

Malignant Hyperthermia Project Synthesis

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## Abstract

Professional organization such the Association of periOperative Registered Nurses and the Malignant Hyperthermia Association of the United States both promote that information related to the genetic disease Malignant Hyperthermia is crucial to the safety of patients undergoing surgery. Both professional organizations recommend that hospital facility should include MH education during the orientation of new healthcare personnel working within the perioperative environment and other healthcare providers that could be involved in responding to a MH crisis. Upon initiating an assessment of the perioperative orientation plan and annual training at Genesys Regional Medical Center (GRMC) it was discovered that education related to MH was not included in either the orientation curriculum or annual competency training. The purpose of this paper is to provide a synthesis of a scholarly project with the goals to develop, implement, and evaluate an online MH learning module for GRMC perioperative nursing staff. The paper will further discuss the objectives established to support the overall goals. Along with theory, practice, and research to support the overall project development. Evaluations and further recommendations will also be presented.

*Keywords: nursing, malignant hyperthermia, nursing education, perioperative nursing*

### Malignant Hyperthermia Project Synthesis

According to the American Nurses Association (ANA) and National Nursing Staff Development Organization (NNSDO) (2010), the Nursing Professional Development Specialist (NPDS) utilizes multiple roles such as educator, facilitator, researcher, and collaborator to facilitate the professional development of nurses in their engagement in learning activities to enhance their professional competence. By implementing the NPDS role of educator, the subject of Malignant Hyperthermia (MH) was identified as imperative patient care information related to the practice of perioperative nursing. In identifying that time is crucial when the life threatening MH disorder is suspected and/or recognized the Association of periOperative Registered Nurses (AORN) (2011), recommends that every facility should include MH training in the orientation plan for new members of the perioperative team and other teams involved in responding to a MH crisis. Upon completing an assessment of the perioperative orientation plan and annual training, at Genesys Regional Medical Center (GRMC), it was identified that education related to MH was not included as part of the perioperative nursing annual training or orientation curriculum.

The purpose of the following paper is to provide a synthesis of my scholarly project providing a discussion of the goals and objectives for developing, implementing, and evaluating an online learning module in reference to Malignant Hyperthermia. Also provided, is a description and discussion of my personal and professional accountability in the implementation of the learning module, along with analysis of the project outcomes and adherence to legal and professional standards. Evaluation of the scholarly project provided from recipients and my project preceptor will also be discussed. Lastly, recommendations for future project and education implementation will be presented.

### **Scholarly Project Goals and Objectives**

Through the close guidance and direction of my preceptor Lisa Tedrow, MSN, RNC-NIC, BC, Clinical Educator for Women's and Children's at Genesys Regional Medical Center (GRMC). I developed, implemented, and evaluated a Malignant Hyperthermia online learning module, as presented in Appendix A, for the perioperative nursing staff at GRMC. In order to develop and implement an education module based upon theory and best practice, an extensive literature search and review was conducted. Upon multiple meetings with my preceptor and having expansive conversations around learning theory, education delivery, time limitation, and evaluations the decision was made to move forward with the development of an online learning module to be implemented through GRMC's learning management system.

In order to provide project focus, guidance, and time management, a project-planning guide was created identifying the following goals and objectives for my Malignant Hyperthermia (MH) learning module project. The goals for this scholarly project was to develop, implement, and evaluate a computer-based (on-line) MH learning module for GRMC's perioperative nursing staff. In order to accomplish the established goals, the following objectives were identified. The first objective was conducting a literature search in order to obtain information and evidence-based practice related to the assessment and treatment of MH. The second objective involved the development of learning objectives for the MH learning module utilizing Bloom's Taxonomy for the cognitive domain moving from basic knowledge to analysis of a patient care scenario.

The third objective will focus on the actual creation of the MH learning module content, that addressed patient assessment, signs and symptom recognition, nursing intervention during crisis, and post MH event nursing care. The fourth objective focused on meeting with personnel that manage GRMC's learning management system in order to verify program compatibility and

confirmation of a date for learning content upload unto GRMC's learning management system (LMS). Objective five was another endeavor to conduct a literature search and review to identify and support appropriate evaluation methods to assess learned knowledge and effectiveness of learning content.

Objectives six and seven, represent the activities around conducting a small test to verify the learning content and data collection was successfully upload unto the LMS. Once verification has been established the module will be made available to the perioperative nursing staff. The last objective, number eight, will focus on data collection through the LMS system and analysis of the evaluation of the data through the assessment process. The learning module objectives, content, and delivery could be improved depending upon feedback and evaluation analysis.

### **Personal and Professional Accountability**

As a learning adult completing the Master's in Nursing Education graduate program, I held myself accountable to myself as a student, to my preceptor as an adult learner, and to GRMC to follow through on my commitment to develop a MH learning module. I was accountable for my own choices and actions related to the development, implementation, and evaluation of my scholarly project, while striving to attain the goals I established for myself. I was accountable for scheduling meeting and planning an agenda for the meeting focus and organization, being cognizant to stakeholder time. I followed up agenda items needing further attention or clarification with timely emails. I was also accountable to adhere to my established project timeline and if problems did arise I needed to notify the appropriate stakeholders involved and established a recovery plan to keep my project on track.

As a professional nurse in a novice nurse educator role, I had the responsibility to engage in the teaching-learning process. I assumed the learning facilitator role in the development of an

online learning module under the guidance and direction of my preceptor Lisa Tedrow, MSN, RNC-NIC, BC. I practiced within the scope of practice related to the National League for Nurses (2007) Core Competencies of nurse educators and reflected upon my academic knowledge and skill to make decisions in the best interest of nursing staff education and project completion. I functioned professionally and competently within the project agency and educational environment always keeping the best interest of my target audience in mind. Also, as a member of the Association of periOperative Registered Nurses and previous perioperative staff nurse I am accountable to be a role model for the nursing profession. Through my behaviors of accountability and responsibility, I hope to have proved my professional dedication as a novice educator.

### **Analysis of Adherence to Standards**

#### **Legal and Ethical Adherence**

Utilizing the *Code of ethics for nurses with interpretative statements* (American Nurses Association, 2001), as a guide, I took responsibility for maintaining standards of quality nursing education without discrimination of any kind and maintained confidentiality. In implementing this responsibility I requested the learner not to sign their names to their testing evaluations and program evaluation. I also supplied letter envelopes for the learners to folder and place their evaluation form in and supplied a sealed collection container that was checked daily. My ethical behaviors involved any and all interactions between my preceptor and agency site and my ethical responsibility for ethical conduct of respect, privacy, and honesty while developing and implementing this scholarly project. I did not attempt to influence my preceptor or agency through gifts or personal influence. While identifying and utilizing literature to support my scholarly project, I credited the authors and theorists I based and adopted my project on. I also

requested permission via email from the Malignant Hyperthermia Association of the United States (MHAUS) to provide their contact information within my education program. I received a response within hours and was granted permission (MHAUS, 2012). As a nurse educator in this role I accepted full responsibility for my actions and competencies in the practice of nursing and education of learners.

### **Nursing and Organizational Standards**

The National Nursing Staff Development Organization (NNSDO) and American Nurses Association (ANA) (2010) promote, that nursing professional development practice has a specialty focus that facilitates the lifelong learning and development activities of nurses aimed at influencing the fulfillment for professional growth. Having the opportunity to create and implement an online Malignant Hyperthermia learning module for GRMC's perioperative nursing staff provided me the experience in understanding, not only the various roles within Nursing Professional Development (NPD) but also the standards that guide their practice. In promoting education of the perioperative nurses to meet their professional development needs, Malignant Hyperthermia education was identified as a topic recommended by two professional organizations, the Association of preoperative Registered Nurses (AORN) (2011) and the American Society of PeriAnesthesia Nurses (ASPN) (2010) as a competence for nurses working within the perioperative unit.

The Association of periOperative Registered Nurses has established a guideline within the professional organization's standards and recommended practices, promoting that every healthcare facility providing surgical services, to include MH training as part of new healthcare providers orientation plan and ongoing annual training to facilitate healthcare provider competency. By facilitating strategies and methods to promote positive learning and engage

learners in professional growth allowed me to meet the standards for a NPD specialist (NNSDO and ANA, 2010) and to fulfill the MH education recommendation by AORN, for nurses working within the perioperative units.

### **Evaluation of Scholarly Project**

In order to organize the evaluation process for the online learning malignant hyperthermia module, the theoretical framework of systems theory was identified for its elements of input, output, and, feedback. Hayes (2011) defines each systems theory concepts as follows; input may be identified as the student enrolled in the learning experience, throughput is the implementation of the curriculum, output is the actual measurement of knowledge acquisition, and feedback is the information loop that provides data related to characteristics involved within the other theory elements. Hayes (2011) notes, that each of the concepts impacts all the other concepts and the analysis of each element provides valuable data for effectiveness of the overall education experience.

The input data collected from the nursing staff was obtained utilizing a 5-point Likert scale tool, as presented in Appendix C. This tool allowed input from the nursing staff related to their attitude towards the content of the learning module and the value of the information for their practice. As noted by McLeod (2008), the Likert scale is a simple numeric scale that assigns numeric ratings to specific responses and are used to measure the degree to which an individuals attitude or opinion meets or does not meet a particular criteria. In evaluation surveys, Likert scales are typically used to measure the degree to which a respondent agrees or disagrees with a particular statement, measuring individual value (McLeod, 2008). Collected data from the Likert scale tool, as shown in Appendix C, presents the scoring and additional comments for input from twenty nurses within the perioperative unit. Scoring related to the nurses attitude toward the



method of delivery and value of the information related to their practice fell high on the rating scale indicating a positive attitude towards computer learning and content value related to their practice. Although the input is important to the overall content development and method delivery, output is also important for evaluation of learner accomplishment.

Evaluation of output was collected utilizing a summative and formative approach. Garrison And Ehringhaus (n.d.) note that in order to have a balanced assessment, both summative and formative evaluations are imperative for information gathering. Bourke and Ihrke (2011) define formative evaluation as feedback collected during the education process. Through this assessment students can adjusted their learning in order to achieve learning outcomes. In order to collect and provide formative data, quiz questions, as presented in Appendix A, were integrated throughout the MH learning module for individual student feedback. The intermittent quiz questions allowed opportunity for the nursing staff to check their learning and verify content achievement. Overall course learning was assessed through implementing a summative evaluation. Gaberson and Osermann (2007) state, summative evaluation judges the quality of the student's achievement in the course, not the progress of the learner in meeting the course objectives. In order to determine if the overall malignant hyperthermia course objectives were met and student learning had been achieved, test question, as presented in Appendix D, including multiple choice, true and false, and fill-in the blank questions was implemented through a test bank in the learning management system (LMS). Upon final collection of the summative evaluations, twenty nurses had volunteered to engage with the MH learning content and completed the summative tests, showing scores from 90 -100 percent. In addition to the evaluation of student learning and course effectiveness, preceptor-student evaluation was also

implemented utilizing a specific, measureable, achievable, realistic, and time-bound (S.M.A.R.T.) format.

A preceptor-student evaluation tool, as present in Appendix B, was also initiated as a formal tool to document communication and feedback related to the achievement of the identified project goals and objectives. Berry and Thomas (2011) present, feedback is the process of comparing identified objectives with current progress toward meeting the overall stated goals. Upon completion of the project and following my project presentation, I met with my preceptor Lisa Tedrow. Lisa provided positive feedback and constructive advice, as she reviewed my evaluations from the staff nurses. Lisa's advice pointed out future improvement for my Likert scale evaluation. Although I focused on the summative evaluation connecting to the learning objective for assessment, she stated that is just as important to also provide questions on the Likert evaluation to receive feedback from the learner identifying whether or not they felt the content met the learning objectives. I accepted this advice with great generosity and emphasized this is why I choose her as a preceptor. Overall Lisa stated she was very pleased with project deliverable and my project presentation met professional quality. Lisa's recommendation was to follow the project through the process of requiring the learning module to become part of the perioperative annual competency requirements.

### **Recommendations for Future Implementation**

One of the consistent themes that seemed to be presented from feedback through the use of the evaluation process was the nursing staffs request for hands-on or simulation education. Especially related to MH sign and symptom recognition, management, and specific drug (dantrolene -MH treatment) reconstitution. Due to the collected input from the nursing staff it is highly recommended to continue malignant hyperthermia (MH) education into the simulation-

learning environment. This learning environment would not only allow the opportunity to apply learned knowledge from the online learning module but also opportunity to develop the psychomotor skills needed to deliver safe patient care. According to Wolfgram and Quinn (2012) simulation allows learners to develop their decision-making skill, enhance their critical thinking, and increase their level of confidence. Henneman, Cunningham, Roche, and Cumin (2007), state greater awareness of patient safety has been demonstrated with the use of simulation. Due to higher patient acuity in hospital settings, learners must come to the patient bedside competent to deal with rapidly changing situations, situations that can be experienced through simulation learning (Wolfgram and Quinn, 2012). By extending MH education into a simulated learning opportunity would allow GMRC's perioperative nursing staff the hands-on experience to recognize, intervene, and treat the rare condition of malignant hyperthermia.

### **Demonstration of Application**

The learning module developed for this project is intended to be useful to a variety of novice to expert nurses, however, for the purpose of making consistent overall design decisions throughout the project a specific audience of learners was identified as the primary target audience. The project learning module was geared towards experienced nurses who are currently working within the perioperative area. So, for my design purposes, it was expected that all probable learners are current perioperative nursing staff.

### **Constructivist Learning**

Constructivist learning principles were utilized to develop the online learning module. These principles were chosen because teaching under a constructivist paradigm offers the opportunity, according to Crawford (2011), to provide learner-centered active involvement that should promote higher-order thinking in the online environment while addressing the learning

needs of adult learners. According to Legg, Adelman, Mueller, and Levitt (2009), constructivism offers a different choice to established pedagogy in nursing education in that it not only considers previous learning but also is learner-centered and results in the building, modification, and expansion of new knowledge. The constructivist learning theory is also supported by Knowles' principles of adult learning.

### **Adult Learning Principles**

Knowles, as noted by Cheng (2012), promotes that adult learner's needs differ from traditional students in the following ways; adults need to know why they need to learn something, adults need to learn experientially, adults approach learning as problem-solving, and adults learn best when the topic is of immediate value. Learners require learning environments that are rich in opportunity to build knowledge, supporting the use of online learning. Crawford (2011) reports online education can be seen as a gateway to learning for the adult learner, as it increases student control providing a greater sense of self-direction and autonomy.

### **Electronic Learning**

Since the target audience for this teaching-learning process was identified as perioperative staff nurses employed within a hospital setting, not academic. Electronic learning was the choice for information delivery due to convenient availability and access for the staff nurses and consistency for the same information to be delivered to all nurses. As information technology has developed and grown as noted by Kala, Isaramalai, and Pohthong (2010), the benefits of electronic learning have profoundly become recognized. These benefits include: providing consistency with the delivery of education information, lowering instruction time, and promoting cognitive recall (Kala, Isaramalai, and Pohthong, 2010). As a facilitator of learning

and utilizing a constructivism learning theory, I recognize that active learner involvement, such as a case study strategy, is needed to engage the learner within the online learning environment.

### **Case Study Learning Strategy**

In acknowledging that the learning management system at GRMC is not capable of online social interaction, discussion boards, or blogging, a case study strategy was implemented to engage learners in assessment and reflection. Through the use of interaction, as noted by Hofsten, Gustafsson, and Haggstrom (2010), learners are able to improve problem-solving skills and acquire new knowledge from experiences within the learning environment. One activity that has shown to facilitate active learning is case studies. According West, Usher, and Delaney (2012), case studies require student examination, reflection, and assessment of patient case content, thus providing a method for the learner to engage in the educational process. This engagement will lead to a greater chance of learner success.

### **Conclusion**

Online learning can be a rich and effective method to delivery learning content. By utilizing a constructivist learning theory and adult learning principle, I developed, implemented, and evaluated an online learning module for the perioperative nursing staff at Genesys Regional Medical Center (GRMC). Focusing on the constructivist principle to engage learners in active learning, I developed and presented a case study within the learning module to promote learning enhancement. While participating in the online learning, nurses were involved in a continuous assessment process utilizing various evaluation methods, to enhance and improve the learning content. The literature and theory presented in this paper demonstrate the role that evidence-based practice has on the development and implementation of a learning module, while the

analysis and evaluation of this learning module demonstrated the outcome of the project when those theories and literature are applied. The analysis and evaluation has indicated that positive learning outcomes were achieved. The recommendation for future education, as supported by professional organizations, are based upon literature and research and could strengthen the perioperative nursing practice if it chosen to be implemented at this hospital institution.

## References

- American Nurses Association (2001). *Code of ethics for nurses with interpretative statements*. Silver Spring, MD: Nursesbooks.org.
- American Nurses Association & National Nursing Staff Development Organization (2010). *Nursing professional development: scope and standard of practice*. Silver Spring, MD: Nursesbooks.org.
- American Society of PeriAnesthesia Nurses (2012). *Standards of perianesthesia nursing practice*. Cherry Hill, NJ: <http://www.aspan.org>.
- Association of periOperative Registered Nurses (2011). *Perioperative standards and recommended practices*. Denver, CO: AORN Publications.
- Berry, S. & Thomas, R. (2008). *Use SMART objective to focus goals, plans, and performance*. Retrieved from <http://www.projectsart.co.uk/pdf>.
- Bourke, M. P. & Ihrke, B. A. (2009). The evaluation process. In D. M. Billings & J. A. Halstead (Eds.), *Teaching in nursing a guide for faculty* (pp. 391-406). St. Louis, MO: Saunders Elsevier.
- Cheng, Y.M. (2012). Exploring the role of interaction and flow in explaining nurses' e-learning acceptance. *Nursing Education Today*. doi: 10.1016/j.nedt.2012.02.005.
- Crawford, T. R. (2011). Using problem-based learning in web-based components of nurse education. *Nurse Education in Practice*. (11) 124-130. doi: 10.1016/j.nepr.2010.10.010.
- Gaberson, K.B. & Oermann, M. H. (2007). *Clinical teaching strategies in nursing* 2<sup>nd</sup> ed. New York, NY: Springer.

Garrison, C. & Ehringhaus, M. (n.d.). *Formative and summative assessments in the classroom*.

Retrieved from <http://www.amle.org/portals/0/pdf>.

Hayes, J. M. (2011). Programmatic evaluation. In M, J. Bradshaw & A. J. Lowenstein (Eds)

*Innovative teaching strategies in nursing and related health professions*. Sudbury, MA: Jones and Bartlett.

Hofsten, A., Gustafsson, C., & Haggstrom, E. (2010). Case seminars open doors to deepen

understanding – Nursing students' experiences of learning. *Nurse Education Today* (30)

533-538. doi: 10.1016/j.nedt.2009.11.001.

Kala, S., Isaramalai, S., & Pohthong, A. (2010). Electronic learning and constructivism: A model

for nursing education. *Nurse Educator Today* (30) 61-66. doi: 10.1016/j.nedt.2009.06.002.

Legg, T. J., Adelman, D., Mueller, D. & Levitt, C. (2009). Constructivist strategies in online

distance education nursing. *Journal of Nursing Education* 48(2), 64-69.

Malignant Hyperthermia Association of the United States (2011). *Healthcare professionals*.

Retrieved from <http://www.mhaus.org/>.

McLeod, S. (2008). Likert scale. Retrieved from

<http://www.simplypsychology.org/likert-scale.html>.

West, C., Usher, K., & Delaney, L. J. (2012). Unfolding case studies in pre-registration nursing

education: Lessons learned. *Nurse Education Today* (32) 576-580. doi:

10.1016/j.nedt.2011.07.002.

Wolfgram, L. J. & Quinn, A. (2012). Integrating simulation innovatively: Evidence in teaching

in nursing education. *Clinical Simulation in Nursing* (8)5, 169-175. doi:

10.1016/j.ecns.2010.09.022.



Appendix A

**Malignant Hyperthermia**  
Keeping Our Patients Safe

By  
Ginger VanDenBerg


**Malignant Hyperthermia**  
Learning Objectives

At the end of the learning module the participant will be able to:

- ❖ Define Malignant Hyperthermia
- ❖ Identify pathophysiology changes related to Malignant Hyperthermia
- ❖ List risk factors and triggering agents related to Malignant Hyperthermia
- ❖ Describe signs & symptoms of a Malignant Hyperthermia crisis
- ❖ Prioritize specific supplies and treatment for Malignant Hyperthermia
- ❖ Define the role of MHAUS


**Malignant Hyperthermia**  
What is it?

- ❖ A rare genetic condition effecting the skeletal muscular cells, characterized by an abnormal hypermetabolic state brought on by certain anesthetic gases and/or succinylcholine.

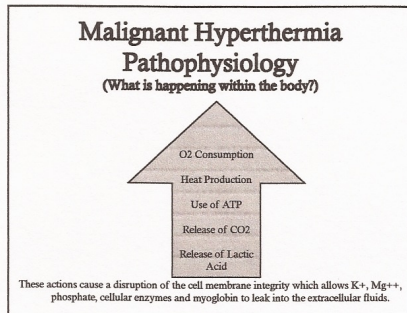


**Malignant Hyperthermia**  
Pathophysiology  
(What is happening within the cell?)

- ❖ The primary defect resides in the skeletal muscle system at the level of calcium release from the sarcoplasmic reticulum of the muscle cell.
- ❖ Triggering agents interfere with the muscle cells ability to control intracellular  $Ca^{++}$ .
- ❖ There is an excess release of  $Ca^{++}$  and interference with  $Ca^{++}$  returning to storage, creating a high intracellular  $Ca^{++}$  level.
- ❖ The high intracellular  $Ca^{++}$  level leads to continuous contractures of the skeletal muscles. Leading to cellular exhaustion and death.



8/8/12



### Malignant Hyperthermia Triggering Agents

|  |   |
|--|---|
| <ul style="list-style-type: none"> <li>❖ Succinylcholine</li> <li style="padding-left: 20px;">A depolarizing muscle relaxant with no reversal</li> </ul> | <ul style="list-style-type: none"> <li>❖ Anesthesia Gases</li> <li style="padding-left: 20px;">Halothane</li> <li style="padding-left: 20px;">Isoflurane</li> <li style="padding-left: 20px;">Enflurane</li> <li style="padding-left: 20px;">Sevoflurane</li> <li style="padding-left: 20px;">Desflurane</li> </ul> |
|--|---|

### Check in question

- ❖ Malignant Hyperthermia is a rare genetic condition that is triggered by certain anesthetic agents such as, succinylcholine or anesthetic gases.  

True or False
- ❖ During a Malignant Hyperthermia crisis, triggering agents interfere with the muscle cells ability to control calcium ions (both release & re-uptake).  

True or False

### Check in question

- ❖ Malignant Hyperthermia is a rare genetic condition that is triggered by certain anesthetic agents such as, succinylcholine or anesthetic gases.  

True
- ❖ During a Malignant Hyperthermia crisis, triggering agents interfere with the muscle cells ability to control calcium ions (both release & re-uptake).  

True

8/8/12

### Malignant Hyperthermia

#### Who is at Risk

- ❖ MH is an autosomal dominant inherited disorder. The child of a MH parent has a 50% risk of also being MH susceptible.
- ❖ Males develop reactions more frequently than females
- ❖ People under 18 years of age have the highest incidence of MH.
- ❖ MH is associated with neuromuscular disorders such as: Central Core Disease, Duchenne muscular dystrophy, myopathies, periodic paralysis, and episodes of heat exhaustion

Fact: Wisconsin, Nebraska, West Virginia, and Michigan have higher reported MH incidences than other states.

### Malignant Hyperthermia

#### Statistics

- ❖ The Malignant Hyperthermia Association of the United States (MHAUS) reports that MH occurs as frequently as 1 : 5,000 patients.
- ❖ The MH mortality rate has been reduced from as high as 70% to < 5% with the treatment of Dantrolene



Fact: MHAUS was formed to provide a central resource center to collect data and provide education/information to the public

### Check in Questions

- ❖ Males develop symptoms more frequently than females.  
True or False
- ❖ Michigan is one of four states that has a higher report incidences of MH.  
True or False
- ❖ It is estimated that MH occurs in 1 : 50,000 patients.  
True or False

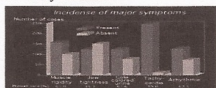
### Check in Questions

- ❖ Males develop symptoms more frequently than females.  
True
- ❖ Michigan is one of four states that has a higher report incidences of MH.  
True
- ❖ It is estimated that MH occurs in 1 : 50,000 patients.  
False

8/8/12

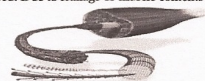
### Malignant Hyperthermia Signs & Symptoms

- ❖ Unexplained Tachycardia-often the first sign (often mistaken for "light anesthesia")
- ❖ Masseter muscle rigidity-that is severe, sustained, and interferes with intubation
- ❖ Hypercarbia-resulting in elevated end tidal CO<sub>2</sub> and O<sub>2</sub> consumption
- ❖ Hyperthermia-Defined in MH as a temp > 40°, often a late sign, body temp can rise as fast as 1° every 5 minutes.



### Malignant Hyperthermia Signs & Symptoms

- ❖ Skin changes- generalized red flushing and/or mottling. Diaphoresis may also be present.
- ❖ Rhabdomyolysis- skeletal muscle is damaged and intracellular contents begin to leak into the bloodstream.
- ❖ Myoglobinuria-becomes evident as a result of muscle tissue breakdown (turning urine a dark red or brown).
- ❖ Renal Function- maybe altered. Due to leakage of muscle contents and filtering by the kidneys.



### Check in Questions

- ❖ Unexplained tachycardia is often the first sign of MH and is frequently mistaken for "light anesthesia".  
True or False
- ❖ Hyperthermia related to MH is defined as a body temp > 40°C and is consider a late sign.  
True or False

### Check in Questions

- ❖ Unexplained tachycardia is often the first sign of MH and is frequently mistaken for "light anesthesia".  
True
- ❖ Hyperthermia related to MH is defined as a body temp > 40°C and is consider a late sign.  
True

8/8/12

### Malignant Hyperthermia Treatment

- ❖ Despite more than 25 years of research, Dantrolene Sodium (Dantrium) is the only clinically available agent for the treatment of MH.
- ❖ Dantrolene is supplied as a lyophilized powder that contains 20mg dantrolene sodium and 3,000mg of mannitol



Fact: It may take from 2-4 licensed personnel to reconstitute the required of dantrolene for rapid administration.

### Malignant Hyperthermia Dantrolene Sodium Handling

- Reconstitute each vial by adding 60 ml of preservative-free water. DO NOT USE bacteriostatic water.
- Shake bottle vigorously until solution is clear
- Protect from light
- Use within 6 hours after reconstitution.

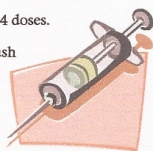


Fact: The liver metabolizes dantrolene, CONTRAINDICATED with active hepatic disease.

### Malignant Hyperthermia Dantrolene Sodium

*(How much is needed?)*

- ❖ 8 to 10mg/kg of dantrolene sodium is needed to treat a patient in acute MH crisis  
(e.g. 50 vials must be available to treat a person who weighs 100-110 kg)
- ❖ Repeat with 2.5mg/kg doses up to 4 doses.
- ❖ Delivery is rapid, continuous IV push



### Malignant Hyperthermia Additional Medication Management

In order to treat symptoms due to cellular leakage & death

- ❖ Insulin - 0.15 units regular/kg
  - ❖ Glucose - 1ml/kg D50W
  - ❖ Calcium Chloride - 2-5mg/kg
  - ❖ Sodium Bicarbonate - 1-2mEq/kg
  - ❖ Furosemide (lasix) - 0.5-1mg/kg
  - ❖ Lidocaine/ Amiodarone
  - ❖ Procainamide
- } Treat Metabolic Acidosis
- } Improve Renal Function
- } Treatment of Arrhythmias

Fact: DO NOT USE CALCIUM CHANNEL BLOCKERS

8/8/12

**Check in question**

- ❖ When reconstituting Dantrolene you should use which of the following?
  - A. 60cc Preservative-Free Water
  - B. 60cc Bacteriostatic Water
- ❖ Each vial of Dantrolene contains 20mgs of Dantrolene?
 

True or False

**Check in question**

- ❖ When reconstituting Dantrolene you should use which of the following?
 

A. 60cc Preservative-Free Water
- ❖ Each vial of Dantrolene contains 20mgs of Dantrolene?
 

True

**Preoperative Nursing  
Role**



- ❖ Assess patient/family history related to MH susceptibility
  - ? Has anyone ever told you that you or a family member had a problem with anesthesia?
  - ? Have you or a family member experienced a high fever while under anesthesia?
- ❖ Notifies Anesthesia and OR nurse if patient concerns related to MH arise.

**Operating Room Nursing  
Role**



- ❖ Collaboration with Anesthesia is imperative
- ❖ Seek extra licensed personnel to mix dantrolene
- ❖ Assemble ice packs & place at axilla and groin areas
- ❖ Dispense cold saline for body cavity irrigation
- ❖ Insert 3 way foley catheter for cold irrigation and urine output
- ❖ Assist with central line placement



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**Post Recovery Nursing**  
Role

- ❖ Continue to deliver dantrolene 1mg/kg IV every 4 to 8 hours (per Anes order)
- ❖ Monitor core temp and continuing cooling until temp is 38°C (100.4° F)
- ❖ Monitor vital signs, urine output, obtain serum studies, monitor for arrhythmias
- ❖ Extubated patients will have difficulty swallowing, weak grip strength and leg movement (educate patient)
- ❖ Monitor for MH recurrence (can occur within the first 24 hours)

Recommendation: Patient should be monitored in a critical care unit for a minimum of 36 hours.

**Check in Question**


- ❖ Should the Preoperative nurse alert Anesthesia if a patient is suspected of being susceptible or having a history of MH.  
True or False
- ❖ Should the Postoperative nurse monitor for recurrence of MH, especially within the first 24 hours?  
True or False

**Check in Question**

- ❖ Should the Preoperative nurse alert Anesthesia if a patient is suspected of being susceptible or having a history of MH.  
True
- ❖ Should the Postoperative nurse monitor for recurrence of MH, especially within the first 24 hours?  
True

**Malignant Hyperthermia**  
Preparedness at Genesys

- ❖ Here at Genesys Regional Medical Center there are 2 available Malignant Hyperthermia tackle boxes.  
1-box is kept on the 3<sup>rd</sup> floor operating room located within the anesthesia workroom.  
1- box is kept on the 1<sup>st</sup> floor labor & delivery operating rooms within the anesthesia workroom



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### Malignant Hyperthermia Preparedness at Genesys

- ❖ The Malignant Hyperthermia Tackle Boxes contain the following:

24 vials of Dantrolene  
25 vials of Preservative-free Sterile Water  
5 amps of Sodium Bicarbonate  
2 amps of Dextrose 50%  
2 amps of Procainamide  
2 amps of Calcium Chloride  
2 amps of 2% Lidocaine  
Assorted Needles, Syringes, Filters, & NG Tube

### MHAUS contact Information

- ❖ The MHAUS goal is to educate the public and offer support to patients and their relatives. Patients and their families should be given information about MHAUS including:

-Website: [www.mhaus.org](http://www.mhaus.org)  
-Phone number: (607)674-7901  
-Email: [info@mhaus.org](mailto:info@mhaus.org)

### Summary

- ❖ MH is an autosomal dominant inherited disorder.
- ❖ More than 50% of MH susceptible people are not aware of their condition.
- ❖ The most frequent triggering agents are succinylcholine & most anesthetic gases.
- ❖ The triggering agents interfere with skeletal muscle cell's ability to regulate the  $Ca^{++}$  ions.
- ❖ Dantrolene is the only treatment available for MH
- ❖ MHAUS is an organization that provides MH education to patients, family members, & health care providers.

### References

- ❖ Association of periOperative Registered Nurse (AORN) (2011), Perioperative standards and recommended practices. Denver, CO: AORN Publications
- ❖ Larach, M. G., Dirkesen, S., Belani, K. et.al. (2012). Creation of a guide for transfer of the care of the malignant hyperthermia patient. [www.anesthesia-analgesia.org/content/114/1/94?related-urls=yes&legid=anesthanalg.114/1/94](http://www.anesthesia-analgesia.org/content/114/1/94?related-urls=yes&legid=anesthanalg.114/1/94).
- ❖ Malignant Hyperthermia Association of the United States (MHAUS) (2011). Healthcare professional. [www.mhaus.org/healthcare-professionals/#\\_UBqRyJrU2L](http://www.mhaus.org/healthcare-professionals/#_UBqRyJrU2L).  
Permission granted from MHAUS to use and distributed contact information



8/8/12

**MH Learning Assessment  
Case Study**

A 16 year old male scheduled to have his appendix out, arrives in the preoperative area. The preoperative nursing assessment reveals the patient denies ever having surgery and is unaware of family members ever having difficulty with anesthesia. However the patient does state he has been treated for heat exhaustion and does have periods of paralysis in his right leg

Name three (3) pieces of patient assessment data that should alert the nurse to the patient being at risk for MH.

**Malignant Hyperthermia  
Learning Module Quiz**

[Please Click Here To Be Redirected To The MH Quiz](#)

Just a reminder this module is not part of nursing's annual competency requirements

Thank you for your time and feedback!

**Appendix B****Preceptor/Student Evaluation Form for Scholarly Project Completion****Preceptor: Lisa Tedrow****Student: Ginger VanDenBerg**

|  |               |                             |                              |          |
|--|---------------|-----------------------------|------------------------------|----------|
| Objective 1.1 Conduct a literature search to identify research and evidence based practice related to the most up to date nursing assessment and medical treatment for Malignant Hyperthermia.<br><i>A bibliography page will be compiled and presented to the project preceptor by May 21, 2012</i> |               |                             |                              |          |
|  | Objective Met | Objective Needs Improvement | Objective Below Expectations | Comments |
| Preceptor Appraisal  | X             |                             |                              |          |
| Student Appraisal  | X             |                             |                              |          |
| Additional Comments for Feedback<br>All literature was recent/most current evidence, from within the past six years. L.T.<br>Bibliography page was compiled and presented on May 21, 2012. G.V.  |               |                             |                              |          |

|   |               |                             |                              |          |
|---|---------------|-----------------------------|------------------------------|----------|
| Objective 1.2 Identify learning objectives utilizing Bloom's Taxonomy for cognitive development.<br><i>Educational learning objectives will be developed identifying learned knowledge to be accomplished, learning objective will be presented.</i>  |               |                             |                              |          |
|   | Objective Met | Objective Needs Improvement | Objective Below Expectations | Comments |
| Preceptor Appraisal   | X             |                             |                              |          |
| Student Appraisal   | X             |                             |                              |          |
| Additional Comments for Feedback<br>Learning objectives were appropriate for the level of learners. We have had nice conversations discussing utilization of different levels of objectives with various levels of learners. L.T.<br>Learning objective were developed, presented, and discussed with preceptor. G.V. |               |                             |                              |          |

|   |               |                             |                              |          |
|---|---------------|-----------------------------|------------------------------|----------|
| Objective 1.3 Develop learning module content that supports the identified learning objectives, based upon the information retrieved from the literature reviewed.<br><i>Utilizing a constructivist learning theory learning content delivered through a powerpoint format will be constructed and presented to the project preceptor by June 5, 2012</i> |               |                             |                              |          |
|   | Objective Met | Objective Needs Improvement | Objective Below Expectations | Comments |
| Preceptor Appraisal   | X             |                             |                              |          |

|  |   |  |  |  |
|--|---|--|--|--|
| Student Appraisal  | X |  |  |  |
| Additional Comments for Feedback<br>The content in the learning module was done well, supported the objectives, the slide design was appropriate, including the photos and graphs. L.T.<br>Although the content development took several days I did present a draft of the powerpoint by June 5 <sup>th</sup> . G.V. |   |  |  |  |

|  |               |                             |                              |          |
|--|---------------|-----------------------------|------------------------------|----------|
| Objective 1.4 Facilitate a meeting with Genesys's information system personnel to verify program compatibility and identify a date for integration of the learning module onto the learning management system.<br><i>A meeting agenda and minutes will be documented related to discussions and decisions for the integrating and implementing the learning module through the LMS, this documentation will be discussed with the project preceptor by June 15, 2012</i> |               |                             |                              |          |
|  | Objective Met | Objective Needs Improvement | Objective Below Expectations | Comments |
| Preceptor Appraisal  | X             |                             |                              |          |
| Student Appraisal  | X             |                             |                              |          |
| Additional Comments for Feedback<br>Reviewed and discussed meeting outcome. L.T.<br>Projected date for implementation is July 9 <sup>nd</sup> . G.V.   |               |                             |                              |          |

|   |               |                             |                              |          |
|---|---------------|-----------------------------|------------------------------|----------|
| Objective 1.5 & 1.6 Conduct research and review of literature to identify appropriate evaluation methods to assess learned knowledge and effectiveness of learning content. Create learner evaluations based upon discuss and feedback from my preceptor identify appropriate evaluation methods.<br><i>A bibliography paper will be compiled and organized to reflect research and review of evaluation methods to capture knowledge learned, the bibliography will be present and discussed with preceptor to chose appropriate evaluation methods, evaluations will be created and integrated into the learning module for preceptor review by June 22, 2012</i> |               |                             |                              |          |
|   | Objective Met | Objective Needs Improvement | Objective Below Expectations | Comments |
| Preceptor Appraisal   | X             |                             |                              |          |
| Student Appraisal   | X             |                             |                              |          |
| Additional Comments for Feedback<br>Various evaluations were discussed, placing emphasis on both summative and formative assessment. L.T.<br>After discussing I will be implementing both summative and formative methods. G.V.<br><br>I would recommend including the program objectives in the participant evaluation to allow the learner an opportunity to reflect upon attainment of program goals and objectives. This is additional feedback for Ginger after her project presentation. L.T.   |               |                             |                              |          |

Objective 2.1 Submit the online learning module content/program to the information systems personnel for integration in the LMS. Assessment of learning content within the LMS will verify module integration is successful and the correct evaluation data is collected.

*Preceptor will review learning module through the online delivery mode and verify evaluation methods are successful by June 27, 2012*

|                                  | Objective Met | Objective Needs Improvement | Objective Below Expectations | Comments |
|----------------------------------|---------------|-----------------------------|------------------------------|----------|
| Preceptor Appraisal              | X             |                             |                              |          |
| Student Appraisal                | X             |                             |                              |          |
| Additional Comments for Feedback |               |                             |                              |          |

Objective 2.2 Implementation of the learning module through the LMS will be achieved through perioperative nursing staff assignment and staff notification of module availability and requested due date will be provided through the employee email system.

*A meeting with preceptor will confirm perioperative nursing assignment and notification by July 9, 2012.*

|   | Objective Met | Objective Needs Improvement | Objective Below Expectations | Comments |
|---|---------------|-----------------------------|------------------------------|----------|
| Preceptor Appraisal   | X             |                             |                              |          |
| Student Appraisal   | X             |                             |                              |          |
| Additional Comments for Feedback<br>Discussed with preceptor the process taken, not to assign the module directly with staff per management request. Explain the process for staff to self assign. G.V. |               |                             |                              |          |

Objective 3.1 Evaluate and report the information and data collected through evaluations.

*A detailed report revealing learner accomplishment and feedback will provide a visual for the preceptor to review and discussion for project improvement and success.*

|   | Objective Met | Objective Needs Improvement | Objective Below Expectations | Comments |
|---|---------------|-----------------------------|------------------------------|----------|
| Preceptor Appraisal   | X             |                             |                              |          |
| Student Appraisal   | X             |                             |                              |          |
| Additional Comments for Feedback<br>Program was well received by nursing staff, reflected by positive written evaluations as well as verbal comments. |               |                             |                              |          |

Appendix C

Completed Likert Scale Evaluation

Malignant Hyperthermia Learning Module

Your input is encourage to improve learning content and delivery

This is anonymous –please do not summit your name, fold evaluation when completed, place in provided envelopes, seal envelope and place in box.

Thank you for your feedback, Ginger VanDenBerg

| <i>Place an X under the heading that reflects your opinion to the following questions</i> | Strongly Agree<br>5 | Agree<br>4 | Undecided<br>3 | Disagree<br>2 | Strongly Disagree<br>1 |
|---|---------------------|------------|----------------|---------------|------------------------|
| The course content was organized and in a logical order.                                  | X                   |            |                |               |                        |
| The course content can be applied to my nursing practice                                  | X                   |            |                |               |                        |
| The course content will benefit my nursing practice                                       | X                   |            |                |               |                        |
| I found the online method for content delivery easy to use                                | X                   |            |                |               |                        |
| The online method was appropriate for this content delivery                               |                     | X          |                |               |                        |
| Additional Comments/Feedback<br><i>would appreciate hands-on, mock run through.</i>       |                     |            |                |               |                        |

## Appendix D

Formative Evaluation Questions Loaded into the test bank

## Malignant Hyperthermia Quiz

1. A child of a parent who has been diagnosed with Malignant Hyperthermia has a 50% chance of also having Malignant Hyperthermia?
  - a. True
  - b. False
  
2. Males more commonly develop MH than females?
  - a. True
  - b. False
  - c.
3. Circle two (2) key factors of a patient's medical history pointing to them being susceptible to MH?

Congenital Heart Disease

Repeated Infections

Central Core Disease

Periodic Paralysis
4. The depolarizing muscle relaxant Succinylcholine is considered one of the triggering agents for MH?
  - a. True
  - b. False
  - c.
5. The triggering agents for MH interfere with what skeletal muscle cell ion?
  - a. Magnesium
  - b. Potassium
  - c. Calcium
  - d. Sodium
  
6. What is the only drug used to treat MH?

7. Circle two (2) signs and symptoms of a MH crisis.

Headaches

Increased Heart Rate

Muscle Rigidity

Excessive Tearing

8. Recurrence of MH can occur during the first 24 hours following an MH crisis?
- True
  - False
9. When dissolving Dantrolene (in a vial) what solution is used?
- Preservative-free sterile water
  - Bacteriostatic water
10. Does MHAUS stand for Malignant Hyperthermia Association of United States?
- True
  - False
11. Lasix is given IV push to help flush what organ(s) during a MH crisis?
12. Genesys Regional Medical Center has 2 MH tackle boxes, where are they located?
13. Name two (2) drugs found within the MH tackle box
14. You are providing nursing care for a patient after having a MH crisis, should you provide the patient and family with information about MHAUS?
15. Name two (2) interventions a nurse may have to consider when caring for a patient after a MH crisis