ERRORS IN RADIOLOGY: WHY DO WE MAKE THEM AND HOW CAN THEY BE REDUCED?

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DISCLOSURE

• The author has nothing to disclose
At the conclusion of this session, participants should be able to:

1. Demonstrate an understanding of types of errors which can occur in an imaging department

2. Recognize situations in the radiology work environment which can predispose to increased risk of errors

3. Apply knowledge from this presentation to implement changes in the department to increase standardization and safety of patient imaging care
OUTLINE

• Review of typical errors
  • Active vs latent
• Sources of errors
• Situations in the radiology work environment which can predispose to increased risk of errors
• Examples of errors
• Systems available to identify errors, modify process and reduce risks
• Utility of standardization for safety of patient imaging care
Accuracy of radiology reports is critical in making appropriate patient care decisions.

Identify “active” and “latent” sources of error in a work place to devise plans to minimize their impact.

Institute of Medicine reported that 90% of medical errors result from systemic problems rather than individual factors.

Processes may be referred to as having sharp and blunt ends

Active = sharp end of scalpel: usually person-related

- Failure of execution of a task
- Slip/lapse
- Knowledge-based
- Inadequate planning
- Behavior related failure: Intentional or motivational problems
LATENT ERROR

- Systems failure

- Blunt end – parts of the process farther away from the action itself
  - Regulators, accreditors, administrators, and designers function at the blunt end
  - Equipment design flaws (e.g. interface not intuitive)
  - Organizational flaws, such as staffing decisions that can increase the likelihood of error
ERRORS

▶ Swiss Cheese model
▶ Acknowledges that humans make mistakes
▶ Focuses on identification of an underlying system failure
▶ Safeguards, defenses, and barriers must be implemented to prevent an error
Increasing focus in radiology literature on latent errors

Patient experience from time of request to time physician acts on radiology finding, is the result of many individual steps

It is everyone’s responsibility to close up these latent holes

Lee CS et al. AJR 2013;201(3)

Reason, J Human Error: models and management. BMJ. 2000;320(7237)
CORRECTING LATENT ERRORS

- Routines can then be analyzed, potential problems identified, and amendments made if necessary, in order to prevent future errors, incidents
- Airline industry uses this area to focus on most often
Need for continuous efforts to improve quality, safety and reduce errors in health care

Balanced with efficiency and appropriateness

Quality assurance goals:

• Patient safety
• Improving efficiency
• Lowering cost
• Improving patient outcomes
DIVISION DIRECTOR

- Part of the job is quality assurance
- Identify errors, categorize active errors
- Work to identify underlying latent errors
- Make changes to reduce active & latent errors
Previously, emphasis on active/human errors including:

- FN
- SOS
- FP
- Cognitive: complacency, faulty reasoning, lack of knowledge etc.
- Other

Little emphasis on system related factors that could contribute to these errors

Peer-to-Peer Quality Initiative Program

Body Imaging Section

RE: MRN#: 12345678

Before sending a QUIP please remember to enter the case MRN into the Subject line.

Study:
Date:

Dear colleague,

Your report for the above case was recently reviewed in the light of new information which may not have been available to you.

For the purpose of quality assurance would you please have a look at the case.

Specific issue for review:

Action taken:
- [ ] case reviewed
- [ ] addendum dictated
- [ ] case discussed with attending staff
- [ ] other:

Please forward this form to both me and Brenda Lewicki identifying the action taken.

Thank you for your contribution to our ongoing departmental quality assurance program.

Sincerely,
Dr. Ana Kielar
TYPES OF ERRORS MADE BY YEAR IN DIVISION OF ABDOMINAL RADIOLOGY: FN AND SOS

- False Negative
- Cognitive Error
- Ordering Issue

QUIP 2009 - 2014

SOS
Ordering Issue
Cognitive Error
False Positive
False Negative
WHAT DID WE DO ABOUT IT?

- QUIP (Quality initiative project)
  - So that the individual learns of their error in a non-punitive fashion
- Standardized template reports
  - Case of the week (showing an anonymized error, and a pearl to reduce this in the future)
    - So that everyone can learn from our errors

CT BRAIN WITHOUT CONTRAST, <<Order Observation Time>>

INDICATION: [<<Clinical Information>>]
COMPARISON: [<<None>>]

TECHNIQUE: Axial CT images of the brain from skull base to vertex, including portions of the face and sinuses, were obtained without contrast. Supplemental 2D reformatted images were generated and reviewed as needed.

ADDITIONAL TECHNIQUE: [<<None>>]

FINDINGS:
  - Calvarium/Skull base: [<<No evidence of fracture or destructive lesion>>]. [<<Mastoids and middle ears grossly clear>>].
  - Paranasal sinuses: [<<Imaged portions clear>>].
  - Brain: [<<No evidence of acute abnormality>>]. [<<No significant white matter disease or acute ischemia>>]. [<<No mass effect, mass lesion, acute hemorrhage or hydrocephalus>>]. [<<>>].

******************************************************************************
CONCLUSION******************************************************************************
[<<No CT evidence of acute intracranial abnormality>>]. [<<>>]
******************************************************************************

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CASE OF THE WEEK

72-year-old female
Rectal cancer post surgery and chemotherapy & radiation.
Fluctuation in CEA levels.
Assess for disease status.
WHERE IS THE ERROR?
THIS WAS REPORTED AS POSSIBLE RECURRENCE WITH SOFT TISSUE IN THE PRESACRAL SAPCE
WHERE IS THE ERROR?
THIS WAS REPORTED AS POSSIBLE RECURRENCE WITH SOFT TISSUE IN THE PRESACRAL SPACE
Where is the error? This was reported as possible recurrence with soft tissue in the presacral space.
WHERE WAS THE ERROR?
Specific Error: The structure being measured was actually the uterus

Type of Error: Perceptual False Positive

Organ Involved: Uterus

Pearl to Avoid this Error:
Sagittal reformats seem to help a lot… In this case, sagittal images helpful to prevent false positive findings (normal uterus present there b/c rectum has been removed and the uterus is filling the potential space)
CORONAL REFORMATS HELP....
1. Perceptual:

- **False-positive**: An abnormality is described which is not real

Pescariani L, Inches, Radio Med 2006;111:252
FALSE POSITIVE ERROR
1. Perceptual:

- **False-negative**: An abnormality is present but is not described

- **Satisfaction-of-search**: One abnormality is described but a 2nd abnormality is not reported (form of false-negative study)
64 year old man with prostate cancer

- CECT of abdomen demonstrated retroperitoneal lymph nodes (arrow)
- Base of lungs were included and in retrospect there were filling defects in the pulmonary arteries which were not described

- A CT using PE protocol was performed same day due to sudden increasing chest pain and shortness of breath. It demonstrated bilateral pulmonary emboli (arrows)
History: Abdominal pain
- Missed metastasis to tail of pancreas
- No history of melanoma provided....
2. Cognitive:

- An abnormality is identified but the wrong diagnosis is made

(e.g. Epiploic appendagitis vs. diverticulitis)

Lee CS, et al AJR.2013;201(3):611-7
CASE INTERPRETED AS SLUGE IN GB
Emphysematous cholecystitis
3. Communication:

- Report is misinterpretable due to spelling, grammar or transcription errors
  - Ania says “Calcification”…. Computer says “ossification, concretions” etc
  - Ania says “Vascetomy”…. Computer says “mastectomy”

- Right/left
LATENT FACTORS CONTRIBUTING TO ERRORS IN RADIOLOGY

► Environmental
  • Temperature
  • Lighting
  • Ergonomics
Interruptions

- Pages
- On the fly consults
- Lectures, meetings
- Emails and smart phones?

Do telephone call interruptions have an impact on radiology resident diagnostic accuracy?

Balint BJ et al. Do telephone call interruptions have an impact on radiology resident diagnostic accuracy? Acad Radiol. 2014 Dec;21(12):1623-8
LATENT FACTORS CONTRIBUTING TO ERRORS IN RADIOLOGY

▶ Work volume
▶ Too high???
  • Studies have shown that most abnormal findings on plain radiographs are found during the first few seconds of searching the image, with the number of true-positive findings decreasing abruptly after a short time
▶ Early morning
▶ Last case

Complicated cases

- Many images and sequences to review (hard if you get interrupted)
- Lack of provided history
  - Abdominal CT quality assurance review at TOH
  - 52/350 (15.1%) of cases were missing information that may have potentially impacted either the imaging protocol chosen or the final diagnosis
Wrong imaging requested

- History provided important!!
- Many imaging modalities available
- Many protocols to choose from
LATENT FACTORS CONTRIBUTING TO ERRORS IN RADIOLOGY

Imaging Quality

- Motion artifact
- Lack of iv/oral contrast
- Previous not available on PACS
STEPS TO REDUCE ERRORS

- Identify if there is latent source
- Standardization
- Lifelong learning
M&M ROUNDS

- Means of reviewing errors and adverse events in an environment that
  - Facilitates learning
  - Encourages accountability
  - Promotes leadership
  - Promotes academic development.
QUALITY ASSURANCE

- A comprehensive goal to ensure excellent standards by collecting and evaluating data in a systematic fashion
- Performance indicators: Metrics
- Safety, process/procedure, professional satisfaction, patient outcomes
- QA helps guide decisions about clinical practice and operational management
YOU HAVE IDENTIFIED AN ERROR: NOW WHAT?

- One time thing or not?
- Communicate error in non-punitive fashion
  - Peer education/ Peer review / QUIP
- Quality assurance
  - PQI
YOU HAVE IDENTIFIED A RECURRENT ERROR: NOW WHAT?

- PDSA
- Lean management
- Kaizen
- Root cause analysis
- Six Sigma $6\sigma$
PDSA CYCLE

- Trail and learning approach
- Hypothesis -> test on small scale before making large scale changes
- System flowchart
- Observations to determine problems
- Action implemented to improve the process

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CAN BE DONE FOR ALMOST ANY TOPIC!

- Can be simple
- Can be small scale
PARACENTESIS PRACTICE ASSESSMENT

- Assessed use of pre-procedural pause, consent, time to complete paracentesis
- Medical student filled out standard form related to paracentesis observations
- Initial results (33 cases) analyzed 5 weeks into observations
- Each radiologists received email of their own results and group means/ranges
- Educational Powerpoint presented at divisional meeting
- Repeat observation for another 6 weeks (27 cases)
# PRACTICE ASSESSMENT RESULTS: TIME 16 -> 13 MIN

<table>
<thead>
<tr>
<th>Areas of Interest</th>
<th>Frequency Before Intervention (n)</th>
<th>Frequency After Intervention (n)</th>
<th>Significance (P-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outlined risk of damage to nearby structures</strong></td>
<td>24% (n=8)</td>
<td>54% (n=14)</td>
<td>0.02*</td>
</tr>
<tr>
<td><strong>Outlined risk of infection</strong></td>
<td>82% (n=27)</td>
<td>100% (n=26)</td>
<td>0.022*</td>
</tr>
<tr>
<td><strong>Outlined risk of bleeding</strong></td>
<td>91% (n=30)</td>
<td>100% (n=26)</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>Inquired about patient allergies</strong></td>
<td>36% (n=12)</td>
<td>54% (n=14)</td>
<td>0.18</td>
</tr>
<tr>
<td><strong>Inquired about patient use of blood thinners</strong></td>
<td>67% (n=22)</td>
<td>88% (n=23)</td>
<td>0.051*</td>
</tr>
<tr>
<td><strong>Inquired about patient bloodwork</strong></td>
<td>42% (n=14)</td>
<td>77% (n=20)</td>
<td>0.0078*</td>
</tr>
<tr>
<td><strong>Gave patient the opportunity to ask questions</strong></td>
<td>73% (n=24)</td>
<td>100% (n=26)</td>
<td>0.0038*</td>
</tr>
<tr>
<td><strong>Performed pre-procedural pause</strong></td>
<td>22% (n=6)</td>
<td>85% (n=22)</td>
<td>3.91E-07 *</td>
</tr>
</tbody>
</table>
LEAN AND KAIZEN MODELS

▶ These tools include the human element to traditional PDSA cycles to reduce waste, improve efficiency and implement positive change

▶ Takes into account importance of human relations and workplace culture as a key component required for sustained change
  
  • Culture

▶ Kaizen = "change for better"
SIX SIGMA

- More complex analysis
- Set of techniques and tools for process improvement
- Goal: to improve quality of a process by identifying and removing the causes of defects and minimizing variability in processes
- Uses empirical & statistical methods
- A six sigma process is one in which 99.99966% of all opportunities to produce some “part” are statistically expected to be free of defects (3.4 defective features per million opportunities)
DMAIC (acronym for Define, Measure, Analyze, Improve and Control)
ROOT CAUSE ANALYSIS

- Perform promptly after event
- Applies to errors, sentinel events or near misses
- Retrospective process
- 4-10 people with various roles
- Fishbone (cause and effect) diagram
ROOT CAUSE ANALYSIS

- Determine both human factors and systems associated with the sentinel event

- Analyze the underlying systems and process though a series of “why” questions to determine where risk occurred in an attempt to redesign a system

- Identify risk points and their contributions towards an adverse event

- Determine improvement process that may lead to future reduction in likelihood for future similar events
ROOT CAUSE ANALYSIS

- Who/What/When/Where/How?
- Should be a no blame discussion…
- “What factors were responsible” rather than “Who is responsible?”
- Confidentially of the reporting within the RCA process
  - Code of silence develops otherwise
WHAT I HAVE LEARNED?

► A lot more to learn about these techniques....

► Don’t make mountains out of molehills
  • If something goes wrong.... Once.... Do we really need new policies and procedures for everything? Depends on how serious the error was
  • However, people involved need to know about it and have an opportunity to learn

► Small steps until you can take bigger steps
  • A work in progress
WHAT WE HAVE IMPLEMENTED IN PAST FEW YEARS

- Common reporting rooms (abdomen, chest, MSK, neuro etc)
  - Can discuss unusual cases and help each other
  - Increased accountability
  - Easier for technologists and clinicians to find help

- Standardized template reporting

- Radiology-specific M&M rounds

- Evidence-based reporting standards
  - BIRADS, LIRADS, PIRADS, TIRADS etc
STANDARDIZED REPORTS

- Reduces risks of satisfaction-of-search errors
  - Complex cases (pancreatic tumor staging)
  - Learners ensure they look at all structures
- Looks professional
- Faster for specialists to look up area they are interested in
- Faster for radiologists to perform comparisons?
CONCLUSIONS

- There are many possible active and latent factors contributing to errors in radiology
- Identify them
- Communicate them in non-punitive fashion
- If repeated errors, use tools to study them and develop systems/processes to help reduce the holes in your Swiss cheese
- Life long learning
REFERENCES


