

Malignant Hyperthermia (MH) Simulations: Keeping Staff Cool During MH Crisis

Jenny McCormick, MSN, RN, CNOR, EMT-B; Karen Kline, BSN, RN, CNOR; Ali Kazemi, MD; Michael Saccoci, DO, MPH; Cheryl Moses, BSN, RN, CNOR; Beth Bond, BSN, RN, CNOR, CSSM



CARILION CLINIC

Clinical Issue / Identified Gaps

Malignant Hyperthermia (MH) is an inherited disorder of skeletal muscle triggered in susceptible patients that results in hyper metabolism, skeletal muscle damage, hyperthermia, and possibly death.¹ An Operating Room (OR) Registered Nurse (RN) preceptor identified the need for augmented education using hands-on MH crisis simulations. Previous MH education for OR staff included an annual lecture. Most staff in that OR had not experienced an MH crisis in practice. Therefore, this simulation was designed to increase staff perceptions of knowledge, skill, and confidence when reacting to an MH crisis.

Description of Team

It is important to involve stakeholders from each department that will be involved in the simulation during the planning phase.² The initial planning team included a simulation lab education facilitator, the RN preceptors from two OR departments, the director of both OR departments, and anesthesiologists.

Preparation & Planning

Scenario design and development is an important step in the education process to ensure that learning objectives are met and that the participants have a meaningful learning experience.³ The MH simulation scenarios were designed and executed based on information from the Malignant Hyperthermia Association of the United States (MHAUS) and the Association of periOperative Registered Nurses (AORN).^{1,4} Learning objectives were established early in the planning process. After that, simulation scenarios were edited by the planning team. The team also completed a practice run of the MH simulation before the first session was offered.



Supplies & Equipment

Simulation can take place in an actual OR, a simulated OR in a sim lab, or another setting that can be set up to mimic an OR. Supplies that will be needed for a realistic MH scenario may include:

- Manikin draped for surgery, laryngeal mask airway (LMA) in place and connected to ventilator
- Vital sign software
- Crash Cart
- Defibrillator
- Intubation equipment
- Peripheral IVs
- 1000 mL bag of chilled normal saline
- Simulated Dantrolene
- Bags of ice
- Cooler
- Suture practice pad
- Suture
- MH emergency cart contents
- Anesthesia machine filters
- Sterile water
- Blood draw tubes
- MHAUS algorithm
- 18 gauge blunt fill needles
- 60 cc luer lock syringes
- Central line kit
- Foley catheter

Simulation Case Description

The facilitator should set the expectation for the learners. Learners should be assigned a role for the simulation based on their actual role in the OR. Depending on the number of learners, some may need to be assigned to observe until extra assistance is needed during the emergency simulation. Example: "Patient is undergoing a right arm arteriovenous fistula surgery. The patient has no previous surgical history. An uneventful propofol induction was performed and anesthesia has been maintained with sevoflurane. An LMA is in place and the patient is breathing spontaneously. The first soft count and the instrument count have been completed. Scenario begins with closing the skin incision."

Scenario Progression

The simulation scenario progresses based on actions that are performed by the learners.

Actions	Vital Sign Changes
30 seconds into the scenario	HR 100 with PVCs R 20 BP 80/40 EtCO ₂ 75 O ₂ 96% Temp 102.2 F
If no dantrolene given after 1 minute	HR 140 with increased PVCs R 24 BP 70/30 EtCO ₂ 90 O ₂ 95% Temp 107.6 F
Once first dose of dantrolene given, vital signs change after 30 seconds Patient will be intubated	HR 110 with decreased PVCs R 20 BP 90/60 EtCO ₂ 65 O ₂ 96% Temp 107.6 F
1 minute after previous vital sign changes	HR 90 BP 110/65
Trend remaining vital signs over the next 5 minutes	Trend Temp down to 100.4 Trend EtCO ₂ down to 40

Implementation

Fifty six learners have participated in an MH simulation during four different sessions. Multidisciplinary participants included the following job roles:

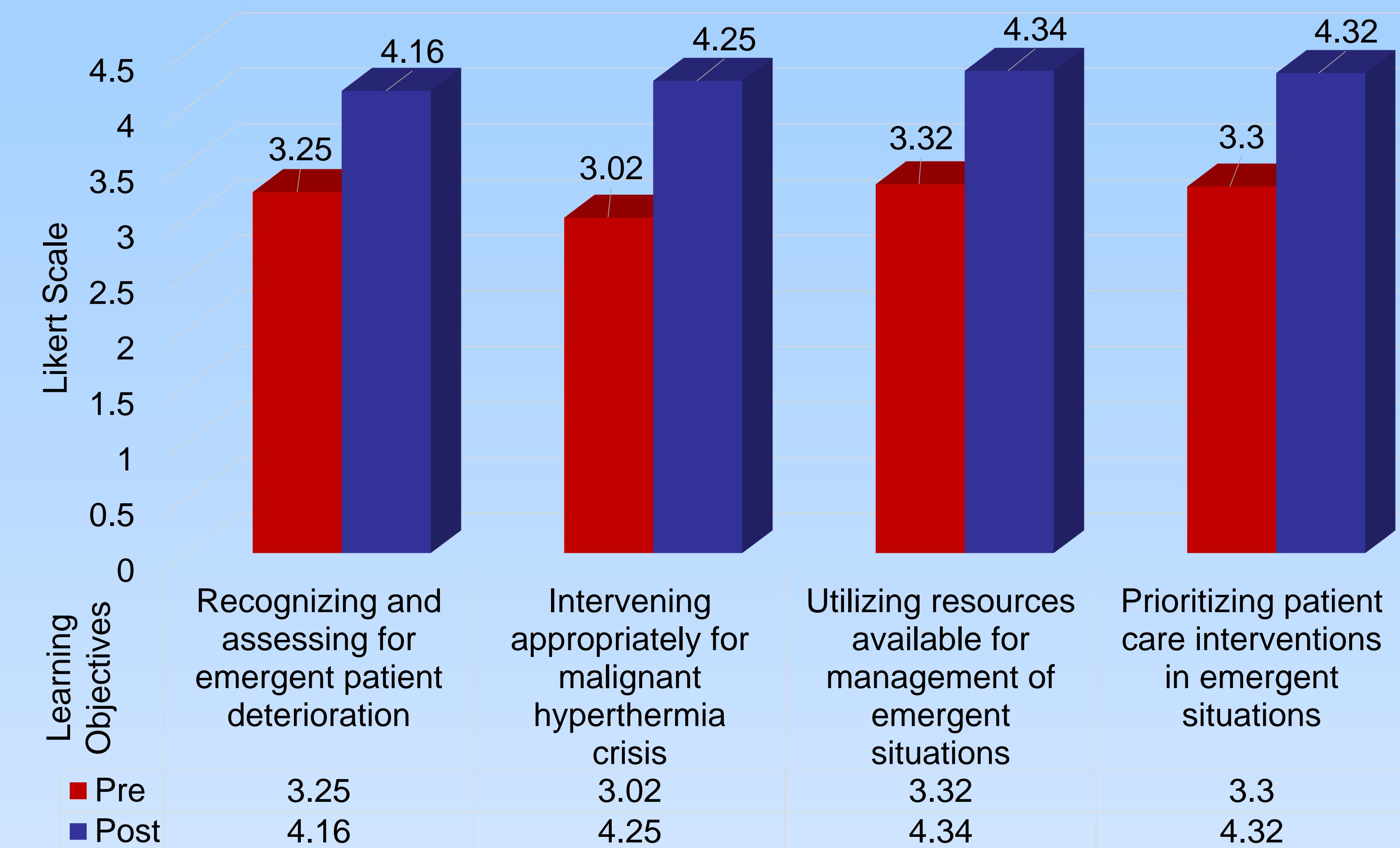
- Surgeon
- Anesthesiologist
- Resident
- Medical student
- Physician assistant
- Nurse practitioner
- Perfusionist
- RN
- Licensed Practical Nurse
- Surgical technologist
- Anesthesia technician (tech)
- Perioperative tech
- Cardiovascular tech
- Clinical associate

Assessment

A pre and post evaluation was used as an assessment tool. The learners were asked to assess the change in their knowledge and skill level. The learners rated their level of confidence for each learning objective using a 5-point Likert scale, ranging from "Very Low" (score of 1) to "Very High" (score of 5).²

Outcome

Data analysis was performed on the self-evaluations using a paired sample t-test. All evaluation scores were statistically significant with a p-value less than 0.001.



Feedback

Written feedback from the learners included the following comments:

- Excellent hands on, impressed with teamwork
- Excellent training and simulation
- Hands on is a great way to practice
- Have more of a discussion of everyone's jobs
- I like the "real life" scenario
- Positive experience, very informative and great environment for learning
- Valuable hands on training
- Very informative, instructors are very knowledgeable
- Was nice to do a hands-on practice and not just hearing it
- Wish we could have done another round in different roles

Implications

Simulation education can be used to increase the knowledge, skills, and confidence of OR staff during emergency events. Simulation can provide a place for learners to practice skills and receive instruction in a safe environment that poses no risk to patients.⁵

Acknowledgements

Support for poster development, printing, and travel was provided by the Carilion Clinic Office of Nursing Research, Evidence-Based Practice, and Excellence. We would like to thank the staff at the Carilion Clinic Center for Simulation, Research, and Patient Safety for their support during the simulations, especially Adam Baber for his audio-visual expertise. We would also like to thank Dr. Michael Thompson for his participation in some of the simulations.

References

1. Rosenberg MD., H. (2010). Malignant Hyperthermia Syndrome. Malignant Hyperthermia Association of the United States.
2. INACSL Standards Committee (2016). INACSL Standards of Best Practice: SimulationSM Simulation-enhanced interprofessional education (Sim-IPE). Clinical Simulation in Nursing, 12(S),S34-S38.<http://dx.doi.org/10.1016/j.ecns.2016.09.011>
3. Huffman, J. L., McNeil, G., Bismilla, Z., & Lai, A. (2016). Essentials of scenario building for simulation-based education. In Grant, V. J. & Cheng, A (Eds.), Comprehensive Healthcare Simulation: Pediatrics (pp. 19-29). doi:10.1007/978-3-319-24187-6_2
4. Association of periOperative Registered Nurses (AORN). (2014). Malignant hyperthermia perioperative simulation scenario. Retrieved from: <https://www.aorn.org/education/staff-development/simulation-scenarios>
5. Robertson, J. M., Dias, R. D., Yule, S., & Smink, D. S. (2017). Operating Room Team Training with Simulation: A Systematic Review. Journal Of Laparoendoscopic & Advanced Surgical Techniques. Part A, 27(5), 475-480. <https://doi.org/10.1089/lap.2017.0043>