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Identifying and managing latent safety threats through a zone-wide emergency department in-situ multidiscipline simulation program: A quality improvement project

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Abstract

Background: Latent safety threats (LSTs) are system-based issues that threaten patient safety, which can materialize at any time and were previously unrecognized. While LSTs such as system deficiencies, equipment failures, training, or conditions predisposing medical errors are frequently reported in the literature, a paucity was noted in their management and mitigation. The purpose of this quality improvement project was to utilize translational simulations to identify, manage, and mitigate future latent safety threats in our EDs.

Methods: In 2017, 18 in-situ inter-professional simulation sessions were conducted at 11 EDs. Following each session, a survey assessment tool was completed by participants to identify LSTs. Findings were shared with site educators and managers to facilitate institutional follow up. For reporting, LSTs were categorized thematically and coded as either (i) resolved, (ii) ongoing, or (iii) not managed. Site follow-ups were completed at six months, one, and two years following the simulation.

Results: A total *n* = 158 LSTs were identified. The number and percentage by theme were: staff 48 (30.4%), equipment 41 (25.9%), medications 33 (20.9%), resuscitation resources 24 (15.2%), and information technology (IT) issues 12 (7.6%). Twelve-month follow-up identified 149 LSTs resolved and nine required ongoing work to manage. Two-year follow-up identified all but two LSTs resolved. No occurrences of an LST 'not managed' were identified.

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Conclusions: Translation simulation effectively identified LSTs. Through the creation of a structured plan and systematic long-term follow-up, all identified threats were addressed while a limited number required ongoing management.

Keywords: latent safety threat, in-situ simulation, translational simulation, quality improvement, resuscitation

Introduction/Background

Emergency departments (EDs) have a great potential for adverse events. Errors in care result from the increased acuity, complexity, and high-pressure environment. In the United States, yearly, approximately 400,000 hospitalized patients suffer from some form of preventable harm including and around 100,000 patients who die in hospitals and clinics. (Rodziewicz et al., 2021). Many adverse events result from flaws in design, organization, or equipment. These types of preventable errors are referred to as latent safety threats, and may not be apparent to the healthcare team until the adverse event occurs (Patterson et al., 2013). Translational simulation describes healthcare simulation focused directly on improving patient care and healthcare systems, through diagnosing safety and performance issues and delivering simulation-based intervention, irrespective of the location, modality or content (Brazil, 2017). Previous studies conducted in ED and intensive care unit (ICU) settings have demonstrated the effectiveness of translational simulation in proactively identifying latent safety threats thereby creating an opportunity for teams to prevent negative effects before patient care is compromised (Patterson et al., 2013; Petrosoniak et al., 2017; Knight et al., 2018). In addition, a comprehensive process has been proposed to test new departments through simulation (Adler et al., 2018; Barlow et al., 2017). However, despite these efforts highlighting that latent safety threats are common and identifiable through simulation, there is limited evidence on how latent safety threats are effectively managed. The primary objective of this project was to improve quality of care and patient safety by utilizing translational in-situ inter-professional simulation to identify, manage, and mitigate latent safety threats in the ED. Secondary objectives included identification of common latent safety threats between EDs, and determination of standardized quality improvement activities for implementation across the local hospital network.

Methods

Simulation

In 2017, as part of an Edmonton Zone Quality Improvement (QI) Initiative, a translational in-situ multidisciplinary simulation strategy was employed using cross-sectional qualitative QI study methodology. The cumulative patient census of the departments was over 500,000 per year. Prior to commencement of the program, a needs assessment was distributed to participating sites, and data collected aided in content development. A standardized library of simulations was developed and peer reviewed. A total of 18 simulations were completed in 11 EDs. Each simulation consisted of three scenarios and was conducted over four hours, with an adult or pediatric focus.

The simulations were facilitated by a clinical nurse specialist, an adult or pediatric emergency physician, and a simulation consultant. The sessions were open to all site-based ED staff including nurses, physicians, pharmacists, nurse practitioners, and respiratory therapists. Trainees were not included in these simulations. The scenarios were conducted in-situ, similar to previous work (Couto et al., 2018), allowing the inter-professional teams to interact in their own environment, affording the assessment of systemic competence, and detection of latent safety threats.

Prior to engaging in the simulation scenario, participant groups received a pre-brief highlighting the purpose of translational simulation and the intent of identifying latent safety threats in their clinical space. Following each of the three scenarios, facilitators guided a group debrief with particular attention to elicit any latent safety threats. The debriefs were modelled after the PEARLS framework (promoting excellence and reflective learning in simulation) approach, a blended approach that consists of self-assessment, focused discussion, and directed feedback (Eppich & Cheng, 2015). After each simulation, the participants received a QI survey to provide anonymous feedback on the simulations themselves, as well as any system, medical, equipment, or safety threats that they identified. (Appendix A) This survey was created a priori by the research team and based on face validity from expert level consultation with key stakeholders.

Simulation follow-up and latent safety threat mitigation

Within a week of the simulation, the facilitators and the local participating nurse educator completed a separate feedback form (Appendix B) and a copy submitted to the unit manager. This form collated participant, facilitator, and nurse educator perspectives on latent safety threats, identified barriers to change and proposed a plan to improve quality care and mitigate the identified LSTs. The clinical nurse specialist conducted follow-up with the site educator and manager at 6, 12, and 24 months following the simulation. Sites self-reported LSTs mitigation status. The purpose of this follow-up was to determine if a risk reduction strategy was successfully implemented for each identified issue, and if particular latent safety threats had been resolved, required ongoing work to manage, or were not managed. Outcome consensus between the three staff was required.

In addition to the site-specific reduction of latent safety threats, an analysis of all latent safety threats across sites was conducted, identifying a saturation of common themes. Identified themes directly impacting patient safety were brought up at zone quality meetings to assess for common mitigation strategies. Organizational learnings were shared with provincial groups. Following this successful pilot, the initiative has been mandated and supported by local quality leads and directors and has continued as previously described.

Data analysis

Twelve-month site follow up of latent safety threats are reported. Simulation participant survey results were described and categorized thematically. Results were compiled and independently analyzed by two researchers (MC, DOD). Participant comments

regarding specific latent safety threats were independently coded into themes in an emergent fashion by two researchers (MC, DOD). Any disagreements were resolved by a third researcher (WM). Results from the site-specific follow-up surveys were reported as frequency data of whether latent safety threats were managed or not. The examination for common latent safety threats are reported both descriptively and numerically.

Ethics

A Research Ethics Community Consensus Initiative Screening Tool was utilized and determined this work was quality improvement and program evaluation contexts, and was of minimal risk to participants (https://arecci.albertainnovates.ca/). Review by the University of Alberta Ethics Board agreed with this assessment and waived ethics. SQUIRE reporting guidelines (Ogrinc et al. 2015) were followed for manuscript preparation (see Appendix C for reviewer checklist).

Results

A total of 158 latent safety threats were identified using translational in-situ simulations. The number and percentage by theme were: staff 48 (30.4%), equipment 41 (25.9%), medications 33 (20.9%), resuscitation resources 24 (15.2%), and IT issues 12 (7.6%). Six- and twelve-month site follow ups revealed all identified latent safety threats were addressed with 149 latent safety threats resolved (Table 1) and the remaining nine required ongoing efforts to manage after this 12-month review (Table 2). All outcomes were unanimously agreed upon by the site educator, manager, and the clinical nurse specialist. There were no cases of unmanaged latent safety threats. Common threats were identified in multiple EDs that benefited from common quality improvement measures. See Table 3 for description of common specific latent safety threats and the mitigating quality improvement measure that took place at the organizational level.

Table 1

Numbers of Identified Latent Safety Threats and 12-Month Resolution

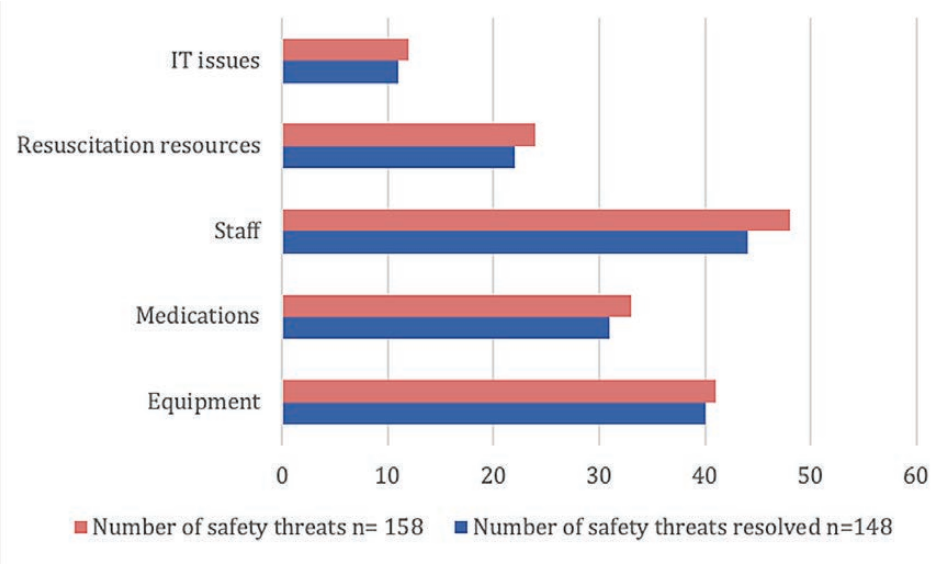

Table 2

Description of Ongoing Threats at 12-Month Follow-Up by Theme

Resuscitation resources	• Code cart only used in one third of the scenarios • Resuscitation room too small
IT issues	• Lack of Website access to resources such as UptoDate
Staff	• Ineffective adenosine administration with stopcock flush • Blood hung by gravity rather than under pressure bag • No fluid warmer used • No respiratory therapist during the night or on shift
Medications	• Missing medications in crash cart to assist with intubation • Parental manual had different administration times between pediatric and adult patients

Table 3

Common Identified Latent Safety Threats in Multiple EDs and Mitigating QI Measures

Latent safety threat theme	Latent safety threat details	Quality improvement measure
Medication	Medication cart far from room and difficulty finding medications and supplies within it	Resuscitation room medication cart created with medications and supplies re-organized
Medication	Particular medications or concentrations missing	Created standardized ED medication list
Medication	Difficulty with pediatric medication calculation during resuscitation	Pediatric calculator uploaded onto resuscitation computers and website
Equipment	Lacking easily accessible procedural equipment like central line & chest tube	Created dedicated procedural kits/boxes
Equipment	Equipment failure including laryngoscopy light not working, overhead infant warmer broken, transvenous pacer balloon failed	Supply carts checked and malfunctioning equipment replaced
Equipment	Unnecessary supplies in room taking up space (e.g., eye cart, suturing cart)	Cleared out resuscitation rooms
Equipment	Non-appropriate equipment identified (e.g., pentastarch IV fluid, trochanter chest tubes, out-of-date Broselow tapes)	Removed and replaced where appropriate
Staff /equipment	No 24/7 respiratory therapist (RT) for BIPAP starts	Ordered Heated Humidified High Flow Nasal Cannula (Airvo) units and trained RNs to utilize to temporize prior to transfer
Staff	Intraosseous placement training lacking	Nursing educational sessions set up for supporting competency and currency
Resuscitation resource	Pediatric cart lacked key supplies, difficult to navigate & find items	Instituted standardized pediatric resuscitation cart and monthly checks
Resuscitation resource	Computer in the room continuously logs out, and the printer doesn't work	Checked all the computers in the room, and fixed printing issue
Resuscitation resource	Delay accessing clinical resources (parental manual, procedural reference, & physician specific resources such as order sets)	Created and maintained a site and zone website as a single point of reference
Resuscitation resource	Delay in mixing infusions (multiple medications and occasions) due in part to not having equipment located together, having to look up mixing and admin instructions	Created a standardized resuscitation focused cart where medications and supplies are grouped together including medication labels with mixing and administration instructions

Following the 12-month follow up and prior to manuscript preparation, a subsequent two-year review was conducted in an identical fashion to the previous reviews to assess the ongoing threats. Eight threats (including one present at multiple sites) from Table 2 were reported to be resolved and two remained due to operational, system, and organizational limitations: building a larger resuscitation room, and increased staffing of a respiratory therapist.

Discussion

The translational simulation quality improvement project successfully identified latent safety threats and supports the recommendation that interdisciplinary simulations should occur across ED teams on a regular basis to support skill retention and improved performance, while promoting high-quality and collaborative care (Heart and Stroke Foundation of Canada, 2020; Kaba et al., 2018). Translational in-situ simulation allows inter-professional teams to identify and mitigate potential errors before reaching patients (Halamek, 2013). When system errors are addressed through a team, the burden on the single provider is lessened and assists in negating individual blame (Van Beuzekom et al., 2010). Exposing and discussing latent risk factors utilizing facilitated debrief following simulated events helps define organizational, management, and environmental factors and facilitates the identification of effective interventions (Van Beuzekom et al., 2010; Zimmerman, 2015).

To ensure lasting change in improving patient safety, our work highlights the importance of continuous follow-up to achieve successful threat mitigation. We noted that on 12-month follow-up, 10 threats remained but required ongoing management to alleviate. Previous work identifies that remaining latent safety threats after this time period are not unexpected (Dadiz, et al. 2020). However, at two-year follow-up, eight of the remaining 10 threats were mitigated. For the two remaining latent safety threats, a) lack of resuscitation space, and b) missing an RRT or key staff, both have been reduced as best as possible given the organizational context and resources. In the case of limited resuscitation space, this has been improved by removing non-resuscitation equipment from the room to maximize the available space. For the decreased number of available RRT, the EDs have provided additional training and support to RN staff.

Our translational simulation quality improvement project integrated a systematic framework. This has been recently well described by Nickson et al. (2021) as an operational approach to implementing translation simulation into practice by exploring environments and targeting interventions focused on clinical performance and quality outcomes. The approach of the systematic framework is based on an input-process-output approach. Our quality improvement project focused significantly on what Nickson et al. (2021) describe as the output stage and our threat mitigation practice practices appeared similar to their described practice of assigning ownership of the identified threats to the operational decision maker/site leadership, and using focused follow up to ensure resolution. This appeared aligned with the emerging literature (Dadiz et al., 2020; Petrosoniak et al., 2019). Without diligent attention to this phase, we do not feel we would have been able to achieve the lasting change in mitigating threats to patient safety.

An unintended consequence of this work was the realization that our findings of common themes are generalizable to the wider province and potentially nationally and internationally. This work was shared provincially to help inform a process improvement plan for all EDs within Alberta. A number of latent safety threats were able to be managed by a broad organizational learning strategy where one threat found in a single ED elucidated change for all the sites. For example, the identification that an inappropriate volume expander (pentastarch) was being stocked in local EDs led to a province-wide process to remove this fluid from all EDs.

Limitations

Our work has limitations, including the nature of our cross-sectional qualitative QI study methodology. We included a convenience sample, which may have resulted in sampling and selection bias of participants.

We did not specifically assess interconnection of threats, though we did find that during the threat mitigation process following the simulation, multiple intervention strategies were often required to address a threat such as equipment layout, process change, and staff training (Dadiz et al., 2020). We feel the interconnectedness of common latent safety threats within the ED is an area of interest for future study.

Conclusions

Translational simulation effectively and consistently identified latent safety threats in all EDs studied with common themes emerging. The systematic creation of a structured plan involving a threat mitigation strategy and follow-up resolved most latent safety threats, with a small number requiring ongoing work to manage. Using translational in-situ inter-professional simulation to identify system issues allows staff to anticipate barriers to care in the actual clinical environment prior to them happening. Once identified, these latent safety threats can be addressed, which directly impacts patient safety.

Takeaways for bedside emergency nurses

- Latent safety threats are common in emergency departments and translational in-situ inter-professional simulation can effectively identify them.
- Using a structured debrief and sustained follow up process resulted in all latent safety threats being identified, mitigated, resolved, or effectively managed.
- Latent safety threat themes were identified and generalizable to the multiple EDs allowing for a collaborative quality improved approach.

Acknowledgments

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Conflict(s) of interest

We, the authors, declare no conflicts of interest.

CRediT author statement

Domhnall O'Dochartaigh, investigation, data curation, formal analysis, writing-reviewing and editing; Lisa T. L. Ying, writing-reviewing and editing; Kristin Simard, investigation, writing-reviewing and editing; Christina Eichorst, investigation, writing-review and editing; Alyshah Kaba, writing-reviewing and editing, Lorissa Mews, conceptualization, methodology, investigation, writing-review and editing; Melissa Chan, supervision, conceptualization, methodology, investigation, data curation, formal analysis, writing-review and editing; Taryn Brown, conceptualization, investigation, methodology, writing-review and editing; Allison Kirkham, investigation, writing-reviewing and editing; Warren Ma, supervision, investigation, formal analysis, writing-review and editing.

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Appendix A

GENERAL POST-SIMULATION FEEDBACK FORM

Date/ED Site: _____

Please list the simulation topic(s) covered: _____

Please list your role in the simulation (ex MD, nurse, RRT, etc): _____

Please rate your agreement with the following statements:

The simulation achieved the stated learning objectives.

Strongly Disagree Disagree Neutral Agree Strongly Agree

The simulation scenario(s) represented a real-life situation.

Strongly Disagree Disagree Neutral Agree Strongly Agree

I was able to suspend belief during the simulation scenario(s).

Strongly Disagree Disagree Neutral Agree Strongly Agree

I felt that the learning environment was safe

Strongly Disagree Disagree Neutral Agree Strongly Agree

The debriefing session(s) generated useful discussion amongst the group.

Strongly Disagree Disagree Neutral Agree Strongly Agree

The knowledge gained from the scenario(s) will be helpful to me in practice.

Strongly Disagree Disagree Neutral Agree Strongly Agree

The crisis resource management experience gained from the scenario(s) will be helpful in practice.

Strongly Disagree Disagree Neutral Agree Strongly Agree

Please select which CanMeds Roles you feel were covered in the simulation today.

Professional Communicator Collaborator Scholar Health Advocate Leader

Was there any bias you identified today?

Yes No **If you selected "Yes", can you please describe the bias you identified:**

_____

_____

1. ***What did you like most about this session? Any suggestions for improvement?***

_____

_____

2. ***What systems issues were identified during the simulation (e.g., unable to find/don't know how to use equipment, dosing information not available, etc…)?*** **PLEASE BE SPECIFIC**

_____

_____

3. ***Any suggestions on ways to improve system issues?***

_____

_____

Appendix B

GENERAL POST-SIMULATION FEEDBACK FORM – CNEs

Please list the simulation topic(s) covered: _____

Please list your site:

1) What systems issues, or latent safety threats were identified during the simulation (eg. unable to find/unfamiliar with equipment, dosing information not available, etc…)?

_____

_____

2) What suggestions do you have for ways to improve these system issues? (ie. Training, relocating things in the room, obtaining equipment, Access to protocols)

_____

_____

3) What barriers do you predict may make it difficult for your site to improve these system issues?

_____

_____

4) Please list some specific things you could implement within the next 3- 6 months to improve this system issue:

_____

_____

5) What things can the Edmonton Emergency Zone Quality Council do to help you make changes?

_____

_____

Appendix C

Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) September 15, 2015

Text Section and Item Name	Section or Item Description	
Notes to authors	• The SQUIRE guidelines provide a framework for reporting new knowledge about how to improve healthcare • The SQUIRE guidelines are intended for reports that describe system level work to improve the quality, safety, and value of healthcare, and used methods to establish that observed outcomes were due to the intervention(s). • A range of approaches exists for improving healthcare. SQUIRE may be adapted for reporting any of these. • Authors should consider every SQUIRE item, but it may be inappropriate or unnecessary to include every SQUIRE element in a particular manuscript. • The SQUIRE Glossary contains definitions of many of the key words in SQUIRE. • The Explanation and Elaboration document provides specific examples of well-written SQUIRE items, and an in-depth explanation of each item. • Please cite SQUIRE when it is used to write a manuscript.	**As you review the manuscript, place a checkmark in this column for each SQUIRE item that is appropriately addressed in the manuscript. Remember that not every item is necessary in every manuscript.**
Title and Abstract		
1. Title	Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patient-centeredness, timeliness, cost, efficiency, and equity of healthcare)	
2. Abstract	a. Provide adequate information to aid in searching and indexing b. Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary such as: background, local problem, methods, interventions, results, conclusions	
Introduction	*Why did you start?*	
3. Problem Description	Nature and significance of the local problem	
4. Available knowledge	Summary of what is currently known about the problem, including relevant previous studies	
5. Rationale	Informal or formal frameworks, models, concepts, and/or theories used to explain the problem, any reasons or assumptions that were used to develop the intervention(s), and reasons why the intervention(s) was expected to work	
6. Specific aims	Purpose of the project and of this report	
Methods	*What did you do?*	
7. Context	Contextual elements considered important at the outset of introducing the intervention(s)	
8. Intervention(s)	a. Description of the intervention(s) in sufficient detail that others could reproduce it b. Specifics of the team involved in the work	

9. Study of the Intervention(s)	a. Approach chosen for assessing the impact of the intervention(s) b. Approach used to establish whether the observed outcomes were due to the intervention(s)
10. Measures	**a.** Measures chosen for studying processes and outcomes of the intervention(s), including rationale for choosing them, their operational definitions, and their validity and reliability b. Description of the approach to the ongoing assessment of contextual elements that contributed to the success, failure, efficiency, and cost c. Methods employed for assessing completeness and accuracy of data
11. Analysis	a. Qualitative and quantitative methods used to draw inferences from the data b. Methods for understanding variation within the data, including the effects of time as a variable
12. Ethical Considerations	Ethical aspects of implementing and studying the intervention(s) and how they were addressed, including, but not limited to, formal ethics review and potential conflict(s) of interest
Results	*What did you find?*
13. Results	a. Initial steps of the intervention(s) and their evolution over time (*e.g.*, time-line diagram, flow chart, or table), including modifications made to the intervention during the project b. Details of the process measures and outcome c. Contextual elements that interacted with the intervention(s) d. Observed associations between outcomes, interventions, and relevant contextual elements e. Unintended consequences such as unexpected benefits, problems, failures, or costs associated with the intervention(s). f. Details about missing data
Discussion	*What does it mean?*
14. Summary	a. Key findings, including relevance to the rationale and specific aims b. Particular strengths of the project
15. Interpretation	a. Nature of the association between the intervention(s) and the outcomes b. Comparison of results with findings from other publications c. Impact of the project on people and systems d. Reasons for any differences between observed and anticipated outcomes, including the influence of context e. Costs and strategic trade-offs, including opportunity costs
16. Limitations	a. Limits to the generalizability of the work b. Factors that might have limited internal validity such as confounding, bias, or imprecision in the design, methods, measurement, or analysis c. Efforts made to minimize and adjust for limitations
17. Conclusions	a. Usefulness of the work b. Sustainability c. Potential for spread to other contexts d. Implications for practice and for further study in the field e. Suggested next steps
Other information	
18. Funding	Sources of funding that supported this work. Role, if any, of the funding organization in the design, implementation, interpretation, and reporting