NSIR-RT BULLETIN

Welcome to the electronic bulletin for the National System for Incident Reporting - Radiation Treatment (NSIR-RT). This Bulletin supports continuous learning from incident data through the presentation of data trends and case studies. It will also provide system users with information on program developments and enhancements.

Highlights

NSIR-RT Pilot Evaluation

CIHI has released the NSIR-RT Pilot Evaluation Report describing feedback received and itemizing the priority changes to the NSIR-RT Minimum Data Set and system.

NSIR-RT Advisory Committee

The NSIR-RT Advisory Committee has been struck to oversee the operation and evolution of NSIR-RT to assure that it meets the current and future needs of the Canadian radiation treatment community. This NISR-RT Bulletin is one of the ways the Advisory Committee will communicate incident data and information.

Automation Bias in Radiation Treatment

Overview

To increase safety, efficiency, capacity and performance, automation has been widely integrated into the aviation, auto, power and healthcare industries and has had a positive effect on the planning and delivery of radiation treatment. However, the increase in automation can present involuntary challenges for users (Gouraud, Delorme et al. 2017). In 2016, the Institute for Safe Medication Practices in Canada (ISMP) issued a safety bulletin describing human over reliance on technology, using the analysis of an incident submitted through the National System for Incident Reporting (Cohen, Smetzer 2017). They highlighted two involuntary cognitive shortcuts: automation bias, and automation complacency.

Automation bias is the tendency to rely more heavily on cues and decisions provided by technology than on human reasoning and decision making (Cohen, Smetzer 2017). Automation complacency may occur when users have developed over-confidence in technology, vigilance has declined as experience with the system has increased, and users have lost sight that information coming from the system has, at some critical points, originally been inputted by a person (Browne, Cook 2011, Cohen, Smetzer 2017, Gouraud, Delorme et al. 2017). Furthermore, automation can fail users in two ways: 1) a failure of omission (providing no advice) and 2) a failure of commission (providing incorrect advice) (Goddard, Roudsari et al. 2012, Wickens, Clegg et al. 2015).

A review of the anonymous voluntarily-reported NSIR-RT incidents was conducted and several examples of automation errors in Canadian radiation treatment were found. The cases described below illustrate the breadth of incidents that can occur as a result of automation processes.

By the Numbers

Incident Submitted: 2,456

Actual Incidents: 1,412

Severity: None (1,141), Mild (243), Moderate (24), Severe (4)

Incident Investigation Courses

Radiation Treatment Incident Investigation and Learning

In November 2017 and again in April 2018 CPQR held a 7-week online course *Radiation Treatment Incident Investigation and Analysis* course designed to provide a foundation for the rigorous and harmonized investigation and reporting of radiation treatment incidents at the local, regional and national levels. Participants have found that the course helped increase their understanding of incident classification systems through interactive sessions and assignments. CPQR is considering offering the course again so please stay tuned for more information.

Case Study 1: Automation Bias of Omission

Incident Description

A patient receiving whole brain treatment, was in a cast, set up and imaged on the right lateral with collimator angle of zero degrees from the imaging reference field. After the image match was completed, the right lateral treatment field was moded-up. When the radiation therapists ran through checks of parameters, there were no interlocks on the record-and-verify screen. The right lateral treatment field was initiated. At 114 MUs delivered, therapist noticed the field shape did not appear correct and stopped beam delivery. Therapist noted the planned collimator angle should have been 27 degrees but was being treated at zero degrees. There were no flags or interlocks warning to rotate the collimator to the planned angle of 27 degrees. Collimator was set to the planned angle of 27 degrees and remaining MU's of the right lateral treatment field were delivered correctly and left lateral treatment field was completed without incident.

Investigation

Upon investigation, it was determined that there was a recent procedural change to the whole brain technique. Whole brain patients were now being casted and planned, rather than using a clinical mark-up (CMU). The record-and-verify system tolerance table for whole brain CMU that provided a wide collimator angle range (30 degrees) before initiating an interlock had not been removed from the treatment planning system and was mistakenly linked to the plan. The collimator discrepancy of 27 degrees was therefore not flagged, and the beam was allowed to initiate until noted by the radiation therapist by chance.

Following the incident, the CMU Whole Brain tolerance table was deactivated and no longer available for clinical use. All patients who had been treated since the change in practice were reviewed for possible undetected incidents.

Case Study 2: Automation Bias of Commission

Incident Description

A patient was set-up in a treatment room for a clinical mark-up (CMU) whole brain treatment. The left lateral field was set-up to match field edge supra-orbital ridge to inferior tragal notch, requiring collimator

angle of 356 degrees. At the treatment console, the software prompted the therapist to auto enable the default planned collimator angle of 330 degrees to prevent an interlock and override. The therapist accidentally motion-enabled the collimator angle back to the planned angle of 330 degrees and the full treatment field delivered at a discrepancy of 26 degrees.

Investigation

The incident was not noted until the CMU was set up for the right lateral field and the resulting investigation showed that the technology of the machine system prompted an incorrect action, that was not questioned by the user, leading to error.

Case Study 3: Override Fatigue

Incident Description

A patient was IMRT inverse planned including two non-coplanar treatment angles. On the patient's second fraction the patient was setup, underwent a cone beam CT and had begun treatment. This particular day the patient was transferred from another unit and as per the program's policy the patient's beams were not yet auto-sequenced. This required a treatment override for each beam to acknowledge the discrepancy in treatment machines. Upon completion of the coplanar beams, the prompt for the treatment unit override arose in conjunction with the override indicating the beam parameter of the couch was out of tolerance. The couch angle planned for 90 degrees was delivered with the couch at zero degrees for 70 MUs.

Investigation

The incident was recognized, beam terminated, and the incident reported. This case illustrates override fatigue as a form of automation bias which is classified as expectation bias in the NSIR-RT minimum data set and illustrates how humans performing regular tasks can become predisposed to rely on cues from the regular use of technology and subconsciously stray from active decision making.

Discussion

Errors related to automation biases and complacency can propagate when alerts or overrides become so normal that users become desensitized to the warnings they impart causing them to lose their effectiveness as a safety barrier. As highlighted in Case Study 3, override responses when repetitive, can increase the propensity for errors. This alert fatigue has been studied within electronic decision-making support systems for medication prescribing and ordering which were developed as an aid to reduce medication errors and drug interactions by offering warning alerts for high risk scenarios (Ancker, Edwards et a. 2017, Baysari, Tariq et al. 2017). In this setting, alert fatigue was more common as the number of alerts increased and were perceived to be less informative (Ancker, Edwards et al. 2017), or when the process of overriding alerts became more habitual (Baysari, Tariq et al. 2017). In radiation treatment, alerts, warnings, interlocks and the subsequent acknowledgement or override processes are designed to improve the safety of radiation treatment delivery. However, NSIR-RT incident data suggests

that improved safety is not always the case. While a more fulsome investigation into how automation processes can be adjusted to reduce the likelihood of automation biases or override failure is beyond the scope of this article, a review of the NSIR-RT incident data does suggest some recommendations for consideration by radiation treatment programs.

Recommendations

Programmatic

- Conduct a **failure mode effects analysis (FEMA)** when changing technology. As was noted in the ISMP Canada Safety Bulletin (Cohen, Smetzer 2017) conducting a FEMA to identify where within a process or technology an error could occur will help minimize the occurrence of errors resulting from changes to technology. People have a tendency to trust technology implicitly; adequate FEMA will help ensure that integrated automation processes are accurate.
- Incorporate periodic **reviews of hardware and software parameters** into Radiation Treatment Quality and Safety Committee (RTQAC) processes and facilitate the modification of these parameters, as needed, to prevent incidents and incident recurrence.

Clinical/Staff

- According to research (Skitka, Mosier, & Burdick, 2000), **training** that focuses specifically on automation bias and associated errors has been seen to successfully reduce commission, but not omission, errors. Team leaders should bear this in mind when training staff on automated techniques.
- **Adjusting the circumstances surrounding automated processes**, either by altering how these are displayed, or responded to, or by turning the automation off for a set amount of time to reset staff expectations can increase the attention staff pay to alerts or overrides (Parasuraman, Mouloua, & Molloy, 1996).
- Multi-tasking and team work is intrinsically integrated into the workflow of radiation treatment units. In such environments, creating a process to allow truly **independent double-checks** of plans and set ups, and ensuring that these checks are not conducted while simultaneously doing other tasks, can serve as a safety barrier should an error resulting from automation occur.

Conclusion

While automated processes can increase the consistent delivery of safe radiation treatment, over-reliance on automation can result in errors. Creating programmatic and clinical processes that counter override fatigue or automation biases can help mitigate these errors and can ensure an appropriate focus remains on clinical judgement and decision making.

References available at the end of the Bulletin

NSIR-RT: Better data. Better analysis. Better Decisions.

Whether you have submitted only one, or a thousand and one incidents, you can use NSIR-RT data to help identify patient safety issues, and find recommendations on how other NSIR participants have addressed similar systemic flaws.

Exploring incidents in NSIR-RT

It is easy to generate results with the NSIR-RT analytical tool. Here are some tips:

1. Explore the tool

The tool will prompt you with a series of questions that apply parameters around the data to isolate the incidents relevant to your question. You will quickly learn how to get the information you are looking for.

Benefits include:

- You will see your data in action and can discuss findings with staff. No more black holes.
- You will quickly become an expert on the NSIR-RT MDS (Minimum Data Set), which will come in handy when coding future incidents

2. Cast a wide net

Start by running reports using all the data elements and values that might be relevant to your concept of interest, then refine your search. Other users/facilities may not code incidents exactly the same way you do, so cast a wide net and then scan the data to find what you need.

3. Ask for help

You may have questions or you may find that the NSIR-RT analytical tool does not easily or intuitively produce the targeted analysis you want. Let us know at nsir@cihi.ca, we can help and we can also refer your clinical questions to the NSIR-RT Advisory Committee.

Added bonus: Your feedback on the analytical tool helps us understand what kinds of reports facilities are interested in running, which will help to inform the development of future reports.

Case Study References

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