What we have learned from RO-ILS
Part 2: After the patient is on the table

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Conflict of interest statement
- Current member of the Radiation Oncology Healthcare Advisory Council

What have we learned?
- Common pathways
- Case examples
- Mitigation strategies
- Common threads for ongoing analysis
Flow of where errors occur in radiation oncology

Before Simulation
Pre-Planning Imaging and Simulation
Treatment Planning
Pre-Treatment QA Review (ex: Physics Plan Check)
After Treatment Course is Finished

Frequency distribution of where Events occur

For every ONE critical incident

It is expected that

600

minor incidents have occurred
Submission to the RO-ILS Portal is the first step in the improvement process.

- Aggregate data analysis
- Identification of common error pathways
- Proposal of mitigation strategies

Thinking about error pathways

Categorizing the data

Incident reports commonly fall into one of the following buckets:

- Imaging
- Shifts
- Target selection
- Communication
- Haste
- Changes
- Motion management
- Prior treatments
- Treatment Planning
- Other
Common error pathways

- Patient misidentification
- Incorrect setup
- Problem with reference images
- Lack of IGRT instruction – how to align
- Erroneous IGRT analysis
- Gating error
- Shift error – instruction or implementation
- Equipment down
- Communication
- Rushing

As of Q3 2016, 2344 events had been submitted to RO-ILS
- 39% of those events had been given a severity score of 3.5 or higher
- 60 of those 39% (1.5%) involved imaging errors during treatment
- 51 of those 39% (1.3%) involved shift errors during treatment

Severity score:
- 1: no potential or real harm
- 2: mild potential or real harm
- 3: moderate potential or real harm
- 4: severe potential or real harm
- 5: critical potential or real harm

Error pathways

- Severity score 1: no potential or real harm
- Severity score 2: mild potential or real harm
- Severity score 3: moderate potential or real harm
- Severity score 4: severe potential or real harm
- Severity score 5: critical potential or real harm
In 2016, radiation therapists discovered more incidents than any other group.
Therapists discovered 396 of 815 reported events for which the reporter role was identified.
A patient with metastatic disease was planned for treatment to her spine. The therapists set up the patient according to the documented instruction. Unfortunately, the noted longitudinal shifts were incorrect and those shifts were applied. MV portal images were taken and reviewed by the therapists. Anterior/posterior and lateral alignment looked reasonable, but the erroneous longitudinal position went unnoticed. The patient was treated on her skin. That evening, the attending physician reviewed and approved the portal films.

The patient returned for treatment the next day and the same treatment was repeated.

On the third day, the patient happened to be scheduled on a different accelerator with a new set of therapists. The therapists noted that the non-permanent skin marks were superior to where they expected them to be. The patient was set up to her original tattoos and KV images were acquired. The error was discovered and the treatment was carried out appropriately.
Mitigation Strategies

- Redundant checks/approvals of new patient marks following shifts
- Graphical illustration of shifts
- Minimization of hand-entered shift instruction
  - There is greater risk when shifts are driven by hand-typed setup notes
  - Planned shifts should be transferred to localization data fields within the R&T system
- Automated vertebral body identification

Common Error Pathways - IGRT

Case example – wrong DRRs

- A patient was being treated with a routine course of radiation therapy. Image guided setups were used daily with orthogonal DRRs.
- During the planning process, the dosimetrist had moved the isocenter in order to improve the dose distribution. Unfortunately, the exported DRRs were from an original plan which had a different isocenter.
- Planning DRRs and port films were matched daily, but the patient completed his treatment.
- The incorrect DRRs and geometric treatment miss were found through a routine post-completion review of the patient’s EMR.
Mitigation Strategies

- Redundant checks of the planned and imaging isocenter
  - Physical QA
  - Therapist QA
- Resist autopilot – employ critical thinking with IGRT analysis

More IGRT errors and mitigations

- Poor quality reference image(s)
  - Image quality review for visibility, use technique protocols
- Challenging anatomy
  - Use local high resolution images or phantom bodies, utilize CT protocols, training, and clearly identified landmarks
- Omission of IGRT
  - Review documented instruction and compliance regularly, utilize treatment calendars
- Accidental keystrokes during the fusion/shift process
  - Double check for correct alignment using reference images; review of reference images should be included
- Erroneous IGRT analysis
  - Ensure clear communication from MD regarding what proper alignment should be based on and include with regular QA checks

Common error pathways - Shifts
Case Example- shift documentation

- An SBRT lung patient underwent a verification simulation on the linear accelerator the day before he was to begin his therapy. It was determined that a 0.3 cm anterior shift was required and that was handwritten on a standard documentation worksheet.
- Per standard procedure, the shift was then transcribed into the record and verify system but was entered as 3.0 cm.
- The following day, the patient was set up and shifted 3.0 cm anterior. Fortunately, the error was caught on imaging and the patient was ultimately treated in the correct position.

Mitigation Strategies

- Automated shift calculations and documentation
- Redundant checks/read-back of any manual shift documentation
- Re-imaging policy for shifts beyond a certain magnitude
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- Redundant checks/read-back of any manual shift documentation
- Re-imaging policy for shifts beyond a certain magnitude

More shift errors and mitigations

- Miscommunication from dosimetry
  - Poor communication with patient
  - Incorrect shift entry
- Incorrect association of the isocenter in the R&V system
  - Ensure correct isocenter association between beam and image data sources
- Confusion due to a feet-first or prone patient position
  - Proper patient identification in the simulation and planning software
  - Incorporate additional time into the shift process
- Misunderstanding of how the shift software uses and applies shifts
  - Consider additional training on shift software and process
Contributing Factors
The common threads: Technology

- Technological advancement both protects and contributes to incidents
  - Increased level of automation
  - New safety features
  - Increased complexity
- The need to stay current with advancing technology is matched with by the need for information sharing around resultant events

Contributing Factors
The common threads: Rushing

- The domino effect - rushing to start a patient after simulation
  - WHY: Physician contouring -> Planning -> QA -> Treatment
  - MITIGATION: Define expectations, communicate, and schedule smartly
- Machine schedule - running behind
  - WHY: Machine down, sick patients, patient volume, you name it!
  - MITIGATION: Do not schedule unrealistically, communicate delays, look for systematic improvements

Contributing Factors
The common threads: Communication

- Standardization is key
  - Prescriptions and directives
  - Treatment plan documentation
  - Clinical treatment notes and standardization
  - Patient setup instructions
- We rely on teamwork
  - Therapy teams sometimes divide and conquer but there is a delicate balance
  - Minimize disruption and hand-offs in workflows (in all areas)
Contributing Factors
The Common threads: Focus

- We are all only human... but...
  - There is a time and a place.
  - Radiation console areas should be protected spaces.
  - Team discussions about disruptions and a focused environment should be hosted periodically and as needed.
  - A forum for communication should exist so that anonymous/protected messages can be sent to leadership when this issue needs to be readdressed.

Most issues are not unique to one organization or clinical team.

- Systematic solutions can be very effective at reducing errors.
  - Automation
  - Checklists.

RO-ILS reports allow for the identification of common error pathways and will pave the way for mitigation strategy recommendations.

Macroscopic lessons learned from RO-ILS

- Regular feedback is a key part of incident learning.
  - From in-house safety incidents.
  - From external reported events.

- We've all been there...
  - A non-punitive incident learning environment is key.
  - Information sharing should be encouraged and commended.

The value of information sharing
Think about your own department’s safety culture