Incident Learning Systems and Root Cause Analysis

Barrett S. Caldwell
Purdue University
Disclosures

- Prof. Caldwell has no financial disclosures to report. He has conducted project implementations and redesign efforts for Franciscan Alliance, IU Health Arnett, and Veterans’ Administration facilities, but for student academic experience only (no financial consideration).
Topics to Be Covered

• Types and Purposes of Incident Learning Systems
• Root Cause Analysis
  – Purpose and Perspectives
• Design and Use of RCA Incident Learning Tools
  – Taxonomy Structures
  – Contributing Causes
• RCA Techniques and Improved Investigation / Reporting
Learning Objectives

- Role of Root Cause Analysis in Incident Learning
- Aspects and Limits of RCA Taxonomies
- Multiple Contributing Factors in RCA Investigations
- Multiple Investigations as System Improvement: Aggregation and Mapping
Incident Learning Systems

• Reporting Systems to Examine Healthcare Processes and Events
• Tools for Examining and Reducing Adverse Events and Errors
  – Benefits across the organization
  – Resources required for implementation and maintenance
• Focus on Organizational Learning and Improvement
  - Safety and Quality as linked organizational priorities
Characteristics of Incident Learning Systems

• How and When to Use Tools to Improve Organization Performance
  • Prospective (potential failures anticipated)
    – Failure Modes and Effects Analysis (FMEA)
  • Reactive (response to observed adverse events)
    – Root Cause Analysis seen as reactive / retrospective
  • Proactive (response to near misses, rather than events)
    – Activities to strengthen performance and reduce risk

• Importance of Scope and Range

2013 Summer School, Colorado Springs, CO
Balancing Incident Learning Priorities

- Need to Consider Culture, Resources, Participation
  - Encouraging staff to contribute without undue censorship or risk
  - Thresholds for reporting
  - Organizational understanding of role of system
  - Efficiency of data entry and retrieval

- What are Primary Goals to Achieve?
Discussion Point 1:

• A colleague suggests that analyses of “near misses” are not helpful, because “nothing bad happened”. You point out that it is important to use proactive analyses to...
  1. Increase training for poor operators.
  2. Improve practice for RCA teams.
  3. Satisfy legal and accreditation groups.
  4. Improve awareness of latent factors.
  5. Strengthen formal RCA charters.
Discussion 1 Feedback

• Correct Answer, #4:  
  – Improve awareness of latent factors.

• Sources:  
  – NASA, 2013  
  – Paradies, 2010
Root Cause Analysis (RCA)

• Reactive / Retrospective Tool
• History of Studying Improved Work Processes
• Multiple Potential Motivations
  – Placing blame on specific individuals
  – Learning from specific past events and errors
  – Categorizing and organizing multiple events to determine larger patterns
• Importance of Healthcare Adapations
Perspectives on RCA

• Differences in Primary Emphasis
  – Process Control
  – Error Reduction
  – System Understanding

• Industry-Based Differences
  – Regulatory and Oversight Roles
  – Function Allocation and Task Roles

• Importance of Overcoming Bias
  – Investigator biases differ from, or hide, Operator biases
  – Return to “Primary Goals” discussion
Contributions and Conditions

• Multiple Taxonomies Exist with Substantial Overlap; Different Contributing Factors Can Be Emphasized
• Importance of Examining Latent Risk Factors as well as Active Failures
  - Limits of Proactive methods: “Never... Always...”
  - Explicit vs indirect and related fault paths
  - Errors vs intentional bad behaviors
Design and Use of RCA Incident Analysis Tools

• Examples of Taxonomy Structures
  - Types of events
  - Types of causes
  - Opportunities for corrections

• Contributing Causal Factors (Performance Shaping Factors)
  – Organizational
  – Technical
  – Human
  – Other
Example of Factors in RCA: Ottawa

• Over 300 patients with significant underdosage in orthovoltage unit at The Ottawa Hospital Cancer Centre
  • Peter Dunscome and co-authors 2008 report
• Multiple Contributing Factors (see next page)
  – Orange: staff demands and poor implementation protocols
  – Yellow: Cultural and organizational de-prioritization
  – Green: Normalization of deviance
Example of Factors in RCA: Ottawa
RCA Investigation: Single and Multiple Contributors

- Root Cause Investigation Tools Address Multiple Potential Causal Factors
  - Checklists for investigation
  - Performance Shaping Factors (org, tech, human)
- Order of Investigation Inquiry Adds Artifact
RCA Investigation: Improving Systemic Understanding

• Value of “Pachinko” vs. “Pinball” Model
  – Pinball: First relevant causal factor is noted as “primary” cause, investigation is concluded
  – Pachinko: Multiple causal factors indicated, investigation continues after identifying factor; primary and secondary determinations later
Conduct of Investigations

• Criteria / Need for RCA
  – Determining definition / threshold for event
  – Increased value of “near miss” non-events for proactive investigations, but harder to conduct forensics (preserve scene, formal investigation
  – Importance of team formation, charter, process

• Individual and Multiple Event Investigations
  – Comparisons of similar patterns from incident reports supporting additional “lessons learned”
  – Development of reports and databases for statistical analyses of contributing factors
Discussion Point 2:

• The Pachinko model of identifying event contributions corrects which flaw in the Pinball model?
  1. Errors of “always do this” corrections.
  2. Deficiencies of RCA team formation.
  3. Weaknesses of studying near misses.
  4. Biases from assuming evil intention.
  5. Artifacts from item presentation order.
Discussion 2 Feedback

• Correct Answer, #5:
  – Artifacts from item presentation order

• Sources:
  – Caldwell, 2008
RCA Conclusion: Critical Mechanisms and Methods

• Incident Learning Tools:
  • Investigation Tools, Collection and Analysis Techniques, and Reporting Processes
• Causal Taxonomies Include Multiple Factors
  - Organizational Policies / Procedures, Technology, Device Interfaces, Human Performance, Work Processes, Environmental Factors
RCA: Conclusion: System Improvement from Incidents

• Primary Emphases for Good Incident Learning / RCA
  – Identifying Multiple Contributing Causes
  – Avoiding biases on provider fault / blame that limit learning
  – Empowering investigation teams to focus on opportunities for system improvement rather than punishment
Discussion Point 3

• The AAPM WGPE Taxonomy Includes a special focus on which aspect of RCA contributing factors?
  1. Formal human factors concepts.
  2. Primary emphasis on active failures.
  3. Analysis of intentional violations.
  4. Healthcare events other than RT.
  5. Specification of single primary cause.
Discussion 3 Feedback

• Correct Answer, #1
  – Formal human factors concepts
• Sources:
  – Ford, et al., 2012
Discussion Point 4

• A senior medical colleague asks you to participate in an incident investigation team, with a focus on appropriate punishments for any clear medical errors. You remind the colleague...
  
  1. That multiple persons may be at fault.
  2. That errors and violations are similar.
  3. To limit bias of emphasizing blame.
  4. To emphasize appropriate retraining.
  5. To consider legal actions as well.
Discussion 4 Feedback

• Correct Answer, #3:
  – To limit bias of emphasizing blame

• Sources:
  – NASA, 2013
  – NCRP, 2012
Root Cause Analysis Example from the IAEA Accident Update

Steven Sutlief, PhD
VA Puget Sound
Disclosures

• The presenter has no conflicts of interest to disclose.
Source of Material

• Many of the slides included here use material drawn directly from the slide set “Module 2.10: Accident update – some newer events” included in the IAEA Training Course on Prevention of Accidental Exposure in Radiotherapy.
RCA Example - Objectives

Session Objective

• To apply root cause analysis to a published incident in radiation therapy.
RCA Examples – IAEA Accident Update

• SRS, Incorrect manual parameter transfer, Glasgow Scotland, 2006
• SRS, Image reversal, Detroit Michigan, 2007
• SRS, Inappropriate chamber measurement, Toulouse France, 2007
• Dynamic Wedges, Erroneous calculation, Epinal France, 2004
• IMRT, Data glitch during save, New York State, 2005
Case: Stereotactic Radiosurgery

Incorrect manual parameter transfer
Glasgow, Scotland
2006
Impact of the accident

- Total dose to Lisa Norris from Rt & Lt Lateral head fields was 55.5 Gy
- She died nine months after the accident
• 2/1/2006: An SRS treatment calculation was checked by a senior checker.
• The senior checker identified an error in the dose output calculation.
• Likely as a consequence, the error in calculations for patient Lisa Norris was identified that same day.
SRS Case - Findings

- Whole CNS plans still went by the “old system”, where TPS calculates MU for 1 Gy with subsequent upscaling for dose per fx
- A “medulla planning form” was used, which is passed to treatment radiographers for final MU calculations

From IAEA Prevention of accidental exposure in radiotherapy

2013 Summer School, Colorado Springs, CO
SRS Case - Findings

• HOWEVER – “Planner X” let the TPS calculate the MU for the full dose per fx – not for 1 Gy as intended

• Since the dose per fx to the head was 1.67 Gy, the MU’s entered in the form were 67% too high for each of the head-fields

From IAEA Prevention of accidental exposure in radiotherapy

2013 Summer School, Colorado Springs, CO
SRS Case - Findings

- This error was not found by the more senior planners who checked the plan.
- The radiographer on the unit thus multiplied with the dose per fx a second time.
- 2.92 Gy per fx to the head.

From IAEA Prevention of accidental exposure in radiotherapy.

2013 Summer School, Colorado Springs, CO
SRS Case— Additional Findings

• The bulk of the planning was done by “Planner X” in Dec’05, a junior planner
• “Planner X” had not yet been registered internally to be competent to plan whole CNS, or to train on these
• “Planner X” got initial instructions and the opportunity to be supervised when creating the plan

From IAEA Prevention of accidental exposure in radiotherapy
2013 Summer School, Colorado Springs, CO
SRS Case—Additional Findings

- Before 2005: TPS calculated MU for 1 Gy followed by manual multiplication with the intended dose per fraction for the correct MU-setting to use.
- May 2005: RV system was upgraded to be a more integrated platform.
- The center decided to input the dose per fraction already in the TPS, for most but not all treatment techniques.

From IAEA Prevention of accidental exposure in radiotherapy

2013 Summer School, Colorado Springs, CO
SRS Case – Additional Findings

- At the time: Radiotherapy physics staffing levels in Scotland less than 60% of the recommended level
- “Glasgow has problems with recruiting physicists, as shown by their high number of vacancies.”
- Center’s 14.5 FTE staff level was far below the 18 FTE recommended by IPEM guidelines.

From IAEA Prevention of accidental exposure in radiotherapy
2013 Summer School, Colorado Springs, CO
SRS Case – Causal Assignments

• Why did the planner enter the MU/fx in the MU/Gy box?
  – Insufficient time for careful calculation
  – Employee without depth of experience
  – Recent change in treatment planning process

• Why wasn’t the error caught upon review?
  – Overlooked by senior plan checkers
  – The radiographer propagated the error.
SRS Case – Causal Assignments

• Why was there insufficient time for careful calculation?
• Why was an employee without depth of experience performing the calculation?
• Why did this happen in light of recent change in treatment planning process?
• Why was the error overlooked by senior plan checkers and the radiographer?
SRS Case – Causal Assignments using The AAPM WGPE Causal Taxonomy

Why was there insufficient time for careful calculation?

1. Organizational management
   a. Planning for program maintenance or expansion
      i. Inadequate human resources
         1. Staffing not consistent with professional clinical recommendations
Case 1: SRS – Causal Assignments using The AAPM WGPE Causal Taxonomy

Why was an employee without depth of experience performing the calculation?

1. Organizational management
   c. Training; acquiring, and transmitting knowledge and skills
      iii. Inadequate periodic assessment of staff competencies
Why did this happen in light of recent change in the treatment planning process?

1. Organizational management
   c. Training; acquiring, and transmitting knowledge and skills
      i. Appropriate skills not acquired from facility training
SRS Case – Causal Assignments using The AAPM WGPE Causal Taxonomy

Why was the error overlooked by senior plan checkers and the radiographer?

1. Organizational management
   f. Leadership and external issues
   v. Inadequate supervision

Perhaps also a procedural issue (Taxonomy 1.b)
SRS Case – Causal Assignments using The AAPM WGPE Causal Taxonomy

Human factors question: What was the error?

6. Procedural issues
   c. Failure to select the correct rule to address problem
      ii. Old or invalid rule
SRS Case – Corrective Actions

• Include in the Quality Assurance Program
  – Formal procedures for verifying the risks following the introduction of new technologies and procedures
  – Independent MU checking of ALL treatment plans [procedural reinforcement]
• Review staffing levels and competencies

From IAEA Prevention of accidental exposure in radiotherapy

2013 Summer School, Colorado Springs, CO
SRS Case – Corrective Actions

• Ensure that all staff
  – Are properly trained in safety critical procedures
  – Are included in training programmes and has supervision as necessary, and that records of training are kept up-to-date
  – Understand their responsibilities

From IAEA Prevention of accidental exposure in radiotherapy

2013 Summer School, Colorado Springs, CO
References