20Presentations/FMEA-&-Measurement_Systems_Analysis.ppt

Failure Modes and Effects Analysis

- **What's the point?**
- Provides a structured way of prioritizing risk.
- Helps to focus efforts aimed at minimizing adverse outcomes.
- **How does FMEA do that?**
- Assembles a group of people (experts) and asks them to dream up potential risks (failure modes) and to assign a few numbers to them.
- Numbers are easy to sort.

"The purpose of computing is insight, not numbers! " R.W. Hamming

Failure Modes and Effects Analysis

- It can be used as a standalone tool or as a part of a broader quality system
- FMEA – part of FDA process
- Applications:
  - Equipment/productds
  - QA/QC development
  - Process development

Failure Modes and Effects Analysis

- **Vocabulary**
- **Failure Mode**: How a part or process can fail to meet specifications.
- **Cause**: A deficiency that results in a failure mode; sources of variation.
- **Effect**: Impact on customer if the failure mode is not prevented or corrected.

Failure definition and spectrum

- Publicized - One side of the spectrum, usually large dosimetric errors – NY Times Articles
- Semi-publicized – RPC data
  - Approximately 30% of *participating* institutions fail to deliver IMRT dose indicated in their treatment plans to within 7% or 4mm to an anthropomorphic phantom (IJROBP. 2008;71(1 Suppl):S71-5).
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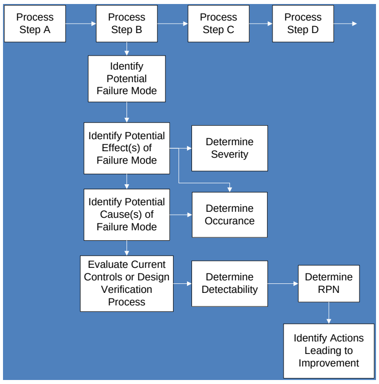
Organizational Goals

- RT - Service or Manufacturing Industry?
  - Quality
  - Patient and employee safety
  - Patient and employee satisfaction
  - Efficiency

Process Itself Matters

- “High-quality” means minimizing process variation and moving the average closer to the optimum value - *Med. Phys., 2007. 34(5): p. 1529-1533.*
- Stable and well defined processes enable:
  - Standardization
  - Quantification
  - Benchmarking
  - Improvements
  - Quality Control

FMEA Structure/Process



Failure Modes and Effects Analysis

- **Identifying potential failure modes**
  - Must be comprehensive
  - Must be unambiguous – remove interpretation
  - May be linked to severity
- **Identifying potential effect(s) of failure mode**
  - Use most severe
  - Easiest one to agree on

FMEA in Numbers

- **Occurrence** (O) describes the probability that a particular cause for the occurrence of a failure mode occurs. (1-10)
- **Severity** (S) describes the severity of the effect on the final process outcome resulting from the failure mode if it is not detected or corrected. (1-10)
- **Lack of Detectability** (D) describes the probability that the failure will not be detected. (1-10)

RPN Score

- Three part system
  - Probability of failure - O
  - Severity of failure - S
  - Probability that a failure would NOT be detected - D

Probability of error	Severity	Probability no detection	RPN
A	B	C	A*B*C

Risk Priority Number (RPN) = Frequency * Severity * Probability

Scoring frequency of failure

Qualitative Review	Ranking	Failure Rate
Failure is unlikely	1	< 100 ppm
Few failures	3	< 500 ppm
Occasional failure	6	< 0.5 %
Repeated failures	8	< 2.0 %
Failures are inevitable	10	> 5.0 %

Six Sigma Levels of Performance

Sigma Level	DPMO	Error as %	Quality Yield	Cost of Quality/Cost of Poor Quality as % of Total Operating Cost
2	308,537	30.8%	69.0%	Uncompetitive
3	66,807	6.7%	93.3%	24-40%
4	6,219	0.6%	99.4%	15-20%
5	233	0.0233%	99.98%	5-15%
6	3.4	0.00034%	99.9997%	World Class

Scoring Severity of Failure

Severity	Rank
Minor to Inconvenience	1-3
Minor dosimetric error	4
Limited toxicity	5-6
Serious toxicity	7-9
Catastrophic	10

Probability that a failure will NOT be detected

Probability	Rank
1/10,000	1
1/5000	2
1/2000	3
1/1000	4
1/200	6
1/50	8
1/20	9
1/10	10

Failure Modes and Effects Analysis

- *NO* special QA\QC in place for any of the processes or equipment
- Errors are discovered only downstream through routine processes
- Drastically different from all our training and beliefs
- Challenging to continuously remember

Failure Modes and Effects Analysis

- **Identifying potential cause(s) of failure mode**
  - Depends on experience
  - Often get a wide spread
- **Evaluate current controls or design verification process**
  - Assume no QC
  - This is difficult to do for us

Failure Modes and Effects Analysis

- Each failure can have multiple causes
- Each failure can have multiple consequences

- Example – Isocenter misplacement
- Causes
  - Laser misalignment
  - Patient setup misinterpretation
  - Many others…..
- Consequences/Severity
  - Depend on magnitude of misplacement
  - Use the most sever one

Failure Modes and Effects Analysis

- **Two major challenges in completing an FMEA**

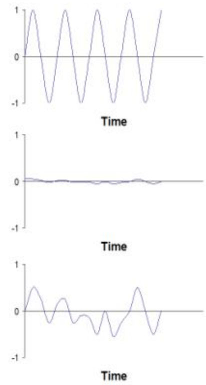
1. To be confident that all possible significant failure modes have been identified.
   - This requires that experts contributing to the FMEA have a wide range of experience
2. The description of the failure mode must be completely clear and different sources that result in the same failure must be differentiated.
   - Different sources may result in the same failure but will have different likelihoods of occurrence.

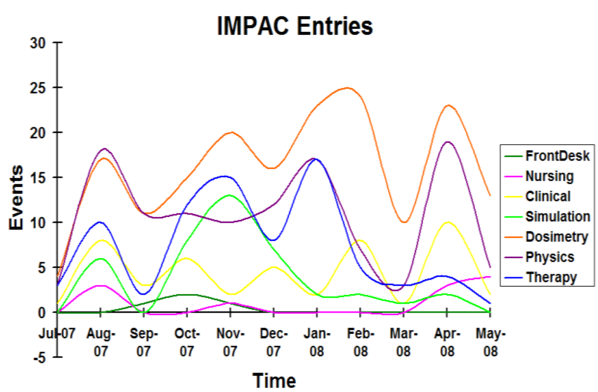
System Performance

a) The demands on our operations continually change
   - Patient numbers
   - Available staff
   - Available machines

b) Well designed systems maintain constant performance

c) Poorly designed systems cannot cope with these changes





Event Reporting

- Mandatory (statutory)
  - Reporting required by law
  - NRC in U.S.
  - State requirements
  - Mainly concentrated on well defined *treatment delivery* errors
  - Guidelines for near-miss reporting typically not provided
- Voluntary
  - Mainly at institutional level
  - Some states in the U.S. have voluntary reporting systems – utility for radiation therapy not clear
  - Errors and near misses tracked

Voluntary Reporting

Dependent on Many Factors

- Culture
- Reporting guidelines
- Reporting system
- Competence to interpret reported data
- Willingness to implement, when necessary, significant changes based on collected data and subsequent analyses
- Ability to share the collected data and provide feedback

Lessons Learned I

Naming a Voluntary Reporting System

- We often name our homegrown software by what it does
- Our brand new web-based system, back in 2007, was named “Process Improvement Logs”
- Our staff provided a nickname

“E-Snitch”

Organizational Culture

- “*Shared values (what is important) and beliefs (how things work) that interact with an organization’s structures and control systems to produce behavioural norms (the way we do things around here).*” Uttal, B., Fortune, 17 October 1983.
- Safety culture
  - Reporting culture
  - Just culture

Organizational Cultures

Pathological Culture	Bureaucratic Culture	Generative Culture
Do not want to know	May not find out	Actively seek it
Messengers (whistle blowers) are “shot”	Messengers are listened to if they arrive	Messengers are trained and rewarded
Responsibility is shirked	Responsibility is compartmentalized	Responsibility is shared
Failure is punished or concealed	Failures lead to local repairs	Failures lead to far reaching reforms
New ideas are actively discouraged	New ideas often present problems	New ideas are welcomed

Reason, J., *Managing the risks of organizational accidents*.

Reporting Culture

- Indemnity against disciplinarily proceedings and retribution
- Confidentiality
- To the extent practical, separation of those collecting the event data from those with the authority to impose disciplinary actions
- An efficient method for event submission
- A rapid, intelligent, and broadly available method for feedback to the reporting community

Just Culture

Acceptable and Unacceptable Actions

- Vast majority of errors is due to factors and actions where attribution of blame is not appropriate nor useful
- Rare events are due to unacceptable actions:
  - Recklessness
  - Negligent or malevolent behavior
- The line between these can be thin and the tendency is to attribute errors to acceptable actions
- It is operationally impossible to give a blanket immunity which would include unacceptable actions

Errors and Near Misses

- Error
  - "The failure of planned action to be completed as intended (i.e., error of execution) or the use of a wrong plan to achieve an aim (i.e., error of planning)."

Institute of Medicine. To Err is Human: Building a Safer Health System, 2000.

Errors and Near Misses

- Near Misses
  - Near Hits
  - Free Lessons
  - Close Calls
  - Near Collisions

Small to Sentinel Events

"We know that single events are rare, but we do not know how small events can become chained together so that they result in a disastrous outcome. In the absence of this understanding, people must wait until some crisis actually occurs before they can diagnose a problem, rather than be in a position to detect a potential problem before it emerges. To anticipate and forestall disasters is to understand regulations in the ways small events can combine to have disproportionally large effects."

K.E. Weick, "The vulnerable system: an analysis of the Tenerife air disaster" in P.J. Forst *et al* Reframing Organizational Culture

Error Process

- Errors are product of a chain of causes

What to Report/Track

- Explicit events – frequent events
- Random events
- Actual errors
- Potential errors (near misses)

Reporting process

- Statutory reporting
  - Which agencies should receive reports
  - Which errors are subject to reporting
  - Do near misses have reporting mandates
  - Reporting process
- Voluntary reporting
  - Which errors/near misses to report
  - Reporting process
  - What should be provided in the report
  - Feedback mechanism

AAPM Working Group on Prevention of Errors

Taxonomy Project

Goal: Develop a structure to facilitate radiation oncology-specific reporting systems

Team: physicists and physicians + ad-hoc

Five key areas:

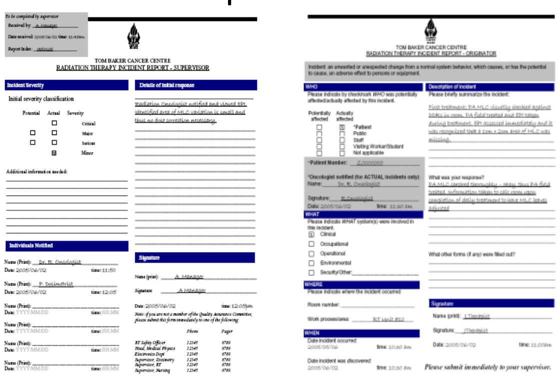
- Definitions
- Common process map
- Severity ranking scale
- Root causes taxonomy
- Recommended data structures

Workshop: April 14-15 Final report: July 31

Reporting Systems

- Paper
  - Single form or set of multiple forms
  - Well defined submission and routing process
  - Manual processing and data extraction
- Electronic
  - Desktop or web-based applications
  - Commercial and home grown (rad-onc specific)
  - Automatic processing and data mining
  - ROSIS - http://www.clin.radfys.lu.se/default.asp

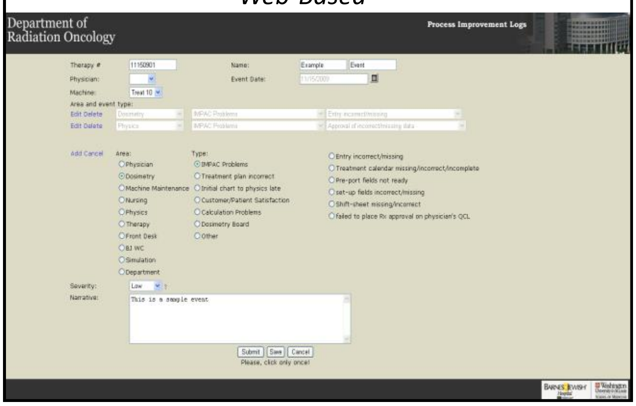
Paper Based



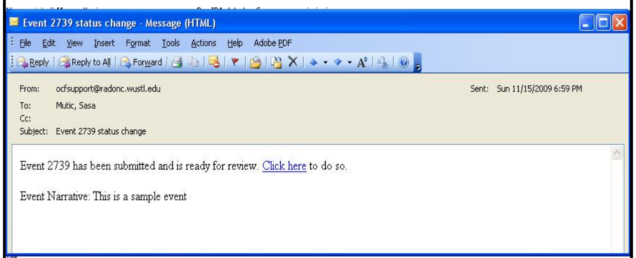
Cooke, D.L., et al., *A Reference guide for learning from incidents in radiation treatment*, in *Imitative Series*. 2006, Alberta Heritage Foundation for Medical Research: Alberta, Canada.

Electronic

Web-Based



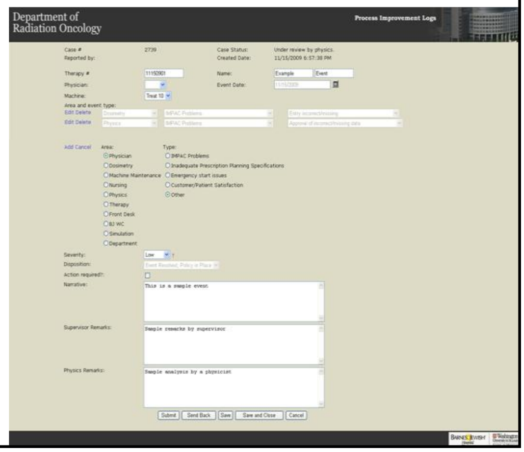
Electronic
Web-Based



Notification e-mail, automatically routed through email, alpha pages, text messaging to supervisors

Electronic

Web-Based



Event Data Use

MD Orders Example - change to consents

The Problem:

- During 19 months - ~500 Events submitted on 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 – 20 events during the four months of pilot

Feedback Mechanisms

- Feedback process often stated as a prerequisite
- Our current implementation does not have a systematic process for direct feedback to individual reporters
- Feedback largely provided to individual groups with major event summaries and process changes
- Large fraction of events submitted unanimously

Conclusions

- Sustainable data collection possible
- Need to collect broader parameters to determine failure triggers
- Electronic processes and standardized classification could facilitate benchmarking among institutions
- Possible savings and improvements could translate to greater resources available for direct patient care

Questions/Comments

Which of the following is <u>not</u> a part of FMEA vocabulary as presented here:

20%	1.	Failure mode
20%	2.	Cause
20%	3.	FTE
20%	4.	Effect
20%	5.	RPN

10
Countdown

Which of the following is <u>not</u> a part of FMEA vocabulary as presented here:

1. Failure mode
2. Cause
3. **<u>FTE</u>**
4. Effect
5. RPN

Letter "D" in the described FMEA process stands for:

20%	1. Demonstrated occurrence
20%	2. Demonstrated severity
20%	3. Probability of detection
20%	4. Probability of no detection
20%	5. Demonstrated detection

10

Countdown

Letter "D" in the described FMEA process stands for:

1. Demonstrated occurrence
2. Demonstrated severity
3. Probability of detection
4. **Probability of no detection**
5. Demonstrated detection

Just culture addresses which of the following:

20%	1. Indemnity against disciplinary proceedings and retribution
20%	2. Reporting confidentiality
20%	3. Separation of those collecting the event data from those with the authority to impose disciplinary actions
20%	4. Justification process for event reporting
20%	5. A just method for feedback to the reporting community

10

Countdown

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4. Justification process for event reporting
5. A just method for feedback to the reporting community

Electronic reporting systems can improve all of the following <u>except:</u>

20%	1. Management buy-in
20%	2. Ease of reporting
20%	3. Communication
20%	4. Event analysis and disposition
20%	5. Feedback process

10
Countdown

Electronic reporting systems can improve all of the following <u>except:</u>

1. **<u>Management buy-in</u>**
2. Ease of reporting
3. Communication
4. Event analysis and disposition
5. Feedback process

FMEA can be used in radiation therapy for the following:

20%	1. As a part of FDA quality system
20%	2. Treatment machine commissioning
20%	3. New process implementation
20%	4. Design of QA/QM program
20%	5. All of the above

10
Countdown

FMEA can be used in radiation therapy for the following:

1. As a part of FDA quality system
2. Treatment machine commissioning
3. New process implementation
4. Design of QA/QM program
5. **<u>All of the above</u>**

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FMEA
Incident reporting

(II)Preventing errors .... Ford
Error-proofing approaches
Checklists, portal dosimetry, QC checks
Culture of safety

Error-proofing

How are errors prevented?

- Make them impossible
- Make them less likely
- Make them easier to spot
- Make the impact less

Error-proofing

How are errors prevented?

- **Make them impossible … “forcing functions”**
- Make them less likely
- Make them easier to spot
- Make the impact less

Forcing functions to ELIMINATE mistakes

In simulation training residents have tried to defibrillate patients while the lead was still in the dummy load for test – perceptual narrowing

Peter Doyle, PhD, Johns Hopkins, 2011

Forcing functions to ELIMINATE mistakes

Gamma Knife C helmet collimators

… interlock to prevent the use of the wrong helmet

Elekta Inc.

Example Failure Mode:

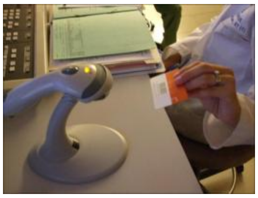
Plan pulled up for wrong patient in R&V system

Goal: Make the error <u>**impossible**</u>

<u>Two proposed solutions:</u>

“Time-out” vs. Patient ID card

Example Failure Mode:
Treatment plan and DRR (film) pulled up in R&V system



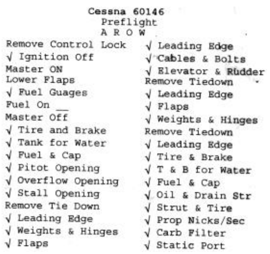
- Patient ID card scanner
- Pulls up electronic record in R&V system
- Even better solutions?
  RFID technology

Error-proofing

How are errors prevented?

- Make them impossible
- **Make them less likely**
- Make them easier to spot
- Make the impact less

Checklists

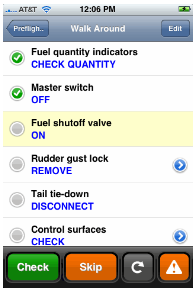


Cessna 60146
Preflight
A R O W

Remove Control Lock
√ Ignition Off
Master ON
Lower Flaps
√ Fuel Guages
Fuel On __
Master Off
√ Tire and Brake
√ Tank for Water
√ Fuel & Cap
√ Pitot Opening
√ Overflow Opening
√ Stall Opening
Remove Tie Down
√ Leading Edge
√ Weights & Hinges
√ Flaps

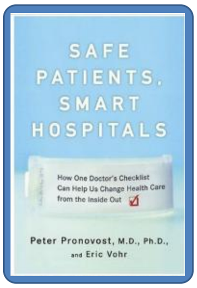
√ Leading Edge
√ Cables & Bolts
√ Elevator & Rudder
Remove Tiedown
√ Leading Edge
√ Flaps
√ Weights & Hinges
Remove Tiedown
√ Leading Edge
√ Tire & Brake
√ T & B for Water
√ Fuel & Cap
√ Oil & Drain Str
√ Strut & Tire
√ Prop Nicks/Sec
√ Carb Filter
√ Static Port

Cessna150.net



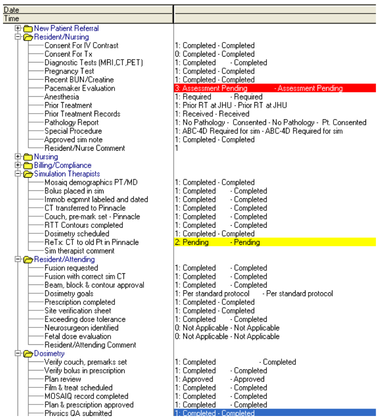
ForeFlight Inc. ©

Checklists



- Standardization of important tasks
- Making sure they get done

A Rad Onc Checklist



Date / Time	
New Patient Referral	
Resident/Nursing	
Consent For IV Contrast	1: Completed - Completed
Consent For Tx	0: Completed - Completed
Diagnostic Tests (MRI,CT,PET)	1: Completed - Completed
Pregnancy Test	1: Completed - Completed
Recent BUN/Creatine	1: Completed - Completed
Pacemaker Evaluation	3: Assessment Pending - Assessment Pending
Anesthesia	1: Required - Required
Prior Treatment	1: Prior RT at JHU - Prior RT at JHU
Prior Treatment Records	1: Received - Received
Pathology Report	1: No Pathology - Consented - No Pathology - Pt. Consented
Special Procedure	1: ABC-4D Required for sim - ABC-4D Required for sim
Approved sim note	1: Completed - Completed
Resident/Nurse Comment	1
Nursing	
Billing/Compliance	
Simulation Therapists	
Mosaiq demographics PT/MD	1: Completed - Completed
Bolus placed in sim	1: Completed - Completed
Immob eqpmnt labeled and dated	1: Completed - Completed
CT transferred to Pinnacle	1: Completed - Completed
Couch, pre-mark set - Pinnacle	1: Completed - Completed
RTT Contours completed	1: Completed - Completed
Dosimetry scheduled	1: Completed - Completed
ReTx: CT to old Pt in Pinnacle	2: Pending - Pending
Sim therapist comment	
Resident/Attending	
Fusion requested	1: Completed - Completed
Fusion with correct sim CT	1: Completed - Completed
Beam, block & contour approval	1: Completed - Completed
Dosimetry goals	1: Per standard protocol - Per standard protocol
Prescription completed	1: Completed - Completed
Site verification sheet	1: Completed - Completed
Exceeding dose tolerance	1: Completed - Completed
Neurosurgeon identified	0: Not Applicable - Not Applicable
Fetal dose evaluation	0: Not Applicable - Not Applicable
Resident/Attending Comment	
Dosimetry	
Verify couch, premarks set	1: Completed - Completed
Verify bolus in prescription	1: Completed - Completed
Plan review	1: Approved - Approved
Film & treat scheduled	1: Completed - Completed
MOSAIQ record completed	1: Completed - Completed
Plan & prescription approved	1: Completed - Completed
Physics QA submitted	1: Completed - Completed

Error-proofing Example

- Physician intends to treat R calf but puts beams on L calf
- Cause: patient CT feet-first, no obvious R/L indicator
- Caught during planning by alert dosimetrist
- Incident report logged. Discussed at QC meeting.

Error-proofing Example

Which side is left?

Error-proofing Example

Radiology

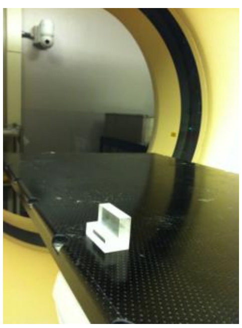
Error-proofing Example

Which side is left?

Error-proofing Example

Solution	Challenge
Train people not to do this	Weak solution. Turnover.
Setup picture R&V	R&V often not open
BB on involved side	Mistake side. Miss or mistake BB.
Wire L ankle	Miss wire. Mistake for scar.
Write an “L” as a contour	RTT mistakes side.
Rewrite software	Vendor response required
L side marker	**??**

Error-proofing Example



“L” marker placed on left side of patient

Error-proofing Example

Which side is left?

Error-proofing Example

Solution	Challenge
Train people not to do this	Weak solution. Turnover.
Setup picture R&V	R&V often not open
BB on involved side	Mistake side. Miss or mistake BB.
Wire L ankle	Miss wire. Mistake for scar.
Write an "L" as a contour	RTT mistakes side.
Rewrite software	Vendor response required
L side marker	**Marker on wrong side**

Error-proofing

Forcing functions
Make more obvious
Policy and procedure
Staff training

BETTER

Inst. Safe Medical Practices

Error-proofing

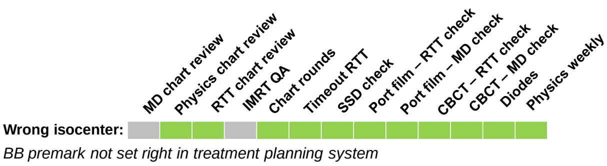
How are errors prevented?

- Make them impossible
- Make them less likely
- **Make them easier to spot … QA**
- Make the impact less

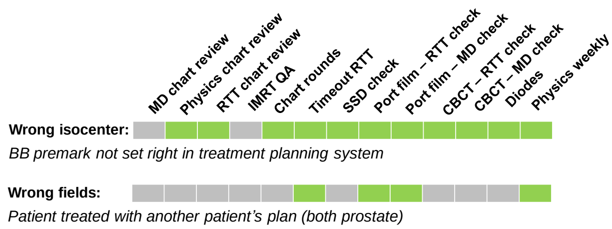
Common QA checks

- Double check of every plan by 3 people
- Measurement of dose (in some cases)
- Peer review (Chart rounds)
- Films and CT (daily to weekly)

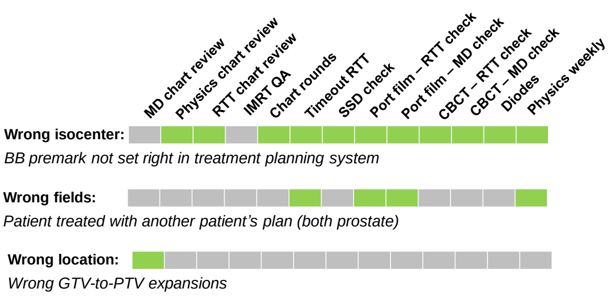
Quantifying Quality Control



Quantifying Quality Control



Quantifying Quality Control



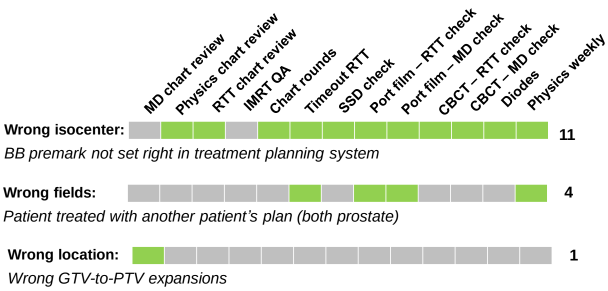
Quantifying Quality Control

An analysis of the effectiveness of common QA checks

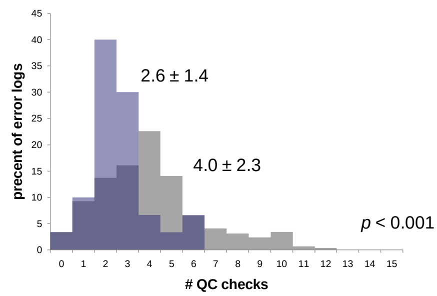
- JHU & Wash U
- Data:
  - incident reports: 2007-2011
  - 4,407 reports
  - 292 (7%) "high potential severity"

Ford, Mutic, et al.

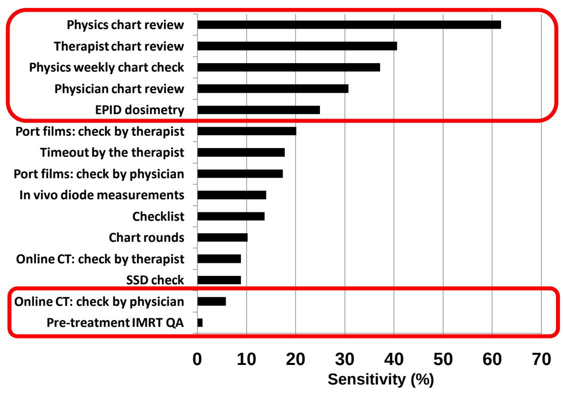
Quantifying Quality Control



Quantifying Quality Control



Quantifying Quality Control

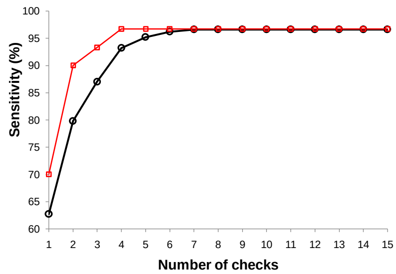


Quantifying Quality Control

Note: checks are not used in isolation

How effective are COMBINED checks?

Quantifying Quality Control

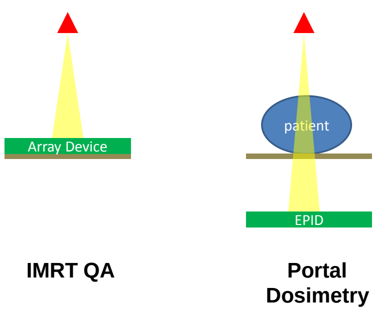


Quantifying Quality Control

Most effective checks in combination:

- Physician and physics chart review
- Portal dosimetry or port films ✔
- RTT timeout
- Checklists

Why is this better?



A long history, but few adopters

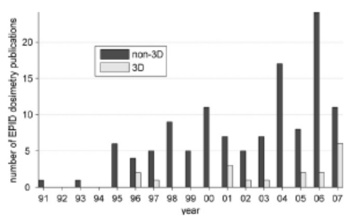


Fig. 1. Number of publications on EPID dosimetry (as found on Pubmed www.pubmed.com).

From van Elmpt et al. R&O review, 2008

Catching errors with *in vivo* EPID dosimetry

A. Mans,[a] M. Wendling,[b] L. N. McDermott,[c] J.-J. Sonke, R. Tielenburg, R. Vijlbrief, B. Mijnheer, M. van Herk, and J. C. Stroom
Department of Radiation Oncology, The Netherlands Cancer Institute—Antoni van Leeuwenhoek Hospital, Plesmanlaan 121, 1066 CX Amsterdam, The Netherlands

Medical Physics, Vol. 37, No. 6, June 2010

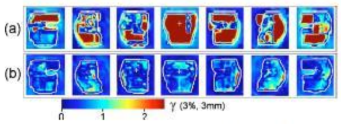


FIG. 2. γ-evaluations of (a) the first (malformed plan) and (b) the second (corrected plan) fractions in a plane parallel to the EPID, intersecting the isocenter. The white "+" indicates the isocenter.

Jan 2005 – Jul 2009: *n=1400*
17 'errors'
40% patient anatomy changes, 60% planning/transfer/delivery

Error-proofing

How are errors prevented?

- Make them impossible
- Make them less likely
- Make them easier to spot
- Make the impact less
- **"Culture of Safety"**

  A term first used in a report on the Cernobyl disaster (1986)

Culture of Safety

ORIGINAL ARTICLE

Exploring Relationships Between Hospital Patient Safety Culture and Adverse Events

Russell E. Mardon, PhD, Kabir Khanna, MA, Joann Sorra, PhD, Naomi Dyer, PhD, and Theresa Famolaro, MPS

J Patient Safety 2010

- AHRQ survey of 179 hospitals
- Better safety culture scores -> fewer adverse events

  p < 0.001

Culture of Safety

Significant reported indicators

- Event reporting and organizational learning
- Handoffs
- Staffing
- Teamwork – within units, across units

Mardon et al., J Patient Safety 2010

Culture of Safety

How to promote culture of safety

- Clear messages and leadership statements
  - event reporting
- Improve handoffs
- M&M conference
- Partner with clinicians

Conclusion

- Promote culture of safety
- Value of incident learning and risk assessment
- Error proofing
  - Standardization
  - Move beyond "QA checks"
  - Evolve toward automated systems

Of the following the most effective method for reducing errors is:

20%	1. Staff Training
20%	2. Forcing function
20%	3. QA checks
20%	4. Policies and Procedures
20%	5. Punitive actions

10
Countdown

Of the following the most effective method for reducing errors is:

1. Staff Training
2. **<u>Forcing function</u>**
3. QA checks
4. Policies and Procedures
5. Punitive actions

EPID-based portal dosimetry is:

20%	1. A possible replacement for IMRT QA
20%	2. More sensitive to most common errors than IMRT QA
20%	3. A possible replacement for in vivo diode measurements
20%	4. In development for 20 years
20%	5. All of the above

10
Countdown

EPID-based portal dosimetry is:

1. A possible replacement for IMRT QA
2. More sensitive to most common errors than IMRT QA
3. A possible replacement for in vivo diode measurements
4. In development for 20 years
5. **All of the above**

A good culture of safety is:

20%	1. Improved by disciplinary measures
20%	2. Enhanced by getting patients treated as quickly as possible
20%	3. Linked to fewer adverse events
20%	4. Mainly the responsibility of management
20%	5. Mainly dependent on having proper QA/QC measures

10
Countdown

A good culture of safety is:

1. Improved by disciplinary measures
2. Enhanced by getting patients treated as quickly as possible
3. **Linked to fewer adverse events**
4. Mainly the responsibility of management
5. Mainly dependent on having proper QA/QC measures


Have A Safe Journey
JOHNS HOPKINS
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