Implementation of An Incident Learning System in a Multidisciplinary Environment: a Leadership Opportunity for Medical Physicists

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Learning Objectives

To understand:
1. The value of a comprehensive incident learning system
2. The barriers that must be overcome to effectively implement such a system
3. Why the physicist plays a vital role in error management
System Safety

- **Unsafe Systems** – mountain climbing, some surgery, etc.
  - Risk of failure inherent in activity & accepted
- **Safer Systems** – road traffic, some healthcare
  - Safety improvement through standardisation
  - QA monitoring, staff training, procedures, etc.
- **Safe Systems** – food supply, charter airlines
  - Safety from top management commitment
  - Written safety policy, safety resources available
- **Ultra-safe Systems** – scheduled airlines, nuclear power
  - Safety supervision, automatic monitoring of process, automatic execution of routine tasks, etc.

*The Field guide to Understanding Human Error, Sidney Dekker, Ashgate 2006*

Approaches to Error Management

- **Incident Learning Systems** are used reactively to analyze incidents that have occurred or proactively to analyze potential incidents (near misses)
- **Failure Modes and Effects Analyses (FMEA) and Fault Tree Analyses** are used prospectively to analyze systems for weaknesses
Outline

Incident Learning
- What is it?
- Why should we do it?
- How do we do it?

Incident Learning System

Adapted from the Tom Baker Cancer Centre, Calgary, funded by the Alberta Heritage Foundation for Medical Research
Definitions

• **Incident**: An unwanted or unexpected *change* from a normal system behaviour that causes or has the potential to cause an adverse effect to persons or equipment

• **Potential Incident** ("near miss"): An incident that causes no harm but signals a *potential weakness* in the health care system


Potential Incidents

*Increasing Severity*

*Increasing Likelihood*

Bird FE and Germain GL, 1986
*Practical Loss Control Leadership*
Institute Publishing, Loganville, GA
### Investigation

- All incidents are investigated
- Composition of investigation team depends on severity of incident
- Priority for completion of investigation depends on severity of incident
- Assessment of impact, process domain and characteristics of the incident
- Investigation report includes causal analysis, recommends corrective actions, and assigns follow-up

#### 1. Inadequate Human Resources
- 1.1. Inconsistent with prof. recommendations
- 1.2. Inconsistent with vendor specs
- 1.3. Inconsistent with regulations
- 1.4. No provision for increase in activities
- 1.5. Personnel availability

#### 2. Inadequate Capital Resources
- 2.1. Inadequate budget for equipment
- 2.2. Inadequate input/service contracts
- 2.3. Inadequate training support
- 2.4. Inadequate IT software
- 2.5. Inappropriate or inadequate equipment

#### 3. Policies, Procedures, Regulations
- 3.1. Relevant policy non-existent
- 3.2. Policy not implemented
- 3.3. Policy inadequate
- 3.4. Policy not followed
- 3.5. External regulation not followed
- 3.6. Conflicting policies

#### 4. Training
- 4.1. Facility training inadequate
- 4.2. Vendor training inadequate
- 4.3. Training needs not identified
- 4.4. Inadequate assessment of staff competencies
- 4.5. Lack of continuing education

#### 5. Communication
- 5.1. Poor/incomplete/unclear/missing documentation
- 5.2. Inadequate communication patterns/design
- 5.3. Inappropriate or misleading communication
- 5.4. Failure to request needed information
- 5.5. Medical records incorrect/incomplete/absent
- 5.6. Lack of timeliness
- 5.7. Verbal instruction inconsistent w documentation

#### 6. Physical Environment
- 6.1. Physical environment inadequate
- 6.2. Distracting environment
- 6.3. Interferences
- 6.4. Conflicting demands/priorities

#### 7. Leadership and External Issues
- 7.1. Inadequate safety culture
- 7.2. Failure to remedy past known shortcomings
- 7.3. Environment not conducive to safety
- 7.4. Hostile work environment
- 7.5. Inadequate supervision
- 7.6. Lack of peer review
- 7.7. Leaders not fluent in the discipline
- 7.8. Outdated practices

#### 8. Materials/Tools/Equipment
- 8.1. Availability
- 8.2. Defective
- 8.3. Used incorrectly
- 8.4. Inadequate assessment of material/tool/equipment for the task

#### 9. Acceptance Testing & Commissioning
- 9.1. Not following best practice documents
- 9.2. Lack of independent review
- 9.3. Lack of review of pre-existing reports
- 9.4. Lack of effective documentation

#### 10. Equipment Design and Construction
- 10.1. Inadequate R&M for QA and QC
- 10.2. Inadequate hazard assessment
- 10.3. Inadequate design specification
- 10.4. Inadequate assessment of operational capabilities
- 10.5. Poor human factors engineering
- 10.6. Interoperability problems
- 10.7. Networking problems (IT)
- 10.8. Inadequate infrastructure
- 10.9. Poor construction (physical)

#### 11. Equipment Maintenance
- 11.1. Failure to report problems to vendor
- 11.2. Failure to follow vendor field change orders
- 11.3. Failure to provide adequate preventive maintenance
- 11.4. Failure by vendor to share failure/safety issues
- 11.5. Unavailability of local and field support

#### 12. Environment (within the facility)
- 12.1. Ergonomics (room layout, equipment setup)
- 12.2. Machine collision issues (room specific)
- 12.3. Environment (water, HVAC, electrical, gas)
- 12.4. IT infrastructure and networking issues
- 12.5. Delay in corrective actions for facility problems

#### 13. External Factors (beyond Facility Control)
- 13.1. Natural environment
- 13.2. Hazards

#### 14. Failure to detect a developing problem
- 14.1. Environmental masking
- 14.2. Distraction
- 14.3. Loss of attention
- 14.4. Inadequate information

#### 15. Failure to interpret a developing problem
- 15.1. Inadequate search
- 15.2. Missing information
- 15.3. Misinterpretation of information
- 15.4. Expectation Bias

#### 16. Failure to select the correct rule
- 16.1. Incomplete or faulty rule
- 16.2. Old or invalid rule
- 16.3. Inappropriate use of a rule

#### 17. Failure to develop an effective plan
- 17.1. Information not seen or sought
- 17.2. Inappropriate assumptions
- 17.3. Failure to recognize a hazard
- 17.4. Information misinterpreted
- 17.5. Inadequate management of change
- 17.6. Inadequate assessment of needs & risks
- 17.7. Side effects not adequately considered
- 17.8. Random options

#### 18. Failure to execute the planned action
- 18.1. Stereotype take-over/faulty triggering
- 18.2. Plan forgotten in progress
- 18.3. Plan misinterpreted
- 18.4. Plan too complicated (bounded reality)

#### 19. Patient-Related Circumstances
- 19.1. Misleading representation
- 19.2. Cognitive performance issues
- 19.3. Non-compliance
- 19.4. Language issues and comprehension
- 19.5. Patient condition, eg, physical capabilities, inability to remain still

#### 20. Human Behavior Involving Staff
- 20.1. Unsound rules, responsibilities & accountabilities
- 20.2. Acting outside one's scope of practice
- 20.3. Skil raising physical error
- 20.4. Poor judgment
- 20.5. Language and comprehension issues
- 20.6. Intentional rule violations
- 20.7. Negligence

#### 21. Other
### Action Hierarchy

<table>
<thead>
<tr>
<th></th>
<th>Stronger Actions</th>
<th>Intermediate Actions</th>
<th>Weaker Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Architectural/physical plant changes</td>
<td>Redundancy</td>
<td>Double checks</td>
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<tr>
<td></td>
<td>New device</td>
<td>Staffing increase workload decrease</td>
<td>Warnings and labels</td>
</tr>
<tr>
<td></td>
<td>Interlock</td>
<td>Software modifications</td>
<td>New procedure/policy</td>
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<tr>
<td></td>
<td>Process simplification</td>
<td>Distraction reduction</td>
<td>Training</td>
</tr>
<tr>
<td></td>
<td>Standardisation</td>
<td>Checklist/cognitive aid</td>
<td>Additional study</td>
</tr>
<tr>
<td></td>
<td>Leadership action</td>
<td>Eliminate look-alikes</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Readback</td>
<td></td>
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<tr>
<td></td>
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<td>Enhanced documentation</td>
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</table>

**US National Centre for Patient Safety (NCPS)**

### Outline

**Incident Learning**
- What is it?
- **Why should we do it?**
- How do we do it?
Radiotherapy Risk Profile

WHO Report, 2008

Analysis of incidents leading to significant adverse events to patients between 1976-2007

3125 patients affected by RT errors

• 55% planning
• 25% commissioning
• 10% treatment delivery
• 9% information transfer

Ottawa Program Summary

Annually:
• 70,000 External Beam Treatments
• ~4,000 New Patients
• ~4,700 Customised Treatment Plans

Treatment Technology:
• 12 External Beam Accelerators
  – 9 Conventional, 2 TomoTherapy, 1 CyberKnife
• 1 Orthovoltage Unit
• 1 HDR Brachytherapy Unit

Staffing
• 95 Radiation Therapists
• 18 Radiation Oncologists
• 18 Medical Physicists + 15 Technical Staff
## Incident Severity

### All Incidents

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tbody>
<tr>
<td>Critical</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Major</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Serious</td>
<td>44</td>
<td>21</td>
<td>26</td>
<td>9</td>
<td>15</td>
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<tr>
<td>Minor</td>
<td>604</td>
<td>661</td>
<td>433</td>
<td>406</td>
<td>269</td>
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Bird FE and Germain GL, 1986
Practical Loss Control Leadership Institute Publishing, Loganville, GA

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## What Have We Learned?

### Assigned Basic Cause (%)

<table>
<thead>
<tr>
<th>Basic Cause Classification</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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</thead>
<tbody>
<tr>
<td>1 Standards/Procedures/Practices</td>
<td>81.8</td>
<td>76.6</td>
<td>79.0</td>
<td>66.8</td>
<td>69.1</td>
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<tr>
<td>2 Materials/Tools/Equipment</td>
<td>1.2</td>
<td>3.0</td>
<td>1.5</td>
<td>3.8</td>
<td>2.8</td>
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<tr>
<td>3 Design</td>
<td>2.0</td>
<td>0.9</td>
<td>0.4</td>
<td>1.9</td>
<td>2.1</td>
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<tr>
<td>4 Work Planning</td>
<td>2.9</td>
<td>3.0</td>
<td>8.0</td>
<td>11.3</td>
<td>11.6</td>
</tr>
<tr>
<td>5 Communication</td>
<td>7.6</td>
<td>9.6</td>
<td>6.9</td>
<td>9.4</td>
<td>8.1</td>
</tr>
<tr>
<td>6 Knowledge/Skill</td>
<td>3.2</td>
<td>3.6</td>
<td>3.3</td>
<td>5.0</td>
<td>2.1</td>
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<tr>
<td>7 Personal Capabilities</td>
<td>0.6</td>
<td>0.2</td>
<td>0.2</td>
<td>1.2</td>
<td>3.2</td>
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<td>8 Personal Judgment</td>
<td>0.3</td>
<td>1.9</td>
<td>0.7</td>
<td>0.2</td>
<td>1.1</td>
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<tr>
<td>9 Natural Factors</td>
<td>0.3</td>
<td>0.3</td>
<td>-</td>
<td>0.2</td>
<td>-</td>
</tr>
</tbody>
</table>
**Procedures**

*The Field Guide to Understanding Human Error*
- Sidney Dekker, Ashgate 2006

- Procedures are resources for action
- Applying procedures successfully is a substantive, skillful, cognitive activity
- Procedures cannot guarantee safety. Safety comes from individuals being skillful at judging when and how they apply.
- Safety improvements come from organisations monitoring and understanding the gap between procedures and practice.

*Breaking the rules: understanding non-compliance with policies and guidelines*
- Carthey et al, BMJ 2011;343:d5283

<table>
<thead>
<tr>
<th>Category</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tbody>
<tr>
<td>Geographic miss</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>1</td>
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<tr>
<td>Incorrect shifts from setup point</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Incorrect patient treated</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Incorrect volume</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
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<tr>
<td>Shielding incorrect</td>
<td>14</td>
<td>4</td>
<td>-</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Incorrect parameter(s)</td>
<td>12</td>
<td>8</td>
<td>3</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Patient positioning error</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>CT errors</td>
<td>8</td>
<td>11</td>
<td>4</td>
<td>6</td>
<td>4</td>
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<tr>
<td>Imaging errors</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Bolus issues</td>
<td>14</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Incorrect accessories</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Incorrect dose/calculation error</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Scheduling errors</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>-</td>
<td>3</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>86</strong></td>
<td><strong>54</strong></td>
<td><strong>36</strong></td>
<td><strong>30</strong></td>
<td><strong>39</strong></td>
</tr>
</tbody>
</table>
Program Changes 2007-2011

Technology
- CMS Focal, XiO, Monaco
- Elekta XVI CBCT
- BrainLAB ExacTrac
- CyberKnife

Techniques
- IGRT
- SBRT – lung, liver, spine
- Conventional IMRT
- VMAT
- New brachytherapy techniques

AND relocation of entire RT operation, commissioning of 5 accelerators, relocation of brachytherapy suite, etc....

Interventions Introduced

General
- changes in staffing levels to concentrate effort in more vulnerable parts of the process
- modification of the quality assurance processes to focus on weaknesses in the treatment preparation process

Human Factor Error Reduction
- reduction of transcription tasks including several achieved by virtue of software upgrades
- template standardization
- treatment table indexing
- first day treatment checklists

Policy and Procedure Changes
- verbalization of treatment parameters prior to treatment delivery
- laterality policy
- documentation of overrides
5 yrs ILS in Ottawa

- Substantial decrease in non-minor incidents
- Planning incidents are numerous, have either zero or minor impact but should be addressed
- **Treatment Delivery** is the most vulnerable point in our process
- Established a “just” environment
- ILS provides rapid feedback on new initiatives/technology
- Data used to maximise efficiency and recognise educational needs

Outline

Incident Learning

- What is it?
- Why should we do it?
- **How do we do it?**
**Error Management**

Requires:
1. Recognition of inevitability of human error
2. Design & implementation of systems to reduce error-provoking tasks
3. Strengthening of defenses to limit effects of remaining errors

*Reason J, Hobbs A. Managing Maintenance Error, 2003*

NB: Human error is not a basic cause in our system!

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**ILS: Design Goals**

An incident learning system that is
- Easy to use
- Free of “blame” or “stigma”
- Driven by continuous improvement in the SYSTEM (errors are normal)
- Key to the success of the learning process: **Leadership commitment & behaviour**

**SAFETY IS A MANAGEMENT CHALLENGE, NOT A MEDICAL PROBLEM!**
**ILS Committee Members**

- Head of Radiation Oncology
- Chief, Medical Physics
- Chief, Radiation Therapy
- 1 Senior Physicist/RSO
- 2 RT Supervisors
- 3 Planning Resource Therapists
- 3 Treatment Resource Therapists
- Administrative Assistant

**Organisational Cultures**

<table>
<thead>
<tr>
<th>Pathological</th>
<th>Bureaucratic</th>
<th>Generative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not want to know</td>
<td>May not find out</td>
<td>Actively seek it</td>
</tr>
<tr>
<td>Messengers are “shot”</td>
<td>Messengers are listened to if they arrive</td>
<td>Messengers are trained and rewarded</td>
</tr>
<tr>
<td>Responsibility is shirked</td>
<td>Responsibility is compartmentalised</td>
<td>Responsibility is shared</td>
</tr>
<tr>
<td>Failure is punished or concealed</td>
<td>Failures lead to local repairs</td>
<td>Failures lead to far reaching reforms</td>
</tr>
<tr>
<td>New ideas are actively discouraged</td>
<td>New ideas often present problems</td>
<td>New ideas are welcomed</td>
</tr>
</tbody>
</table>

*Reason, J: Managing the risks of organisational accidents*
Summary

Incident Learning
- What? – Proactive measure to improve safety culture through the analysis of actual and potential events
- Why? – Physicists are responsible for the accuracy of dose delivered and have the technical and leadership skills
- How? – Multidisciplinary team effort, constant vigilance, non-judgmental

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