MedEdPORTAL® The AAMC Journal of Teaching and Learning Resources

Original Publication Open Access

Unifying Resident Education: 12 Interdisciplinary Critical Care Simulation Scenarios

Mark J. Bullard, MD, MS-HPEd*, Sean M. Fox, MD, Alan C. Heffner, MD, Christie L. Bullard, RN, Catherine M. Wares, MD

*Corresponding author: mark.bullard@atriumhealth.org

Abstract

Introduction: Unified critical care training within residency education is a necessity. We created a simulation-based curriculum designed to educate residents on core topics and procedural skills, which crossed all adult disciplines caring for critically ill patients. **Methods:** Residents from seven adult disciplines participated in this annual program during intern year. Learners were grouped into mixed discipline cohorts. Each cohort attended three distinct 4-hour simulation-based sessions, each consisting of four scenarios followed by postevent debriefing. The curriculum included 12 total clinical scenarios. Scenarios covered a broad array of complex critical care topics facing all adult specialties and reinforced important system-specific initiatives. Assessments evaluated clinical performance metrics, self-reported confidence in curricular topics, procedural and communication skills, resident satisfaction, and interdisciplinary attitudes. **Results:** Quantitative and qualitative data analyzed in three published works over the past 9 years of curricular programming has demonstrated highly satisfied learners along with improved: clinical performance; self-reported confidence in clinical topics, procedural, and communication skills; and interdisciplinary collegiality. **Discussion:** Purposeful focus on curricular development that integrates basic, clinical, and procedural content, while promoting the development of interdisciplinary relationships and the practice of critical thinking skills, is vital for successful education and patient care. This curriculum was well received by interns, covered difficult to obtain GME milestones, and provided an opportunity for interdisciplinary education. In an era of limited time for devoted bedside teaching and variable training exposures to certain disease processes, the development and implementation of this curriculum has filled a void within our system for unified resident education.

Keywords

Critical Care, Simulation Education, Curriculum, Resident Education, Interdisciplinary, Physician, Clinical/Procedural Skills Training, Simulation, Standardized Patient

Educational Objectives

By the end of this activity, residents should:

1. Increase confidence in managing critically ill patients.
2. Increase confidence in select procedural skills.
3. Increase confidence in communication skills.
4. Improve clinical performance.
5. Be satisfied in their overall curricular experience.
6. Improve between-discipline outlooks and attitudes.

Citation:
Bullard MJ, Fox SM, Heffner AC, Bullard CL, Wares CM. Unifying resident education: 12 interdisciplinary critical care simulation scenarios. *MedEdPORTAL*. 2020;16:11009.
https://doi.org/10.15766/mep_2374-8265.11009

Introduction

It is now widely accepted that medical simulation improves the acquisition of knowledge and technical skills while also providing an educational modality which satisfies learners.[1] When paired with postevent debriefing, participation in simulation enhances learning through reflective practice and its experiential, activating, and repetitive nature.[2-5] Compared to other educational modalities, simulation is unique in that it is not dependent on patient availability, helps develop critical thinking skills, hones interprofessional skillsets, creates a forum to reflect and discuss ethical and spiritual issues,[6,7] and allows for the practice of procedural skills prior to their performance on patients.

Cooperative interprofessional patient care is imperative for modern health care. It has been postulated that the educational system is one of the main drivers for placing value in collaboration between various health care professionals.[9]

Additionally, simulation-based interprofessional education (IPE) has demonstrated positive effects for interprofessional collaboration,[10] teamwork,[11,12] communication,[12] and clinical outcomes within the simulated environment.[11] While IPE differs slightly from interdisciplinary education in that the former involves students from two or more professions, and the latter involves students from two or more disciplines within a specific profession, both should abide by the same theoretical frameworks.[8] Thus, interdisciplinary simulation-based education provides an opportunity to improve collaboration between professionals and ultimately improve patient care.

Varying clinical and procedural experiences within medical school and residency have led to inconsistent education vital to the readiness for intensive care, causing residents to feel ill-prepared for intensive care unit rotations.[13] Our interdisciplinary, simulation-based program with interdisciplinary shared debriefings aimed to fill this void and mitigate these challenges. Currently in its ninth year, this curriculum represented a reproducible, interdisciplinary critical care simulation program covering overarching topics that affect all primary adult specialties. To our knowledge, this curriculum represented the only critical care simulation-based program with published quantitative and qualitative data supporting its educational benefits.[14-16] We also provided pre- and postsession asynchronous materials, along with ACGME discipline-specific curricular maps for use by respective programs to demonstrate and document exposure to various specialty-specific milestones. Therefore, this curriculum offered a unique contribution to the existing *MedEdPORTAL* literature.

Methods

Development

We designed this curriculum after an exhaustive needs assessment of our system's learners, their characteristics, institutional and system priorities, as well as time and space constraints. The simulation-based environment was ultimately chosen as the educational modality for this curriculum due to its grounding in educational theory.[2-5] Our learners consisted of all system interns from seven different adult specialties (internal medicine, emergency medicine, family medicine, general surgery, orthopedic surgery, neurosurgery, obstetrics/gynecology) within our tertiary care teaching hospital. Due to challenging clinical schedules and demands faced by resident learners and our clinician educators, our curriculum also blended asynchronous, online, self-paced educational components with the experiential, reflective, and cooperative simulation-based environment.

Approximately 65 interns participated in this annual program during the second half of the intern year. The primary goal of the program was to increase resident confidence and knowledge in managing complex disease processes that cross all adult disciplines. Additionally, the curriculum sought to improve confidence in select procedural and communication skills, leadership and teamwork skills, and create a venue for the discussion of ethical and spiritual topics often lacking in graduate medical education.

An introductory web-based module was developed for, and delivered to, all interns using a learning management system (LMS). This introduction provided an overview of simulation as an educational modality, addressed learner expectations, outlined program objectives, reinforced principles of andragogy, and illustrated the concept of psychological safety. The LMS also provided a delivery platform for educational materials prior to and immediately after each simulation session for independent, asynchronous learning. Presession educational material (Appendix N) helped introduce standardized education for our diverse group of learners and included: evidence-based literature related to the general topics covered during each session, case-based clinical vignettes with questions, and hyperlinks to websites containing relevant procedural and clinical content. Postsession education (Appendix O) included more comprehensive materials covering scenario topics, as well as a summary of key learning points. Providing the residents with key learning points within the postsession educational materials allowed facilitators the freedom to create learner-centric debriefs focusing on discussion topics most important to the residents rather than focusing strictly on learning objectives. This ultimately decreased learner cognitive load during debriefings and fostered resident engagement in rich discussion while also reinforcing learned concepts.

Equipment/Environment

All scenarios were set on the telemetry floor with the understanding that each learner was working an overnight cross-cover with limited supervision, oversight, and resources. The anaphylaxis scenario (Appendix B) was the only exception to the telemetry floor setting and was instead set in the emergency department due to ease of scenario creation. Additionally, all medical disciplines rotate in the emergency department during their intern year within our hospital. Any realism issues related to the patient setting were mitigated by maintaining uniformity to all case settings and disclosing to learners ahead of time the one alternative setting.

Task trainers (central venous catheterization trainer, lumbar puncture trainer, defibrillator with rhythm generator, video laryngoscopy and airway trainer) were incorporated separately from the actual simulation cases for deliberate practice of procedural skills. Specifically, hands-on training was incorporated for all residents within the debriefings for: central venous catheter (CVC) training (Appendix C), defibrillator training (Appendix A), transcutaneous pacing (Appendix F), lumbar puncture and video laryngoscopy (Appendix J), and synchronized cardioversion (Appendix I). The background to each patient scenario, or stem, was also noted (Appendices A-L).

Ventricular Fibrillation Arrest/Postcardiac Arrest Care Simulation Case (Appendix A):

- Environment: telemetry floor, on monitor, case stem per specialty.
- Manikin: high-fidelity manikin, SimMan 3G (defibrillator and rhythm generator for deliberate practice of defibrillation outside of scenario).
- Moulage: gown, one peripheral IV.
- Equipment: intubation equipment (GlideScope), code cart, epinephrine, amiodarone, defibrillator, backboard, oxygen, supraglottic airway, laryngoscope, endotracheal tube, bag valve mask, step stool, crystalloid, ice packs, cooling device.
- Actors: confederate nurse (RN), the three other session learners participated within the scenario to provide additional teammates for an effective code response as directed by the lead learner.

Anaphylaxis With Disclosure of Medication Error Simulation Case (Appendix B):

- Environment: emergency department, on monitor.
- Manikin: high-fidelity manikin, SimMan 3G.
- Moulage: gown, one peripheral IV, older male wig, and glasses.
- Equipment: intubation equipment (GlideScope), epinephrine, diphenhydramine, ranitidine, oxygen, nasal cannula, simple facemask, nonrebreather facemask, crystalloid, albuterol.
- Actors: standardized participant (SP) (playing role of patient's family member), confederate RN.

Upper Gastrointestinal Bleeding With Informed Consent/ Central Venous Catheterization (CVC) Simulation Case (Appendix C):

- Environment: telemetry floor, on monitor, case stem per learner specialty.
- Manikin: high-fidelity manikin, SimMan 3G, (CVC trainer for deliberate practice separate of scenario).
- Moulage: gown, nasogastric tube in place with full suction canister with blood or emesis basin full of blood, no peripheral IV.
- Equipment: intubation equipment, code cart, oxygen, emesis basin, tranexamic acid, packed red blood cells, fresh frozen plasma, prothrombin complex concentrate, platelets, octreotide, proton pump inhibitor, crystalloid, ceftriaxone, ciprofloxacin, central line kit, intraosseous access equipment.
- Actor: confederate RN.

Septic Shock Simulation Case (Appendix D):

- Environment: telemetry floor, on monitor, case stem per learner specialty.
- Manikin: high-fidelity manikin, SimMan 3G.
- Moulage: gown, IV in place, female grey wig, glasses.
- Equipment: intubation equipment, code cart, nasal canula, simple facemask, nonrebreather facemask, oxygen, norepinephrine, hydrocortisone, broad-spectrum antibiotics, crystalloid.
- Actor: confederate RN.

Asystole/Death Notification/Breaking Bad News Simulation Case (Appendix E):

- Environment: telemetry floor, on monitor, case stem per learner specialty.
- Manikin: high-fidelity manikin, SimMan 3G.
- Moulage: gown, IV, age-appropriate wig.
- Equipment: intubation equipment (GlideScope), code cart, epinephrine, defibrillator, step stool, backboard, oxygen, supraglottic airway device, laryngoscope, endotracheal tube, bag valve mask.
- Actors: confederate RN, SP family member, the three other session learners participated within the scenario to provide additional teammates for an effective code response as directed by the lead learner.

Symptomatic Bradycardia With Transcutaneous Pacing Simulation Case (Appendix F):

- Environment: telemetry floor, on monitor, case stem per learner specialty.
- Manikin: high-fidelity manikin, SimMan 3G, (defibrillator and rhythm generator for deliberate practice of pacing outside of scenario).
- Moulage: gown, IV in place.

- Equipment: intubation equipment, code cart, oxygen, defibrillator, transcutaneous pacing pads, atropine, dopamine, crystalloid, analgesic/sedative of choice.
- Actor: confederate RN.

Submassive Pulmonary Embolism With Escalation of Care Simulation Case (Appendix G):

- Environment: telemetry floor, on monitor, case stem per learner specialty.
- Manikin: high-fidelity manikin, SimMan 3G.
- Moulage: gown, IV in antecubital fossa, external lower extremity fixator with mild erythema around hardware insertion sites.
- Equipment: intubation equipment, nasal canula, simple facemask, nonrebreather mask, code cart, oxygen, tenectaplase, alteplase, heparin, low-molecular-weight heparin (LMWH), norepinephrine.
- Actor: confederate RN.

Acute Coronary Syndromes/Non–ST-Segment Elevation Acute Coronary Syndrome (NSTE-ACS) Simulation Case (Appendix H):

- Environment: telemetry floor, on monitor, case stem learner per specialty.
- Manikin: high-fidelity manikin, SimMan 3G.
- Moulage: gown, IV in antecubital fossa.
- Equipment: intubation equipment, code cart, oxygen, aspirin (ASA), heparin, LMWH, clopidogrel, prasugrel.
- Actor: confederate RN.

Unstable Supraventricular Tachycardia (SVT) With Synchronized Direct Current Cardioversion Simulation Case (Appendix I):

- Environment: telemetry floor, on monitor, case stem per learner specialty.
- Manikin: high-fidelity manikin, SimMan 3G, (defibrillator and rhythm generator for deliberate practice of synchronized cardioversion outside of scenario), unresponsive, apneic, and pulseless, with a narrow complex tachycardic rhythm displayed on the monitor.
- Moulage: gown, IV in antecubital fossa.
- Equipment: intubation equipment, code cart, oxygen, defibrillation pads, defibrillator, nasal cannula, simple facemask, nonrebreather mask.
- Actor: confederate RN.

Status Epilepticus With Lumbar Puncture/Video Laryngoscopy Simulation Case (Appendix J):

- Environment: telemetry floor, on monitor, case stem per learner specialty.
- Manikin: high-fidelity manikin, SimMan 3G, (lumbar puncture trainer and video laryngoscopy airway trainer for deliberate practice outside of scenario).
- Moulage: gown, IV in antecubital fossa.
- Equipment: intubation equipment, Glidescope, code cart, oxygen, lumbar puncture kit, benzodiazepines, anti-epileptic drugs, glucometer.
- Actor: confederate RN.

Cardiac Arrest Due to Critical Hyperkalemia Simulation Case (Appendix K):

- Environment: telemetry floor, on monitor, case stem per learner specialty.
- Manikin: high-fidelity manikin, SimMan 3G.
- Moulage: gown, IV in antecubital fossa, outfitted with vascath in right subclavian with dressing.
- Equipment: intubation equipment, code cart, oxygen, insulin, dextrose, albuterol, terbutaline, calcium gluconate, calcium chloride, inline nebulizer.
- Actors: confederate RN, the three other session learners participated within the scenario to provide additional teammates for an effective code response as directed by the lead learner.

Cerebral Vascular Accident and Thrombolytics/Stent Retrieval Thrombectomy Simulation Case (Appendix L):

- Environment: telemetry floor, on monitor, case stem per learner specialty.
- Manikin: none (SP with expressive aphasia and right sided hemiplegia).
- Moulage: in gown, IV in arm.
- Actors: confederate RN, SP.

Personnel

An RN confederate (who wore an earpiece for in-scenario direction) administered medications, and crystalloid and blood products, while providing laboratory values (Appendix M) and historical patient information to the learner. During scenarios focused on communication skills, an SP acted as a family member. Finally, to create experiential fidelity in the acute ischemic stroke scenario, an SP rather than a manikin, was used to demonstrate acute aphasia and hemiplegia. Actors were trained on their role prior to the curriculum by the curriculum director.

Implementation

This mandatory simulation-based curriculum was implemented annually with approximately 65 interns. Small groups of mixed-discipline learners from seven adult disciplines (obstetrics/gynecology, internal medicine, emergency medicine, general surgery, orthopedics, family medicine, and neurosurgery) attended this mandatory simulation-based curriculum at our hospital system's simulation center. The order of implementation of 12 clinical simulation scenarios within the three 4-hour sessions of this curriculum are outlined in the Table.

The curriculum was scheduled for the second half of the academic year to: a) avoid hospital orientation activities held in July and August, b) facilitate the challenges of scheduling a large number of learners, c) avoid resource-limited holiday rotation schedules, and d) allow appropriate time for interns to become comfortable with the transition to patient care within a new hospital setting. Scheduling of simulation sessions was based on intern clinical duties, rotation call schedules, resident work-hour restrictions, holidays, and facilitator availability. A designated scheduling coordinator reminded interns of their scheduled simulated sessions via email the day before each session as well as sending a digital page reminder the day of each session.

As with the implementation of many curricula, this program benefitted from it being required for all learners by our hospital systems' department of medical education. All graduate medical education resides within this department. Due to this top-down directive, initial implementation occurred with ease. Specialty and learner buy-in followed a few years after initiation, and after time all residency programs, including residents and administration, viewed this program as highly beneficial and requisite for their education.

The curriculum was delivered in the following format to permit varying debriefing times for each scenario. Additionally, the formatting allowed for easier standardized scheduling for SP and guest debriefers. Each 4-hour session included one team-based scenario, one hands-on training session, and one case requiring an SP (i.e., family member or patient).

Each 4-hour simulation session consisted of four scenarios and was attended by four residents. Generally, each scenario was led by one of the four residents, while the other three observed. However, for scenarios involving cardiac arrests (i.e., ventricular fibrillation, Appendix A; asystole, Appendix E; and pulseless electrical activity, Appendix K), one resident led the scenario with the other three residents providing roles as directed by the leader. All scenarios ran approximately 10 minutes and were designed as common cross-discipline floor emergencies with anticipated subspecialist consultation and disposition to the critical care unit. To increase realism and resident buy-in to the simulation cases, the background to each patient scenario (stem), was specifically tailored to be applicable to the residents' medical discipline. For example, if the status epilepticus scenario (Appendix J) was led by a surgery intern, it involved a patient who was postoperative from an elective cholecystectomy. However, if this scenario was led by a gynecology intern, it involved a posthysterectomy female patient.

Immediately following each simulated case, the resident participant and three resident observers underwent a shared postevent debriefing (Appendix O). Debriefings, lasting approximately 45 minutes, were conducted by two faculty facilitators (a lead debriefer and an associate debriefer) and explored predetermined learning objectives and provided guided feedback for improvements in future clinical performance.

Table. Curriculum Overview: The Cases, Duration, and Components of Each 4-Hour Session

Session	Cases	Duration (min.)	Components
First	Ventricular fibrillation and post-cardiac arrest care (Appendix A)	60	Case + debriefing + defibrillator training
	Anaphylaxis and medication error disclosure (Appendix B)	45	Case + debriefing + SP (family member)
	Upper bowel gastric and intestine, and informed consent (Appendix C)	75	Case + debriefing + central line training
	Acute coronary syndrome (NSTE-ACS) (Appendix H)	45	Case + debriefing
Second	Asystole with death notification (Appendix E)	60	Case + debriefing + SP (family member)
	Symptomatic bradycardia and transcutaneous pacing (Appendix F)	60	Case + debriefing + transcutaneous pacing training
	Submassive pulmonary embolism (Appendix G)	60	Case + debriefing
	Septic shock (Appendix D)	60	Case + debriefing
Third	Unstable supraventricular tachycardia with synchronized cardioversion (Appendix I)	60	Case + debriefing + cardioversion training
	Status epilepticus (Appendix J)	75	Case + debriefing + lumbar puncture, video laryngoscopy training
	Cardiac arrest due to critical hyperkalemia (Appendix K)	60	Case + debriefing
	Acute cerebral vascular event (Appendix L)	45	Case + debriefing + SP (patient)

Abbreviations: SP, standardized patient; ACS-NSTE, Non–ST-Segment Elevation Acute Coronary Syndrome

Assessment

All quantitative and qualitative evaluation strategies used to measure the effectiveness of the curriculum in achieving the stated educational objectives were described in detail in three previous publications.[14-16] Investigations have included pre/postsurvey responses for curricular effect on learner confidence; pre/postlearner surveys; qualitative analysis of focus group transcription on attitudinal shifting and interdisciplinary interactions; focused assessment on clinical management using the number and frequency of completed critical actions; time to critical action completion; and performance assessment using a previously validated performance assessment tool.[17-20] Residents also assessed the quality of each debriefing session by completing the Debriefing Assessment for Simulation in Healthcare Student Version Short (DASH-SV).[21]

Critical action checklists (Appendices A-L) within each case were created based on expert consensus by three board-certified emergency medicine physicians and one dual board-certified critical care physician based on ACGME core competencies. Our curriculum was created as a formative rather than summative program and thus a scoring rubric was not available for each case. Designed critical actions, however, were representative of observable behaviors to guide learner feedback and spark specific discussion during debriefings. In one published investigation,[15] however, a summative assessment for the case of cardiac arrest due to critical hyperkalemia was used to investigate knowledge acquisition and changes in clinical performance. This assessment tool demonstrated high interexaminer agreement for critical actions and performance ratings when used by calibrated raters in an oral board specialty examination[17-20] and can be found as Figure 2 in Bullard M, Weekes A, Cordle R et al.[15] Furthermore, this tool could easily be modified for use with summative assessments of other case scenarios.

ACGME discipline-specific curricular maps were created by the curriculum director and used by respective programs to demonstrate and document resident exposure to various educational milestones (Appendix P).

Debriefing

Curricular debriefing was facilitated by attending emergency medicine and critical care physicians, along with guests from ethics, pastoral care, and risk management. All facilitators were board-certified emergency medicine physicians or intensive care physicians with specialized training in simulation education. Scenario debriefings were designed around a framework of predetermined learning objectives for each case and were conducted by two facilitators using the PEARLS model of debriefing.[22] Facilitators consisted of a lead debriefer, who had an MS-HPEd degree and more than 10 years of simulation debriefing experience, and one of three other faculty serving as an associate debriefer.[23] All codebriefings were led by the same lead debriefer to ensure debriefings and education were uniformly conducted. Additionally, the use of two facilitators was additive in creating rich discussion. Guest experts from pastoral care, ethics, and risk management were invited to co-debrief during scenarios involving ethical and spiritual topics.

Predetermined educational debriefing points allowed facilitators to promote successful discussion of the learning objectives and were detailed in each scenario's postsession key learning points (Appendix O). Additionally, presession and postsession asynchronous learning materials (Appendices N and O) were created by and available to facilitators for review prior to each of the simulation sessions. As learning objectives were unique for each scenario, there was no unified debriefing template for all scenarios. Each scenario's specific learning objectives and critical actions focused discussion with observable behaviors for guided feedback. Additionally, because pre- and postsession asynchronous materials were used within a formative, learner-centric learning environment, using a basic framework for discussion ensured that all objectives were addressed at some point using a blended learning environment.

Results

All 12 simulation cases for this curriculum have each been employed more than 100 times since the inception of the program and have each been experienced by more than 600 residents from seven different adult disciplines. Over the 9 years of curricular programming, we have investigated and demonstrated the benefits of various aspects of this simulation-based education,[14-16] including:

- Improved confidence in curricular topics: Pre/postcurricular surveys have demonstrated that interns improved confidence in the treatment of anaphylaxis, sepsis, acute coronary syndromes, status epilepticus, pulmonary embolism, advanced cardiac life support algorithms, and cerebral vascular events. Additionally, interns identified improved confidence in procedural skills such as endotracheal intubation, defibrillation, transcutaneous pacing, cardioversion, central line placement, and lumbar puncture, as well as improved confidence in communication skills such as medical error disclosure and death notification.[14]

- Improved clinical acumen: Participant performance metrics assessing learners within the scenario of cardiac arrest due to critical hyperkalemia demonstrated improved clinical performance. Specifically, learners demonstrated improved data acquisition and problem solving skills upon 3-month postsession testing using a previously validated assessment tool, as well as an improved time to the critical action of calcium administration.[15]
- Improved interdisciplinary attitudes and collegiality compared to those not enrolled: Attitudinal shifting was demonstrated by statistically significant improvements in learner perceptions when comparing mean pre- and posttest score differences in four areas: interdisciplinary collegiality, respect, work interactions, and interdisciplinary attitudes.[16]

This program has also demonstrated a high level of learner satisfaction. Nearly 75% of all interns have been interested in having additional sessions in their PGY 2 year.[14] Additionally, the DASH-SV[21] demonstrated effective debriefings while continuing to guide the facilitators to improve specific debriefing behaviors in each subsequent year in each of the DASH domain scores.[14]

Discussion

Purposeful curricular development that combines basic clinical and procedural content, while promoting the development of interdisciplinary relationships and critical thinking skills is vital for successful education. This unique curriculum was well received by interns, filled a void within our hospital system, and provided residents an opportunity to develop and improve interdisciplinary relations and hone critical thinking skills. To our knowledge, this novel, reproducible, interdisciplinary simulation program represents the only critical care simulation curriculum with published quantitative and qualitative data supporting its learning objectives: improved clinical performance, improved confidence in specific clinical topics and procedural skills, improved interdisciplinary attitudes and collegiality, and programming with highly satisfied learners.[14-16] Additionally, outlined pre- and postsession asynchronous materials are included in this curriculum, along with ACGME discipline-specific curricular maps for use by respective programs to demonstrate and document intern exposure to various milestones.

Limitations of our simulation curriculum were reflected in its challenges to implementation. This program required a vast amount of resources and commitment from multiple disciplines. Each residency program within our institution embraced this program by enabling their learners to have 12 hours of protected educational time for the program, taking into account clinical schedules, call schedules, independent didactics, and ACGME resident work-hour restrictions. Additionally, our clinician simulation facilitators have been granted institutional protected time (approximate 30% full-time equivalent split between four faculty) to invest in the education of interns. Other domain experts, such as institutional ethicists, spiritual care specialists, and risk management, volunteered resources such as personnel to lend discussion to debriefings involving complex spiritual and ethical issues. System ancillary staff had been provided to aid in scheduling and providing information technology support for the delivery of asynchronous learning materials. Finally, our simulation center had provided resources (e.g., available scheduling of simulation center use, expendable equipment for training such as CVC kits, lumbar puncture kits, tissue sets, and staffing) to ensure success of the program. Thus, the program is generalizable to other institutions that have similar available resources.

Appendices

A. Ventricular Fibrillation Arrest Simulation Case.docx
B. Anaphylaxis with Error Disclosure Simulation Case.docx
C. Upper GI Bleeding with Informed Consent Simulation Case.docx
D. Septic Shock Simulation Case.docx
E. Breaking Bad News Simulation Case.docx
F. Intrinsic Symptomatic Bradycardia Simulation Case.docx
G. Submassive Pulmonary Embolism Simulation Case.docx
H. Acute Coronary Syndrome Simulation Case.docx
I. Unstable SVT Simulation Case.docx
J. Status Epilepticus Simulation Case.docx
K. Cardiac Arrest - Critical Hyperkalemia Simulation Case.docx
L. Cerebral Vascular Accident Simulation Case.docx
M. Laboratory Values.docx
N. Presession Materials.docx
O. Postsession Materials.docx
P. Milestone Mapping.docx

All appendices are peer reviewed as integral parts of the Original Publication.

Mark J. Bullard, MD, MS-HPEd: Associate Professor, Department of Emergency Medicine, Carolinas Medical Center; Medical Director, Carolinas Simulation Center, Atrium Health

Sean M. Fox, MD: Professor, Department of Emergency Medicine, Carolinas Medical Center, Atrium Health

Alan C. Heffner, MD: Professor, Department of Emergency Medicine, Department of Internal Medicine, Division of Critical Care, Carolinas Medical Center, Atrium Health

Christie L. Bullard, RN: Carolinas Simulation Center, Atrium Health

Catherine M. Wares, MD: Associate Professor, Department of Emergency Medicine, Carolinas Medical Center, Atrium Health

Acknowledgments
Carolinas Simulation Center, Atrium Health, JoAnna Leuck, MD, and Lisa Howley, PhD, assisted in the design, development, and implementation of the initial curriculum.

Disclosures
None to report.

Funding/Support
None to report.

Ethical Approval
Reported as not applicable.

References

1. Cook DA. How much evidence does it take? A cumulative meta-analysis of outcomes of simulation-based education. *Med Educ*. 2014;48(8):750-760. https://doi.org/10.1111/medu.12473
2. Schön DA. *The Reflective Practitioner: How Professionals Think in Action*. Basic Books; 1983.
3. Dewey J. *Experience and Education*. Kappa Delta Pi; 1938.
4. Kolb DA, Fry R. Toward an applied theory of experiential learning. In: Cooper CL, ed. *Theories of Group Process*. Wiley; 1975.
5. Russell JA. Core affect and the psychological construction of emotion. *Psychol Rev*. 2003;110(1):145-172. https://doi.org/10.1037/0033-295x.110.1.145
6. Stroud L, Wong BM, Hollenberg E, Levinson W. Teaching medical error disclosure to physicians-in-training. *Acad Med*. 2013;88(6):884-892. https://doi.org/10.1097/acm.0b013e31828f898f
7. Park I, Gupta A, Mandani K, Haubner L, Peckler B. Breaking bad news education for emergency medicine residents: a novel training module using simulation with the SPIKES protocol. *J Emerg Trauma Shock*. 2010;3(4):385-388. https://doi.org/10.4103/0974-2700.70760
8. *Framework for Action on Interprofessional Education and Collaborative Practice*. World Health Organization; 2010. Accessed May 24, 2018. https://apps.who.int/iris/bitstream/handle/10665/70185/WHO_HRH_HPN_10.3_eng.pdf?sequence=1
9. San Martín-Rodríguez L, Beaulieu M, D'Amour D, Ferrada-Videla M. The determinants of successful collaboration: a review of theoretical and empirical studies. *J Interprof Care*. 2005;19(suppl 1):132-147. https://doi.org/10.1080/13561820500082677
10. Liaw SY, Siau C, Zhou WT, Lau TC. Interprofessional simulation-based education program: a promising approach for changing stereotypes and improving attitudes toward nurse-physician collaboration. *Appl Nurs Res*. 2014;27(4):258-260. https://doi.org/10.1016/j.apnr.2014.03.005
11. Shrader S, Kern D, Zoller J, Blue A. Interprofessional teamwork skills as predictors of clinical outcomes in a simulated healthcare setting. *J Applied Health*. 2013;42(1):e1-e6.
12. Patterson MD, Geis GL, LeMaster T, Wears RL. Impact of multidisciplinary simulation-based training on patient safety in a paediatric emergency department. *BMJ Qual Saf*. 2013;22(5):383-393. https://doi.org/10.1136/bmjqs-2012-000951
13. Yang CP, Leung J, Hunt EA, et al. Pediatric residents do not feel prepared for the most unsettling situations they face in the pediatric intensive care unit. *J Palliat Med*. 2011;14(1):25-30. https://doi.org/10.1089/jpm.2010.0314
14. Bullard MJ, Leuck JA, Howley LD. Unifying interdisciplinary education: designing and implementing an intern simulation educational curriculum to increase confidence in critical care from PGY1 to PGY2. *BMC Res Notes*. 2017;10(1):563. https://doi.org/10.1186/s13104-017-2905-1
15. Bullard MJ, Weekes AJ, Cordle RJ, et al. A mixed-methods comparison of participant and observer learner roles in simulation education. *AEM Educ Train*. 2018;3(1):20-32. https://doi.org/10.1002/aet2.10310
16. Bullard M, Fox SM, Wares CM, Heffner AC, Stephens C, Rossi L. Simulation-based interdisciplinary education improves intern attitudes and outlook toward colleagues in other disciplines. *BMC Med Educ*. 2019;19(1):276. https://doi.org/10.1186/s12909-019-1700-1
17. Platts-Mills TF, Lewin MR, Ma S, Madsen T. The oral certification examination. *Ann Emerg Med*. 2006;47(3):278-282. https://doi.org/10.1016/j.annemergmed.2005.11.031
18. *Oral Exam Results and Scoring*. American Board of Emergency Medicine. Accessed May 5, 2017. https://www.abem.org/public/emergency-medicine-(em)-initial-certification/oral-examination/scoring/performance-criteria
19. Bianchi L, Gallagher EJ, Korte R, Ham HP. Interexaminer agreement on the American Board of Emergency Medicine oral certification examination. *Ann Emerg Med*. 2003;41:859-864. https://doi.org/10.1067/mem.2003.214
20. Gordon JA, Tancredi DN, Binder WD, Wilkerson WM, Shaffer DW. Assessment of a clinical performance evaluation tool for use in a simulator-based testing environment: a pilot study. *Acad Med*. 2003;78(10 suppl):S45-S47. https://doi.org/10.1097/00001888-200310001-00015
21. Brett-Fleegler M, Rudolph J, Eppich W, et al. Debriefing assessment for simulation in healthcare: development and psychometric properties. *Simul Healthc*. 2012;7(5):288-294. https://doi.org/10.1097/sih.0b013e3182620228

22. Eppich W, Cheng A. Promoting excellence and reflective learning in simulation (PEARLS). *Simul Healthc*. 2015;10(2):106-115. https://doi.org/10.1097/sih.0000000000000072

23. Cheng A, Palaganas J, Eppich W, Rudolph J, Robinson T, Grant V. Co-debriefing for simulation-based education. *Simul Healthc*. 2015;10(2):69-75. https://doi.org/10.1097/sih.0000000000000077

Received: December 11, 2019
Accepted: June 16, 2020
Published: October 28, 2020