Interdisciplinary Simulation for the Detection of Latent Risk Threats in a Hyperbaric Medicine Department

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Background

Latent Risk Threats (LRTs) are potential adverse events that lie dormant, only becoming evident when a situation overcomes an organization's prevention mechanisms. The utility of simulation scenarios (SIMs) to identify LRTs has been demonstrated across various clinical environments, but has not been described in UHM, despite the technically complex and uniquely challenging environment. We sought to develop SIMs in order to identify LRTs in UHM.

Objectives

The primary objective of our study was to, in conjunction with an educational project, develop SIMs that would simultaneously educate UHM staff and learners while identifying LRTs that could be corrected at a systems level prior to actual emergency scenarios occuring.

Methods

Six scenarios were developed by simulation educators and UHM leadership (Table 1). SIMs were run twice between February 2017 and January 2019. Scenarios were run in-situ, in either the mono- or multiplace chamber, with high-fidelity mannequins, simulated code cart medications, and emergency equipment. Following each SIM, a facilitated debrief addressed all LRTs and potential solutions were identified by the interdisciplinary UHM team. LRTs were stratified into categories and independently coded by two reviewers. At three-month follow-up, UHM leadership was asked about their response to the identified LRTs.

Table 2. LRT Categories with Examples and Proposed Solutions

Category/ Sub-category	Representative Example of LRT	LRT Solution
Equipment (n=8)	"Ultrasound machine was not where it normally is" and it was discovered that there is no standardized, permanent storage location for the ultrasound machine	Permanent storage location for ultrasound machine was decided upon
Medication (n=2)	"Both concentrations of epinephrine are in the UHM code cart", leading to confusion during chaotic emergency situation	Different doses of epinephrine are now stored in separate areas. Code-cart medications are now standardized, limiting potential for medication errors
System -Policy/Process(n=4)	"Little room to maneuver during monoplace emergency"	Policy change made so that codes are now to be moved to the critical care area of UHM chamber to allow for more space during emergencies
System -Education/Training(n=5)	Staff needed clarity on how to "exit department in case of fire at main entrance"	Increased education on fire evacuation plans
System -Communication(n=3)	"Not enough headsets, and difficult to hear inside the chamber" limiting communication	Increased number of headsets available, and education to encourage the use of loudspeakers during emergencies

Table 1. Six Cases and Brief Descriptions

Angioedema A patient develops angioedema after tPA administration, necessitating a surgical airway at depth
DOPE A patient develops a hypoxia at depth requiring learners to troubleshoot using the DOPE mnemonic (dislodgement, obstruction, pneumothorax, equipment failure), and ultimately treat a pneumothorax
CO & CCB A carbon monoxide (CO) toxic patient also ingested verapamil, requiring aggressive calcium-channel blocker (CCB) toxicity treatment
Fire A fire begins 45 minutes into a UHM treatment in the monoplace chamber requiring ascension and evacuation
Attendant Emergency An attendant has a seizure while caring for a patient at depth, requiring decompression and management of both the attendant and the patient
Monoplace Code A patient being treated for carbon monoxide poisoning develops ventricular tachycardia and arrests during treatment

Results / Discussion

A total of 22 unique LRTs were identified during the SIM sessions. A few LRTs were identified multiple times in different sessions, but only included once in the analysis. After coding the LRTs, the most common LRTs were related to equipment (n=8), systems-education (n=5), systems-policy/process (n=4), systems-communication (n=3), and medications (n=2) (Table 2). At three-month follow-up for each session, UHM leadership had implemented solutions for all of the LRTs.

Utilizing SIMs in the UHM environment is an effective and feasible way to identify potential LRTs in a safe environment. Appropriate policy related solutions were implemented in a timely fashion (within 3 months). Further research will be required to see if solutions for identified LRTs persist and the optimal frequency of running SIMs to continue to identify new LRTs and/or to see the durability of policy changes.