

Use of Simulation to Practice Multidisciplinary Anaphylaxis Management

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Multidisciplinary clinical simulation can be an essential part of nursing education strategies to improve and enhance patient safety and experience. Clinical simulation can be utilized to change practice, reinforce practices, and direct patient and family education needs for a safe discharge. Anaphylaxis is potentially fatal and is increasing in occurrence. A simulation scenario was designed by a multidisciplinary team to review anaphylaxis recognition and to provide simulated practice for emergency response. Clinical scenarios were developed based on evidence-based practices and included a prebriefing and postdebriefing. Bandura's self-efficacy theory was used as a framework to develop the project, as it supports behavior change strategies well suited for clinical simulation. Clinical simulations provide a nonthreatening environment for staff to learn, practice, and receive feedback to improve patient care and serve as a vehicle to role-play expected practices, enhance communication between disciplines, demonstrate progress, and evaluate competency.

Keywords: Simulation, Multidisciplinary anaphylaxis management, Self-efficacy theory

[DIMENS CRIT CARE NURS. 2013;32(6):280-285]

Multidisciplinary clinical simulation can be an essential part of nursing education strategies to improve and enhance patient safety and experience.¹⁻⁵ Clinical simulation can be utilized to change practice, reinforce current practices, and direct patient and family education needs for a safe discharge.¹⁻⁶ A simulation scenario was deemed an effective strategy to review anaphylaxis recognition and treatment in response to a negative patient outcome. The nursing education department identified a need to provide education

addressing the initial rapid recognition and treatment of anaphylaxis and biphasic or rebound anaphylaxis following a challenging clinical situation involving anaphylaxis in a patient with allergen triggers. The simulation program was also selected as the format to re-enforce changes previously implemented by pharmacy on anaphylaxis treatment and storage of epinephrine. These changes were made in response to the recommendation of the Institute of Safe Medicine Practices to avoid multiple concentrations of the same drug

in code carts such as epinephrine concentrations of 1:1000 and 1:10 000.^{7,8} To facilitate communication during the simulation, the ISBAR (introduction, situation, background, assessment, recommendation) handoff format was used.^{9,10} A standardized communication format is recommended by the 2011 Joint Commission Patient Safety Goals.^{8,9} The ISBAR model fit well into the simulation format. To address anaphylaxis and biphasic or rebound anaphylaxis situations, groups of 4 to 6 participants received 2 different scenarios, which were repeated for each group. This repeated scenario helped in training a large number of staff nurses (169) in a limited time frame.

■ ANAPHYLAXIS IN THE HOSPITAL SETTING

Anaphylaxis is potentially fatal and is increasing in occurrence, and recommendations for immediate treatment of anaphylaxis have also changed.¹⁰⁻¹³ In 2006, the National Institute of Allergy and Infectious Disease and other world experts convened a panel to define and to help improve the ability of clinicians and first responders in establishing a rapid diagnosis of anaphylaxis.¹⁰⁻¹³ The National Institute of Allergy and Infectious Disease defines anaphylaxis as a severe, potentially fatal, systemic immunoglobulin E-mediated allergic reaction that occurs suddenly after contact with an allergy-causing substance.¹⁰⁻¹³ Multiple studies have reported that delayed administration of epinephrine may predispose the patient to a biphasic reaction, in which signs and symptoms of anaphylaxis reoccur within 72 hours of the initial event.^{10,11} Research has not shown the ability to predict patient survival from anaphylaxis, even when treated; therefore, it is difficult to know the outcome of an anaphylaxis episode.^{6,10,13}

Bandura's self-efficacy or social cognitive theory provides a theoretical framework for the clinical simulation where understanding and performance predict the expected behavior.¹⁴ Thus, staff learn via observation, imitation, and modeling.¹⁴ Self-efficacy theory attempts to unify the theory of behavioral change to include both cognitive or understanding processes and the performance-based procedures or motor skills that effect psychological changes and supports the idea of clinical simulation.¹⁴ The participants need to be observant, utilize memory, and acquire motivation to learn these clinical behaviors.

■ SPECIFIC CLINICAL CONCERNS

Anaphylaxis and biphasic anaphylaxis are a concern in many areas of the hospital that administer medications, inject dyes, or encounter patients with allergies or angioedema. Additional concerns arise in a safety net hospital with a vulnerable patient population that may not seek emergency treatment until later in the anaphylaxis process.^{10-13,15} In the inpatient population, surgical patients may not be able to complain of itching skin or swelling

throats while under the effects of anesthesia or may be too critically ill to communicate. Additional challenges exist when physical assessment is compromised, such as during surgery when patients are draped with sterile sheets and visual inspection of the skin is limited.

Patients suffering an anaphylactic event in the hospital require extensive discharge teaching regarding administration technique for self-administration of emergency care, using the epinephrine auto-injector, and instructions for emergency follow-up. The current widespread use of epinephrine auto-injectors for allergy treatment was a concern for the staff nurses, as they were unfamiliar with how to properly operate the intramuscular epinephrine auto-injector. Nurses reported that patients and families were asking them to demonstrate the correct usage of epinephrine auto-injectors during discharge teaching. The incorrect use of these pens has resulted in the medication being injected into fingers.¹⁶ In addition, the epinephrine auto-injector trainer, which has been packaged with the epinephrine auto-injector has been mistaken for the actual drug pen.¹⁷ It is important that nurses be able to demonstrate the correct use of equipment that must be included in discharge teaching. For this reason, drug administration using the epinephrine auto-injector was included in the training sessions.

■ DEVELOPMENT AND IMPLEMENTATION OF SIMULATION SCENARIO

A clinical scenario requires evidence-based practice or research to create and develop the roles that demonstrate critical thinking and skill acquisition.^{2,4-6,18,19} The clinical simulation scenario is preceded by a prebriefing and followed by a debriefing.^{2,20,21} The prebrief sets the stage for the scenario, including demonstrating the abilities of the simulation mannequin such as palpable pulses, talking, and breath sounds that are audible through a stethoscope. In addition, the medical equipment used during the simulation was reviewed. Simulation used a concept referred to as "suspension of disbelief." This phenomenon dates back to the 1800s, in which you temporarily disregard information from your senses and logic for the enjoyment of fiction. Staff were asked to immerse themselves in the scenario and to believe the unbelievable.

■ EQUIPMENT AND SIMULATIONS AIDS

Our simulation mannequin became a "Mrs" with the addition of a Halloween wig. Comments on our patient's hairstyle provided some humor to relieve the tension and set the tone for the scenario. The setting included a realistic patient environment equipped with emergency response equipment.

To enhance the visual effects of anaphylaxis, "moulage" or the technique of manufacturing realistic skin wounds for clinical simulation was used to mimic hives. Clear

plastic wrap was placed on the chest and extremities of the simulation manikin and marked with red magic marker to simulate hives.

■ DEVELOPING CLINICAL SCENARIOS

After reviewing existing scenarios available to nursing education, it was determined that the lack of complexity of these standard cases would not cover the issues of concern in appropriate depth. Therefore, clinical scenarios were custom designed, in conjunction with the respiratory therapy and pharmacy personnel, to meet our specific objectives. A scenario with high-fidelity simulation was constructed to be utilized in both critical care and procedural care annual competency days. Prebriefing sets the scene for the simulation scenario.² The simulation was followed by a debriefing that was twice as long as the scenario to allow time for learning and critical thinking to occur.^{2-5,18,19}

■ PARTICIPANTS

The nurse participants in the anaphylaxis simulation included 169 nurses composed of 95 critical care nurses from 5 intensive care units and 67 postanesthesia care nurses from 3 perianesthesia care units, endoscopy nurses, interventional radiology nurses, cardiac catheterization laboratory nurses, electrophysiology laboratory nurses, and cardiac stress laboratory nurses. The staff nurses were expert practitioners in their respective areas. Many of these nurses did not have clinical simulation as part of their basic nursing preparation but were introduced to the concept when simulation and role playing were included in the annual competency day a few years ago.

■ DIRECTING THE SIMULATION

Two nurse educators directed the simulation. One operated the computer equipment and had the ability to produce impromptu voice-overs, simulating the patient's responses. The second nurse educator remained with the group to provide direction and clarify simulation questions.

Respiratory therapists were called in "stat" to the scenarios when potential airway issues arose. The addition of the respiratory staff added realism to the respiratory interventions proposed by the group. In addition, the staff could advise the group on the potential for mechanical ventilation and respiratory treatments required as the clinical events unfolded. Respiratory therapy students were also included in the scenarios as part of their clinical practicum at this academic teaching medical center to strengthen teamwork skills.^{2-5,8,15} Emergency equipment, a medication dispensing machine, intravenous pumps, and cardiac monitoring equipment were available during the scenario.

The scenario incorporated communication with physicians, using the ISBAR format. It required the staff to find the appropriately indicated medications and intrave-

nous fluids necessary to stabilize the patient condition. Failure to initiate critical actions caused the simulated patient to show signs of clinical decompensation, resulting in cardiovascular compromise and arrest. If the anaphylaxis was not recognized from the patient's comment of "I feel itchy," and the "moulage" hives were not noticed under the bed covers, and appropriate actions were not taken, the patient's condition worsened. An antibiotic running intravenously in the beginning of the scenario also needed to be recognized as a potential allergen trigger, immediately discontinued, and the physician notified. Removal of the allergen trigger is crucial.¹⁰⁻¹²

Another critical behavior was the timely identification of the correct dose and concentration of epinephrine and the correct route of administration. Epinephrine is the first-line drug for anaphylaxis treatment.^{10-13,22-25} For adults, the recommended dose of epinephrine (1 mg/mL concentration) is 0.01 mg/kg to a maximum of 0.5 mg (or the usual adult dose of 0.3-0.5 mg per single dose), injected intramuscularly into the midanterolateral thigh (vastus lateralis muscle).^{10-13,22-25} This treatment may be repeated at 5- to 15-minute intervals, based on clinical experience and consensus opinion.^{10-13,22-25} The 1 mg/mL of epinephrine may also be labeled as 1:1000 concentration or dilution.²²⁻²⁵

If the patient does not respond adequately to the intramuscularly administered (IM) epinephrine, then an epinephrine infusion of 2 to 10 µg/min regulated by an infusion pump is suggested.^{10-13,22-24} Titration of the intravenous epinephrine infusion is based on blood pressure, heart rate, and oxygenation monitoring.^{10-12,22-25} It is crucial to distinguish between available dilutions or concentrations of epinephrine to avoid overdosing the prescribed amount of medication. Epinephrine infusion is 0.1 mg/mL or the 1:10 000 dilution.^{10-12,22-25} Protracted or recurrent anaphylaxis in the subsequent scenario required re-administration of epinephrine IM and consideration of a continuous infusion of epinephrine.

There are no absolute contraindications to the use of epinephrine in the treatment of anaphylaxis because the risk of death or serious disability from hypoxic ischemic encephalopathy from inadequately treated anaphylaxis itself usually outweighs other concerns.^{6,10-13} Timely administration of epinephrine in the correct dose and the right route of administration was called for to prevent further deterioration of the patient in the scenario.

Fluid resuscitation should be initiated immediately in patients who present with orthostasis, hypotension, or incomplete response to intramuscular epinephrine.¹⁰ For treatment of hypovolemia, adults should receive 1 to 2 L of normal saline intravenously at a rate of 5 to 10 mL/kg in the first few minutes.¹⁰ Large volumes of fluid, up to 7 L, may be required.^{10,12} Normal saline is preferred initially

for the first few liters, as lactated Ringer's solution may potentially contribute to metabolic acidosis, and dextrose may rapidly extravasate from the circulation into interstitial tissues.¹⁰

Airway compromise required racemic epinephrine nebulizer, trialing of oxygen delivery modes, continuous monitoring of oxygen saturation, and assessment of the need for possible intubation and mechanical ventilation.^{10-12,22-25}

Expert medical specialty consultations should be considered, especially if angioedema is indistinguishable from anaphylaxis. Certain medications may contribute to anaphylaxis and need to be avoided or discontinued. Identification of triggers and future avoidance of the trigger is the plan.^{10-12,22-25} In addition to epinephrine, supplemental treatment options may include H1 antihistamines, H2 blockers for immunoglobulin E mediation, and administration of steroids to treat both angioedema and anaphylaxis.^{10-12,22-25}

CONCLUSION AND DEBRIEFING

Many nurses did not want to end the scenario and engaged in continued discussion, exchanging stories and patient experiences that were related to the scenario, debriefing session included all participants.^{2-4,18-21} Prompt anaphylaxis recognition, treatment, and patient education issues, as well as changes in the storage of epinephrine concentrations by the hospital pharmacy, were reviewed.

The progression through the 3 phases of debriefing (reaction, analysis, and summary) was planned to fit the participant objectives and to allow for a dynamic process of reflection and thinking to occur as suggested by simulation experts.^{2-4,18,19,21} Participant remediation occurred directly following the simulated scenario in the debriefing session.^{4,5,18-19,21} Nursing and respiratory staff discussed open-ended questions about the accuracy of care: what went well, what did not, what was a mistake, and what did we learn?

KEY CONCEPTS SUPPORTED BY EVIDENCE-BASED PRACTICE

During debriefing, key concepts supported by evidence-based research were reinforced. This information included the following:

- rapid anaphylaxis identification^{10-12,22-25};
- treatment and management of initial event and of biphasic anaphylaxis^{10-12,22-25};
- rebound anaphylaxis can occur within 8 to 72 hours following the exposure to the original source or trigger, hence the need to admit patients for monitoring of their response to treatment²⁵;
- patient and family discharge education methods such as utilizing the pneumonic SAFE (S = seek support, A = allergen identification and avoidance, F = follow-up with specialty care, E = epinephrine for emergencies)²⁵;
- effective use of the epinephrine auto-injector prior to discharge of the patient²⁵;
- patients are encouraged to have their epinephrine auto-injectors filled by family members prior to discharge from the facility to avoid any delay in treatment should rebound occur²⁵; and
- plans must be made to include the possibility of rebound anaphylaxis and its prompt treatment.²⁵

During the debriefing session, misconceptions or omissions that occurred during the scenario were corrected by the nurse educators.²⁶ Respiratory therapy reviewed information on mechanical ventilation settings to prevent acute lung injury, sizing of the oral airways, and successful airway management. Discussion included an emphasis on multidisciplinary teamwork, using the model for teamwork training by hospital staff, recommended by the Institute of Medicine to improve patient safety.^{2,7,8}

EVALUATION

Written evaluations of the simulation were extremely positive (Table). Ninety-seven percent (n = 169) of the combined nurses or 98% of critical care nurses (n = 95) and 97% of the procedural area nurses (n = 69) including postanesthesia care units rated the anaphylaxis and biphasic anaphylaxis simulation scenarios in competency day at a range of 4 = very good/helpful to 5 = excellent/most helpful. Nurses stated they had not remembered the change in storage of differing concentrations of epinephrine until after completing the competency day simulation. Nurses reported that they had enhanced their understanding of early, rapid recognition and treatment of anaphylaxis and angioedema.

TABLE Evaluation of Competency Day 2011-2012 Anaphylaxis Simulation for Both Intensive Care Unit and Procedural Nurses

n = 169	5 = Excellent/Very Helpful	4 = Very Good/Helpful	3 = Good/Helpful	2 = Fair/Least Helpful	1 = Poor/Not Helpful
Nurses	107/169 = 63%	57/169 = 34%	3/169 = 2%	2/169 = 1%	0%

Ninety-seven percent of the nurses rated the simulation 4 (very good/helpful) or 5 (excellent/ most helpful).

During the debriefing, staff nurses stated that they were unaware of the changes in the code cart to prevent errors. Specifically, they were not aware of the change in storage of the 2 concentrations of epinephrine and the new recommendation for IM epinephrine. Some nurses reported that they were unfamiliar with biphasic or protracted anaphylaxis treatment, despite traditional teaching strategies from the nursing education and pharmacy departments prior to this competency.

Nurses were intrigued with the talking mannequin in a patient bed with a cardiac monitor and wall unit fully equipped with hospital gases and emergency medical equipment. The realistic setting allowed nurses to forget “this was only a scenario.” Participants commented that the scenarios reminded them to consider that many patients would be unable to complain of anaphylaxis because of anesthesia or unresponsiveness or hypotension secondary to vasodilatation. They also realized how difficult it would be to see skin changes occurring under sterile fields or drapes or bed covers. However, they recognized that triggers of anaphylaxis were evident in the patient’s medication list, extensive allergies, initiation of antibiotics, and history of the event.

CONCLUSIONS/OUTCOMES

In the year following this multidisciplinary simulation on treatment and prevention of anaphylaxis, there have been no negative patient outcomes. Patients who have had anaphylactic episodes have been discharged from the hospital with a “SAFE” plan and a filled prescription for an epinephrine autoinjector(s).

Role playing in clinical simulation is an effective method for enhancing nurses’ confidence in patient assessment skills, recognition of a problem, and accurate communication of findings to others on the healthcare team. Clinical simulation is a nonthreatening environment for all clinical staff to learn, practice, and receive feedback on clinical issues and improve practice.

Acknowledgments

The authors thank the nurses and respiratory therapists of Boston Medical Center for their exceptional patient care given to all patients.

References

1. Durham CF, Alden KR. Enhancing patient safety in nursing education through patient simulation. In: *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. Agency for Healthcare Research and Quality; 2008:3-221-260. www.ahrq.gov/qual/nurseshdbk/. Accessed July 31, 2013.
2. Galloway SJ. Simulation techniques to bridge the gap between novice and competent healthcare professionals. *Online J Issues Nurs*. 2009;2(14): manuscript 3.
3. Ackermann AD. Investigation of learning outcomes for the acquisition and retention of CPR knowledge and skills learned with the use of high-fidelity simulation. *Int Nurs Assoc Clin Simul Learn*. 2009;5:e213-e222.
4. Ackermann AD, Kenny G, Walker C. Simulator programs for new nurses’ orientation: a retention strategy. *J Nurses Staff Dev*. 2007;3(23):136-139.
5. Wickers MP. Establishing the climate for a successful debriefing. *Clin Simul Nurs*. 2010;6(3):e83-e86.
6. Golden D. Patterns of anaphylaxis: acute and late phase features of allergic reactions. In: *Anaphylaxis*. Chichester: Wiley; 2004:101. Novartis Foundation Symposium 257.
7. Preventing medication errors during codes. *ISMP Medication Safety Alert*. February 10, 2011. <http://www.ismp.org/newsletters/acutecare/articles/20110210.asp>. Accessed July 31, 2013.
8. *National Patient Safety Goals*. Oakbrook Terrace, IL: The Joint Commission; 2011. <http://psnet.ahrq.gov/resource.aspx?resourceid=2230>. Accessed July 31, 2013.
9. Wood D. SBAR improves communication in patient handoffs. 2008. http://www.nursezone.com/nursing-news-events/more-features/sbar-improves-communication-in-patient-handoffs_21756.aspx. Accessed July 31, 2013.
10. Lieberman P, Camargo CA Jr, Bohlke K, et al. Epidemiology of anaphylaxis: findings of the American College of Allergy, Asthma and Immunology Epidemiology of Anaphylaxis working group. *Ann Allergy Asthma Immunol*. 2006;97:596.
11. Sampson HA, Muñoz-Furlong A, Campbell RL, et al. Second symposium on the definition and management of anaphylaxis: summary report—second National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network Symposium. *J Allergy Clin Immunol*. 2006;117:391.
12. Sampson HA, Muñoz-Furlong A, Bock SA. Symposium on the definition and management of anaphylaxis: summary report. *J Allergy Clin Immunol*. 2005;115:584.
13. Pumphrey R. Anaphylaxis: can we tell who is at risk of a fatal reaction? *Curr Opin Allergy Clin Immunol*. 2004;4:285.
14. Bandura A. *Self-efficacy: The Exercise of Control*. New York: W. H. Freeman; 1997.
15. Safety Net Hospitals. <http://aspe.hhs.gov/health/reports/02/dsh/ch2.htm>. Accessed July 31, 2013.
16. Training pen in EPIPEN (EPINEPHRINE) 2-Pak may be mistaken as actual EPIPEN. *ISMP Medication Safety Alert. ISMP Quarterly Action Agenda* July-September 2011:15.
17. Thumbs accidentally injected Despite EPIPEN redesign. *ISMP Medication Safety Alert. ISMP Quarterly Action Agenda* November 2010;8(11).
18. Ackerman A. Designing simulation scenarios. Paper presented at the 20th Annual Conference for Nurse Educators Clinicians and Educators: Partners in Developing Tomorrow’s Nurse; June 2012; Hyannis, MA.
19. Ackerman A. Standards of best practices for patient simulation. Paper presented at 20th Annual Conference for Nurse Educators Clinicians and Educators: Partners in Developing Tomorrow’s Nurse; June 2012; Hyannis, MA.
20. Shinnick MA, Woo M, Horwich TB, Steadman R. Debriefing the most important component of simulation? *Clin Simul Nurs*. 2011;7:e105-e111.
21. Cantrell MA. The importance of debriefing in clinical situations. *Int Nurs Assoc Clin Simul Learn*. 2008;4:e19-e23.
22. Simons FER. Anaphylaxis. *J Allergy Clin Immunol*. 2010;125:S161-S181.
23. Lieberman P, Nicklas RA, Oppenheimer J, et al. The diagnosis and management of anaphylaxis practice parameter: 2010 update. *J Allergy Clin Immunol*. 2010;126:477.
24. Anchor J, Settignano RA. Appropriate use of epinephrine in anaphylaxis. *Am J Emerg Med*. 2004;22(6):488-490.
25. Lieberman P, Decker W, Camargo CA, O’Connor R, Oppenheimer J, Simons FE. SAFE: a multidisciplinary approach to anaphylaxis education in the emergency department. *Ann Allergy Asthma Immunol*. 2007;98(6):519-523.
26. Decker S, Fey M, Sideras S, et al. Standards of best practice: simulation standard VI: the debriefing process. *Clin Simul Nurs*. 2013;9(6S):S27-S29.

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This study has no sources of funding.

The authors have disclosed that they have no significant relationship with, or financial interest in, any commercial companies pertaining to this article.

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