

Original Article

High-Fidelity Hybrid Simulation of Allergic Emergencies Demonstrates Improved Preparedness for Office Emergencies in Pediatric Allergy Clinics

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What is already known about this topic? High-fidelity mannequins and standardized patients provide an innovative and interactive method of education that has been shown to be an effective means of teaching in general medical education and some subspecialties.

What does this article add to our knowledge? We investigated the use of this method in the subspecialty of allergy specifically as it relates to treatment of anaphylaxis. We attempted to evaluate retention of knowledge by performing an *in situ* follow-up case 10-12 months later.

How does this study impact current management guidelines? This study reminds the allergy physician of the importance to remain vigilant regarding anaphylactic emergencies and provides a state-of-the-art method to maintain proper training in anaphylaxis.

BACKGROUND: Simulation models that used high-fidelity mannequins have shown promise in medical education, particularly for cases in which the event is uncommon. Allergy physicians encounter emergencies in their offices, and these can be the source of much trepidation.

OBJECTIVE: To determine if case-based simulations with high-fidelity mannequins are effective in teaching and retention of emergency management team skills.

METHODS: Allergy clinics were invited to Arkansas Children's Hospital Pediatric Understanding and Learning through

Simulation Education center for a 1-day workshop to evaluate skills concerning the management of allergic emergencies. A Clinical Emergency Preparedness Team Performance Evaluation was developed to evaluate the competence of teams in several areas: leadership and/or role clarity, closed-loop communication, team support, situational awareness, and scenario-specific skills. Four cases, which focus on common allergic emergencies, were simulated by using high-fidelity mannequins and standardized patients. Teams were evaluated by multiple reviewers by using video recording and standardized scoring. Ten to 12 months

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Spanish Society of Allergy and Clinical Immunology, and the Oregon Allergy, Asthma, and Immunology Society; serves on the National Institute of Allergy and Infectious Disease Safety Monitoring Committee, the Arkansas Medicaid Drug Review Committee, and the National Institute of Allergy and Infectious Disease Study Section. T. T. Perry has received grants from the National Institutes of Health, the University of Arkansas for Medical Sciences (UAMS) Translational Research Institute, and the University of Arkansas for Medical Sciences College of Public Health. A. M. Scurlock is employed by UAMS; and has received research support from the National Institutes of Health. The rest of the authors declare that they have no relevant conflicts of interest.

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Abbreviations used

ACH- Arkansas Children's Hospital
 ACLS- Advanced cardiac life support
 BLS- Basic life support
 CEPT- Clinical Emergency Preparedness Team Evaluation
 CI- Confidence interval
 IOEP- In Office Emergency Preparedness Workshop
 LPN- Licensed practical nurse
 PALS- Pediatric advanced life support
 PULSE- Pediatric Understanding and Learning through
 Simulation Education
 RN- Registered nurse
 SE- Standard error

after initial training, an unannounced *in situ* case was performed to determine retention of the skills training.

RESULTS: Clinics showed significant improvements for role clarity, teamwork, situational awareness, and scenario-specific skills during the 1-day workshop (all $P < .003$). Follow-up *in situ* scenarios 10-12 months later demonstrated retention of skills training at both clinics (all $P \leq .004$).

CONCLUSION: Clinical Emergency Preparedness Team Performance Evaluation scores demonstrated improved team management skills with simulation training in office emergencies. Significant recall of team emergency management skills was demonstrated months after the initial training. © 2013 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2013;■:■-■)

Key words: Medical education; Anaphylaxis; Hybrid simulation education; Allergic emergencies; Anaphylaxis treatment

Physicians who specialize in allergy and immunology encounter a wide variety of potentially life-threatening diseases on a daily basis. They also provide treatments that can cause life-threatening events, including anaphylaxis and death. For example, allergen immunotherapy is implicated in iatrogenic fatalities in the allergy office.¹⁻⁴ Other high-risk patients with allergies are the cause of further episodes of anaphylaxis in the allergist's office. Patients with food allergies require challenges on reintroduction of specific foods into their diets, a test that is not without risk. In a retrospective series review, approximately 50% of patients who underwent oral food challenge had some type of reaction: 39% mild, 33% moderate, and 28% severe.⁵ These iatrogenic emergencies require prompt treatment of anaphylaxis by physicians.

In-office medical emergencies can be a source of trepidation for both medical and administrative personnel. A lack of preparation, equipment, training, and communication among staff members is cited as the most frequent reason for suboptimal patient care in an office emergency in a general pediatric or family practice clinic.⁶⁻⁸ In line with the inadequacies detailed in general clinics regarding emergencies, results of a review article of in-office allergic emergency preparedness suggest that physicians should primarily attempt to prevent reactions, quickly diagnose serious reactions, maintain proper staff training, and maintain adequate supplies to provide emergency treatment.⁹ Proper training in emergencies has been difficult to simulate for various reasons. Textbooks and classroom instruction provide important background to emergency preparedness, but this type of

education lacks both realism and the adrenaline created during crisis events that involve patient care.

Results of recent publications suggest that an alternative approach is needed in medical education to enable health care workers to prepare for emergencies and to reduce human error.¹⁰ Such errors can be minimized through emergency preparedness, crises resource management, team training, and closed-loop communication.¹¹⁻¹⁴ High-fidelity simulation has been used to develop the skills required to manage patients who are critically ill. Within medical training programs, simulation has been used to increase skill and resuscitation confidence,^{15,16} and also to train for rare cases and unplanned events.¹⁷ Simulation also provides the opportunity for practice without putting patients at risk.¹⁸ Furthermore, high-fidelity simulation has been demonstrated to impart effective learning, improved skills, and team cohesion.¹⁹⁻²¹ The purpose of our study was to determine if team training and preparation for office emergencies by using hybrid scenarios, those that include both high-fidelity mannequins and simulated patients and families in allergy clinics, would improve overall patient care and strengthen interoffice team performance during emergent situations. In addition, we evaluated whether training would result in the retention of knowledge and skills needed for allergic emergencies.

METHODS

Study design and participants

A prospective investigation was conducted to measure the effectiveness of emergency preparedness training of office staff in community- and hospital-based allergy clinics by comparing pre- and postintervention outcome measures. These clinics first participated in an In-Office Emergency Preparedness (IOEP) workshop at the Arkansas Children's Hospital (ACH) Pediatric Understanding and Learning through Simulation Education (PULSE) Center. The allergy clinics that participated in the original workshop then partook in an unannounced *in situ* simulation (10-12 months later) on-site in their own clinics. The study was approved by the University of Arkansas for Medical Sciences Institutional Review Board.

The IOEP workshop

The PULSE Center received approximately \$700 per session from its own Physician Hospital Organization to design an IOEP workshop for community and hospital-based clinics. This 4-hour workshop was designed as a team-training model in crisis resource management and emphasized the proper basic life support technique, tips for calling emergency medical services, good leadership skills, teamwork and support, situational awareness, and closed-loop communication for all members of the clinic health care team.

Expert faculty from the Pediatric Allergy and Emergency Medicine divisions developed a standardized curriculum that integrated 4 case-based scenarios. The curriculum included hybrid case scenarios that used both standardized patients and high-fidelity mannequins (SimMan, second generation, and SimBaby, first generation; Laerdal Inc, Gatesville, Tex) to train office staff on common pediatric allergic emergencies (Figure 1, A-C). The cases were designed and tested in the PULSE center at ACH, which has 5 years of experience with case design and implementation, and more than 1800 hours of simulation experience. Standardized patients in our study included professional actors who were trained to accurately and reliably simulate particular clinical scenarios. The high-fidelity mannequins are educational devices

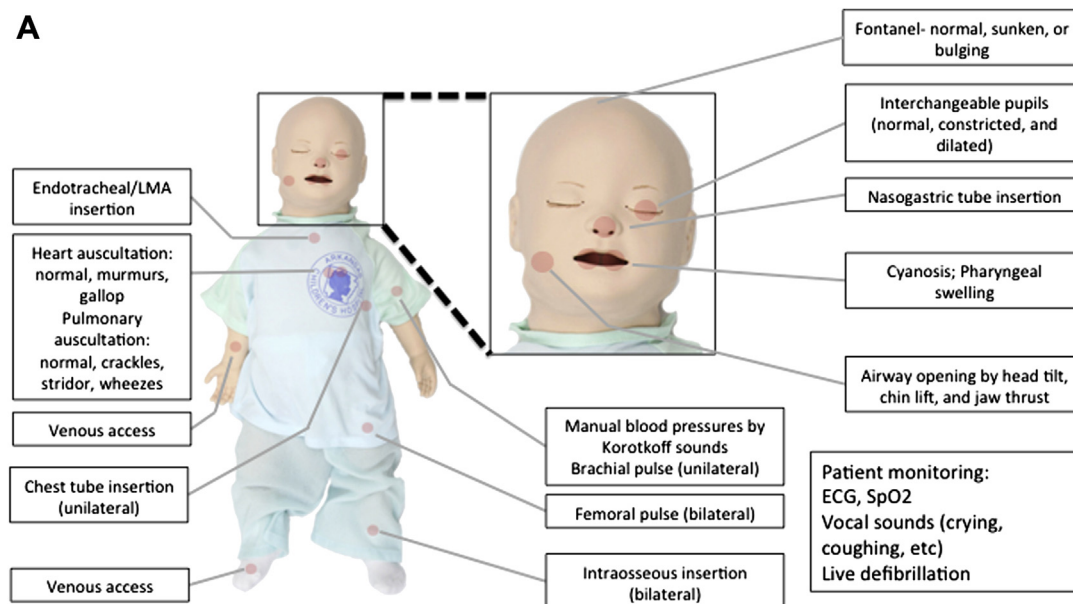


FIGURE 1. High-fidelity mannequins and “The Harvey Method.” **A**, SimBaby, first generation, allowed learners to interface directly with simulations of anaphylaxis with the ability to alter the mannequin’s vital signs and physical examination findings in real time based on the student’s findings and orders.

with software interfaces that allow for real-time simulation of clinical outcomes dependent upon student recognition of symptoms, such as wheezing, hypotension, tongue edema, and lip cyanosis. All the participants were oriented to the PULSE Center and mannequins before participating in the scenarios:

Scenario 1. This scenario was a preinstruction case that involved peanut anaphylaxis with hypotension performed before didactic sessions to simulate an unexpected emergency during the course of a “normal day.” This exercise was intended to measure the participants’ baseline knowledge of anaphylaxis and emergency preparedness, and to evaluate their ability to function as a cohesive unit. A simulated mother provided additional history to the participants who were asked to resuscitate the high-fidelity mannequin that was demonstrating signs of anaphylaxis (see [Anaphylaxis Scenario 1](#) and [Figures E1 and E2](#) in this article’s Online Repository at www.jaci-inpractice.org).²²

Scenario 2. The participants watched a video of a nurse entering a patient’s room (ie, standardized participant) with 2 vials and intending to give allergen immunotherapy to a patient. The nurse is called out of the room. On returning, she provided the wrong allergen immunotherapy to the patient without rechecking the medication, which led to an episode of vomiting and cramping, simulating gastrointestinal symptom-based anaphylaxis. The participants were required to perform correct interventions on the high-fidelity mannequin with gastrointestinal-based anaphylaxis (see [GI Anaphylaxis Scenario 2](#) and [Figures E2 and E3](#) in this article’s Online Repository at www.jaci-inpractice.org).²²

Scenario 3. This case began as a video scenario that involved an adult patient (ie, standardized participant) with chest

pain. The patient complained to his wife of chest pain and shortness of breath. The subjects were asked to elicit a history from the standardized patients and to perform a physical examination to determine that the patient was in status asthmaticus. The participants were required to treat the high-fidelity mannequin with appropriate interventions for chest pain and an asthma exacerbation (see [Asthma Scenario 3](#) and [Figures E4 and E5](#) and in this article’s Online Repository at www.jaci-inpractice.org).²²

Scenario 4. This scenario involved a patient with severe airway obstruction from respiratory syncytial virus infection. During this scenario, the physician team leader was called out of the room after the case had begun to simulate a time when he or she might not be available. The remainder of the team was required to reorganize and provide appropriate airway support to the high-fidelity mannequin (see [RSV Scenario 4](#) and [Figure E6](#) in this article’s Online Repository at www.jaci-inpractice.org).

During each scenario, a simulation technologist was present, and an algorithm of additional symptoms was followed based upon the actions of the students involved in the case. We expected the teams to provide life-saving medications, ie, epinephrine for anaphylaxis cases and albuterol or suctioning for wheezing and/or respiratory syncytial virus cases, within the first 5 minutes of evaluating the patient. If these milestones were not reached, then the technologist would change the parameters necessary (blood pressure, pulse oximetry, etc) based on the algorithm.

We developed the “Harvey training method” based on Team-STEPPS (US Department of Health and Human Services, Agency for Healthcare Research and Quality, Rockville, Md) to help with organization during each scenario.²³⁻²⁵ This method arranges clinics

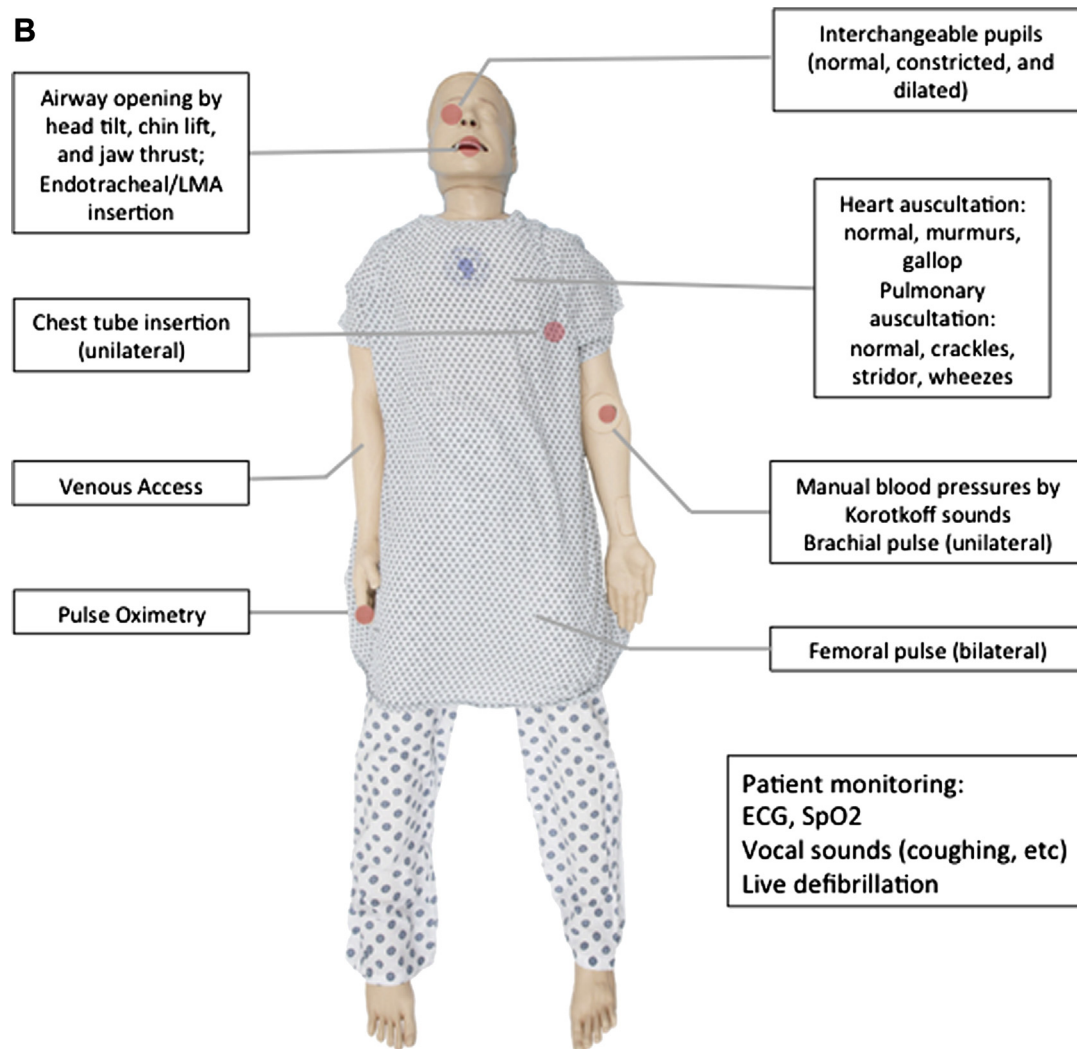


FIGURE 1. High-fidelity mannequins and “The Harvey Method.” **B**, SimMan, first generation, provided similar abilities with regard to real-time alterations of vital signs and physical examination findings with a larger frame consistent with an adult patient.

into teams of 4 to 6 people, including a team leader, a skilled person in charge of the airway, Nurse right, Nurse left, a scribe to maintain a record of all decisions made during the emergency, and a person to call for assistance (Figure 1, C). Nurse right was assigned duties that included obtaining venous access and providing medications, while Nurse left was charged with performing chest compressions if necessary and obtaining vital signs as well as obtaining any necessary supplies. The “Harvey training method” was designed for use within clinics even after the workshop, with review of the duties at each of the positions on a regular basis. The leader was required to make all medical decisions and to quickly and accurately relay these decisions to the medical team. If proper treatment was not administered in a timely manner, ie, epinephrine provided for anaphylaxis, then a flow sheet was followed, which led to increased levels of care (see Figure E2).

Each scenario was videotaped by using 2 cameras fixed to the ceiling, which provided unhindered views of the entire room: one at the head of the bed of the high-fidelity mannequin, and one at the foot of the same bed. After each scenario, a debriefing session was performed with the participants.²⁶ During this session, discussion focused upon the learners’ impressions of what was

done well with regard to the scenario and areas that could be improved. The training process also included skill development that could be used to treat patients in similar emergency scenarios. These skills included airway, breathing, circulation, and any important medications or maneuvers required to maintain patient stability. Medications required to treat patients and important basic emergency medicine skills were reviewed as part of the scenario debriefing.

Unannounced *in situ* simulation

To evaluate the transfer of skills from the workshop to the separate clinics, unannounced simulations were performed in the allergy clinics 10–12 months after the workshop. The *in situ* simulation was coordinated with the office manager to provide an unannounced visit to the clinics at low census times. This *in situ* simulation involved a repeated scenario from the original workshop (peanut allergy with severe anaphylaxis) in which a mother (a standardized parent) brought her unresponsive son (mobile mannequin) to the clinic. The *in situ* scenario was videotaped in each clinic, and a debriefing session followed.

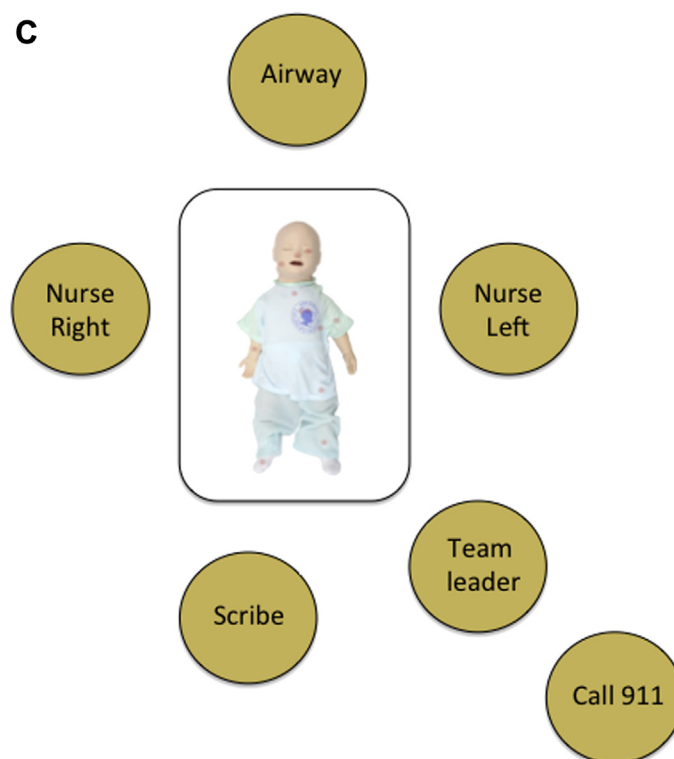


FIGURE 1. High-fidelity mannequins and “The Harvey Method.” **C**, “The Harvey method” allowed clinics to organize into teams with specific roles for individual members before an emergent event.

Data collection instrument

The Clinical Emergency Preparedness Team Evaluation (CEPTE) was developed to assess the team’s performance in 5 areas: (1) role clarity, (2) communication, (3) teamwork, (4) situational awareness, and (5) scenario-specific skills.^{27–29} This evaluation mechanism was adapted from TeamSTEPPS, a system implemented to improve patient safety, communication, and teamwork skills among health care professionals.^{15,23}

Team leadership and role clarity focused on the ability of an individual to take the lead during the scenario. The ability of the leader to establish assigned roles and responsibilities and to communicate essential team-related information was evaluated. Closed-loop communication was evaluated during the allergic emergencies by determining if each team member called out critical information during the emergent event. Each member of the team was expected to use check backs to verify information transfer. Team leaders were evaluated with the expectation for them to call for help appropriately and balance the workload within the team. Team members also were evaluated to determine if they took responsibility for assigned tasks and remained in assigned roles.

Methods for evaluation of the workshop

Three independent evaluators (J.L.K., T.M.T., N.P.), an internal medicine and pediatrics trained physician, an internal medicine and pediatrics trained emergency physician, and a pediatric trained emergency physician, used CEPTE to evaluate team performance and adherence to the skills taught during the workshop. The evaluators were all trained in pediatric advanced life support and were briefed about the important aspects of team training before scoring the subjects. Each watched videotapes of

the workshops and unannounced *in situ* simulations of each scenario. Scores were calculated for each area by using a standardized scoring system for each of the above areas of performance: the team did not perform the required skill, the team attempted to perform the required skill but it was only partially completed, and the team performed the required skill correctly.

Statistical methods

Statistical analyses were performed by using statistical software packages R (version 2.15.1, 2012-06-22) and SAS (version 9.3; SAS Institute, Cary, NC). Figures were produced by using the ggplot2 package in R. All tests performed were 2-sided, and *P* values less than .05 were considered statistically significant. A score of 0 (not done), 1 (attempted), or 2 (done) was recorded for each subscore (role clarity, communication skills, teamwork, situational awareness, and scenario specific skills). This was performed across all scenarios (preinstruction scenario 1, scenario 2, scenario 3, scenario 4, and *in situ* simulation scenario) for 3 reviewers (J.L.K., T.M.T., N.P.) (1, 2, and 3), and for both clinics (hospital-based clinic, community-based clinic). A mean percentage correct measurement was computed for each subscale, scenario, and reviewer combination by summing the total number of points for all the assessment questions and by dividing it by the maximum possible points for all the assessment questions.

A mixed effects model for repeated measures data was performed on the mean percentage correct score for each subscale for all clinic data combined and separately for each clinic (hospital-based clinic and community-based clinic). The response parameter was the rating score, and the model specification was designed to test for a scenario effect. *P* values for all

TABLE I. Demographics

	Community-based allergy clinic participants (n = 16)	Hospital-based allergy clinic participants (n = 10)
Physicians	1	2
ACLS	1	0
PALS	0	2
BLS*	1	1
Board certified in allergy and immunology	1	1
Average no. patients seen monthly by physicians	331	229
Average no. patients on immunotherapy monthly	66	60
Average no. food challenges performed monthly	6	16
Nurses	10 (all LPNs)	6 (all RNs)
BLS*	5	5
Respiratory therapists	2	1
BLS*	2	1
Administrative personnel	3	1
ACLS	1	0
BLS*	3	0

ACLS, Advanced cardiac life support; BLS, basic life support; LPN, licensed practical nurse; PALS, pediatric advanced life support; RN, registered nurse.

*No nurses or respiratory therapists were ACLS or PALS certified.

TABLE II. *P* values for comparison of scenario 1 (pre-instruction) to other scenarios by subscale area for the community-based allergy clinic

	Scenario 1 (pre-instruction) vs scenario 2	Scenario 1 (pre-instruction) vs scenario 3	Scenario 1 (pre-instruction) vs scenario 4	Scenario 1 (pre-instruction) vs scenario <i>in situ</i>	Overall
Role clarity	<.001	<.001	<.001	<.001	<.001
Communication	.001	<.001	.006	<.001	<.001
Teamwork	.002	<.001	.02	.001	.001
Situational awareness	NS	NS	NS	NS	.13
Scenario-specific skills	<.001	<.001	<.001	.004	<.001
Totals	<.001	<.001	<.001	<.001	<.001

NS, Not significant.

TABLE III. *P* values for comparison of scenario 1 (pre-instruction) to other scenarios by subscale area for the hospital-based allergy clinic

	Scenario 1 (pre-instruction) vs scenario 2	Scenario 1 (pre-instruction) vs scenario 3	Scenario 1 (pre-instruction) vs scenario 4	Scenario 1 (pre-instruction) vs scenario <i>in situ</i>	Overall
Role clarity	.02	<.001	<.001	<.001	<.001
Communication	.99	.18	.99	.006	.004
Teamwork	<.001	<.001	<.001	<.001	<.001
Situational awareness	.18	<.001	.006	<.001	<.001
Scenario-specific skills	<.001	<.001	<.001	<.001	<.001
Totals	<.001	<.001	<.001	<.001	<.001

pairwise comparisons among scenarios were adjusted by using a Bonferroni correction. Similarly, when reporting CIs, 98.75% CIs (adjusted for 4 scenario comparisons, $1-0.05/4$) were used to detect differences between scenario 1 (pre-instruction) from the other 4 scenarios, including the *in situ* scenario. When the overall *P* value was not significant, then no individual comparison tests were performed and hence no Bonferroni correction was needed.

RESULTS

Demographics

Medical and administrative personnel from both a community-based allergy clinic and a hospital-based allergy clinic participated in

a 4-hour IOEP workshop at the ACH PULSE Center. The subjects included physicians, respiratory therapists, nurses, and office administration; the demographics for each group are listed in Table I. The community-based allergy clinic was a freestanding facility within the city limits of Little Rock, Arkansas, whereas the hospital-based allergy clinic had their treatment center within ACH proper.

Psychometrics

Interrater agreement between the 3 evaluators of the CEPTE scoring was substantial³⁰ for each clinic, with kappa scores of 0.66 and 0.77 (both $P < .01$).

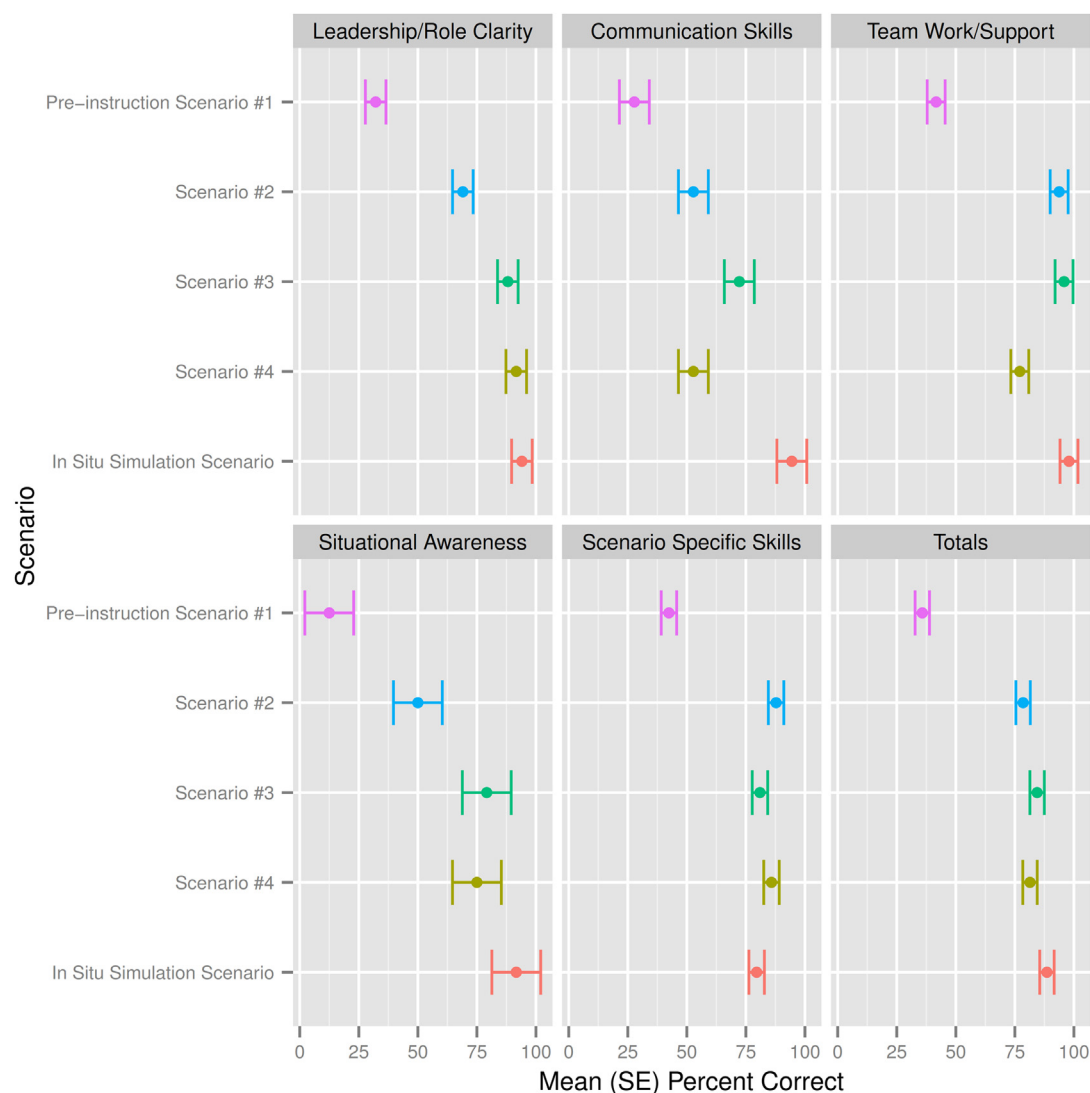


FIGURE 2. Mean percentage correct by scenario and assessment for all clinics tested (Dot, mean; error bars, SE of the mean).

Clinical emergency team evaluation during an IOEP workshop

The community-based allergy clinic showed significant improvement in total team competency scores from baseline (scenario 1) to each subsequent scenario as evidenced by mixed model analysis ($P < .001$). Significant improvement also was established between baseline and subsequent scenarios for the individual measurements of the CEPTE, with the exception of situational awareness between scenarios 1 and all other scenarios ($P = .13$) (Table II).

The hospital-based allergy clinic also had significant improvement in total team competency scores from baseline to each subsequent scenario by mixed models analysis ($P < .001$). Although most areas of the individual measures of the CEPTE did show significant improvement, communication skills did not improve between scenarios 1 and 2 ($P = .99$), scenarios 1 and 3 ($P = .17$), and scenarios 1 and 4 ($P = .99$). Significance also was not obtained for situational awareness between scenarios 1 and 2 ($P = .18$) (Table III).

When scores from both clinics were combined, team competency scores were significantly higher in all 5 team competency areas

measured upon comparison among baseline scores (scenario 1) and subsequent cases (scenarios 2–4) (Figure 2). When we evaluated the outcomes by using pairwise comparisons and adjusted for multiple comparisons by using a Bonferroni correction, role clarity, teamwork, and scenario-specific skills remained significantly improved, whereas communication showed improvement between scenarios 1 and 3 (no significance between scenarios 1 and 2 and scenarios 1 and 4). Likewise, situational awareness improved significantly in comparisons of scenarios 1 and 3 and scenarios 1 and 4, although there was no significant difference between scenarios 1 and 2 (Figure 3). There was a statistical difference between the combined scores for the community-based allergy clinic and the hospital-based allergy clinic ($P < .001$) when all of the competencies were considered against the initial preinstruction case scenario (Figure 3).

Clinical emergency team evaluation for unannounced *in situ* simulation

In the follow-up scenarios performed in the individual clinics, significant improvement was seen for both teams. For the community-based allergy clinic, we showed improvement from

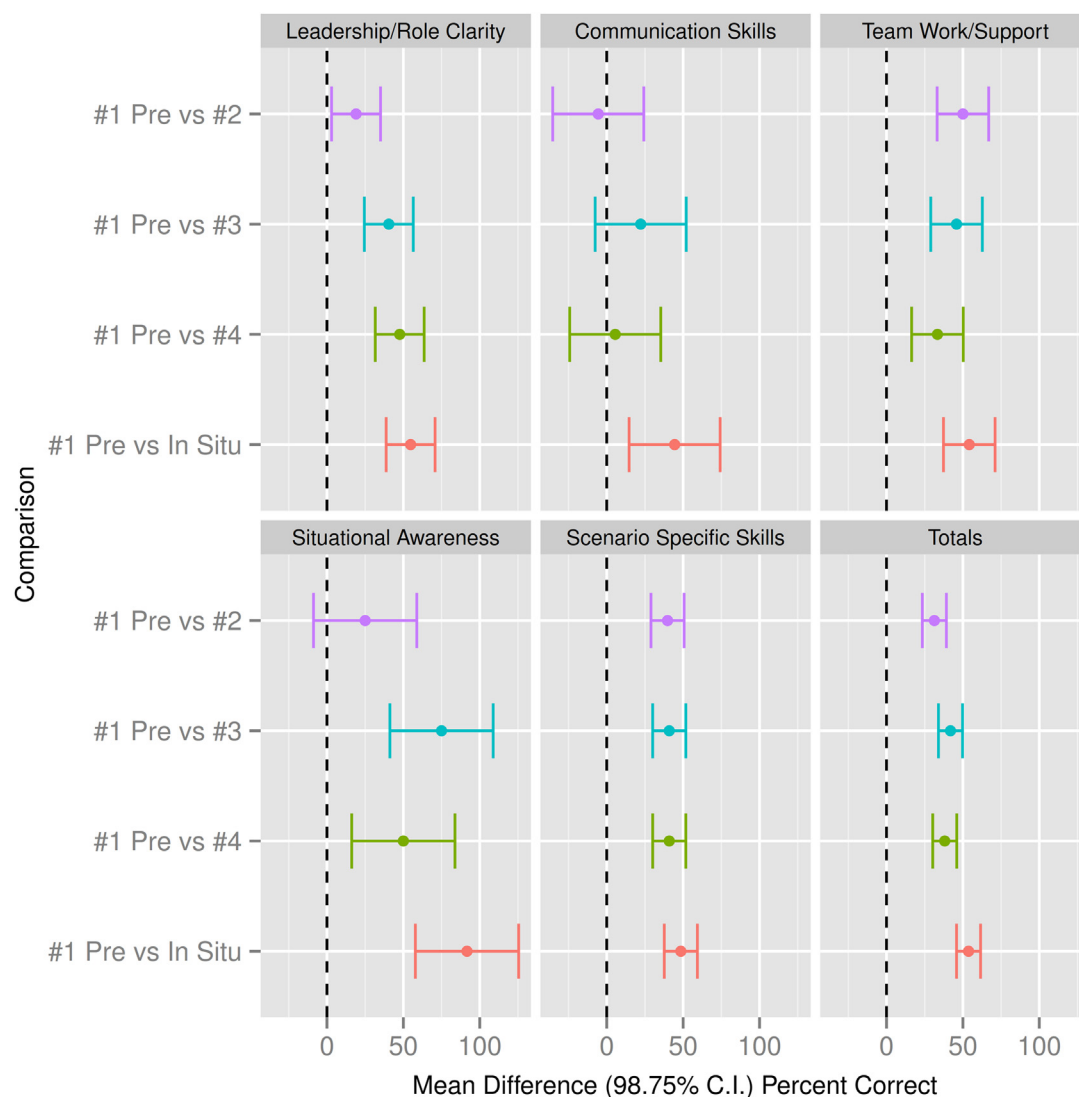


FIGURE 3. Mean and 98.75% CIs of the differences by scenario and subscore for all clinics tested (Dot, mean; error bars, 98.75% CI). The CIs are adjusted for multiple comparisons by using a Bonferroni correction. If the CI crosses 0 (dotted line), then the difference of the means was not statistically significant.

the anaphylaxis preinstruction case to the *in situ* scenario in all key areas ($P < .001$) (Table II). For the hospital-based care allergy clinic, significant improvement also was made from the preinstruction case to the *in situ* case ($P < .001$) (Table III). When both clinics were considered together, all areas showed statistical improvement, with $P \leq .001$ (Figure 2).

DISCUSSION

It is important for physicians who practice allergy and immunology to understand the management of anaphylaxis and other allergic emergencies, and to implement treatment quickly and effectively.^{9,31} In fact, results of previous studies showed that the median time to respiratory or cardiac arrest in different types of anaphylaxis was 30 minutes for foods and minutes for venom but only 5 minutes for allergic reactions that occur in a physician's office.³² The curriculum intervention and workshop on in-office emergency preparedness provided staff in allergy clinics the

tools necessary to deliver efficient anaphylactic treatment through interdisciplinary team training. This interactive teaching method was unique in that it offered teams of physicians, nurses, respiratory therapists, and clinic administrative staff the opportunity to participate. This training approach streamlined emergent care from recognition of illness by the front office staff to triaging by the nurses and to planning and action by physicians. All members of the clinical teams, including administrative personnel, were taught key roles and responsibilities during a patient crisis, which enabled them to function efficiently as a team without any role confusion or duplication.

The IOEP workshop demonstrated that team-focused skills and management of pediatric allergic emergencies could be improved by using simulations with high-fidelity mannequins. All team competency areas showed significant improvement in at least 2 subsequent scenarios, with the most overall improvement observed between scenarios 1 and 2. We hypothesized that this was because both cases involved anaphylaxis scenarios. It was

important to ensure that all members of each clinic team were prepared for clinical emergencies. Therefore, we removed the physician leader during the fourth scenario. Despite the radical change in personnel, other members of the team were able to fill the leadership role, which resulted in comparable findings that were significantly improved over the preinstruction case. The implication was that all members of each team could be taught via hybrid simulations with high-fidelity mannequins during a 4-hour course concerning in-office allergic emergencies.

In scenario 3, we focused upon an adult patient with asthma in the pediatric allergy clinic. It is important to recognize that all physicians in the field of allergy and immunology have ample cross-training in both pediatric and adult allergy. Also important is that asthma and allergies do have a strong predilection to occur within family groups. Furthermore, although a wheezing adult does complicate the differential diagnosis, an adult patient with asthma in this setting would require similar treatment measures as a child.

The unannounced *in situ* simulations were performed to explore the potential impact of simulation training on patient outcomes in a “real life” clinic scenario and to determine if there was evidence of retention of training. We purposefully moved the follow-up cases into the offices of the individual teams because it was important for each participating team to assess its preparation in its own practice setting. We waited 10-12 months after the participants had completed the initial workshop to ascertain retention of skills and knowledge.

The teams demonstrated knowledge and skill retention from the initial presentation of the information at the IOEP workshop to the follow-up case presented in the individual offices as shown in the improvement in all areas of measure on the CEPTE between the initial anaphylaxis scenario and the unannounced *in situ* simulation. Our ability to record clinical team reactions to the scenarios in the PULSE Center and in their own clinical settings is unique. It provides a rare glimpse into the potential impact of training on clinical outcomes. These findings suggest that the IOEP workshops motivated practices to take concrete actions to prepare for allergic emergencies in their respective offices. Team training in crisis resource management has been demonstrated to enhance team performance,³³ reduce errors,¹³ and improve skills in clinical practice.³⁴

Because the outcome of interest in office emergencies is actual resuscitations, we could not determine whether the workshop improved emergency care to patients. Allergic emergencies are so infrequent by nature that we were compelled to use high-fidelity mannequins, which makes it difficult to determine the significance of this intervention. Anecdotal evidence from the 2 teams suggests that the workshop did improve care in at least 1 emergency in a clinic that participated in our workshop. Also, analysis of our data suggests improved communication and situational awareness during the unannounced *in situ* simulation, which are areas most likely addressed by the Harvey team training methods that we implemented during the initial workshop. It should be recognized that high-fidelity simulation provides a risk-free way to teach these rare events. Because high-fidelity mannequins were substituted for actual patients, we were concerned that responses may not be generalizable to “real-life” patient scenarios. We attempted to improve this outcome by stressing the importance of participant buy-in to “the pretend” patient in hopes that they would perform at their best.

Lastly, although our study does meet statistical significance in many areas regarding improvement of emergency preparedness in pediatric allergy offices, it is important to recognize that our findings may not be generalizable to the whole of allergy and immunology because our sample sizes are small. Further studies with more subjects are warranted to prove conclusive results.

Early recognition and treatment of anaphylaxis is life saving and can obviate the need for intensive emergency interventions. However, allergic emergencies often progress rapidly, and personnel in allergy offices should be prepared to institute treatment for cardiac and respiratory collapse. Although some of our mannequin simulations ultimately developed cardiovascular and respiratory collapse, this end point was not a foregone conclusion and could have been avoided with early intervention with epinephrine. We recognize that symptoms that many patients experience in the allergist’s office may not be so severe. However, this study reminds the allergist to be ever vigilant of the signs and symptoms of anaphylaxis and to quickly administer life-saving medications to their patients.

CONCLUSION

This study provides insights into the potential impact of simulation on patient outcomes. Most studies that use simulation often report on pre- and posttest intervention data, but very few provide information on knowledge and skill retention over time. The unannounced *in situ* simulation provided the opportunity to observe teams in their own setting while using their own equipment and was an effective measure of retention of knowledge. The findings of this study are encouraging and illustrate the need to improve the learning environment by including hands-on instruction by using state-of-the-art technology and structured feedback to students.

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A Hybrid Simulation using Standardized Patients and High-Fidelity Mannequins for Anaphylaxis in a Pediatric Patient

Anaphylaxis Scenario 1

Goals and Objectives:

1. Enable an office to prepare for an in-office emergency involving a severe anaphylactic reaction in an organized and safe fashion.
2. Establish an effective leader that is able to delegate responsibilities to other members of the team.
3. Provide members of the team with particular roles in the care and treatment of the patient and their family and ensure that these members stay on task throughout the emergency.
4. Develop a means to communicate effectively using a "closed-loop" communication model, which includes repeating orders and informing when particular orders are completed.
5. Develop a means to remain aware of any and all changes that occur to the patient and staff in an emergency situation.
6. Quickly and accurately develop a differential diagnosis for seizure that includes anaphylaxis and provide timely and effective treatment for the actual diagnosis as well as the most likely threats to the patient's well being.

Standardized Patient Script for Anaphylaxis Scenario

Scene: Clinic in a general pediatric office after office staff has rushed back a child with anaphylactic shock. Mom is standing beside the patient.

Mother heard in hallway by team members.

Mother: Please, someone!! Please, help my baby!!

Mother is in a state of panic. She is very loud and attempting to touch her child. She says things like: "I thought this was just a mild allergy that could be fixed with pills." "This reaction is much worse than the one last night." "Is she going to die?"

Team that arrives may ask questions- answers given by mother according to history as follows:

History for Anaphylaxis Scenario (must be elicited)

HPI: 18 m/o WF with no significant past medical history presents to clinic with respiratory failure, itching and swelling of the face, and hives. According to mother, patient was seen in ED last night after having similar symptoms but much less severe last night after eating his brother's peanut butter and jelly sandwich. He was given ranitidine, epinephrine, Benadryl, and IV fluids. There was no further progression of his symptoms, and he was sent home with Epi Pen Jr, which mom is afraid to use, and hydroxyzine. Mom reports that older brother likes to feed his little sister, and he may have given her a Snickers bar this morning. When arrives at clinic today, patient is cyanotic, in respiratory distress with wheezes, and hypotensive. He is unresponsive to pain.

PMHx: Otitis Media (ear infections)

PSHx: None

Medications: Hydroxyzine

Epi Pen Jr.

Allergies: None told to mom

Immunizations: Up to date

Social: Lives with mom, dad, and older brother (4 yo). No daycare, no sick contacts, no smoking.

FmHx: No allergies

Debriefing

Ask open-ended questions to begin the conversation such as:

1. How do you think the scenario went?
2. What did you do well?
3. What do you think could have been done better?
4. Did everyone feel as though they had a job during the scenario?
 - a. Who was the leader?
5. Was there effective communication during the scenario?
 - a. Was the room quiet enough to hear all orders?
 - b. Was there closed-loop communication?
 - c. Did you need to use the "two-challenge" rule? (A safety mechanism designed to allow staff to challenge something that is incorrect during the emergency which requires two members to question the leader then a third party source has to be consulted.)

It is also important to ask the standardized patient if they felt cared for during the emergency. If you have the ability to tape the scenario, it is important for the team to watch the emergency situation so they are able to critique each step along the way.

A Hybrid Simulation using Standardized Patients and High-Fidelity Mannequins for Anaphylaxis with Gastrointestinal Symptoms in a Pediatric Patient

GI Anaphylaxis Scenario 2

Goals and Objectives:

1. Enable an office to prepare for an in-office emergency involving a severe anaphylactic reaction in an organized and safe fashion.
2. Establish an effective leader that is able to delegate responsibilities to other members of the team.
3. Provide members of the team with particular roles in the care and treatment of the patient and their family and ensure that these members stay on task throughout the emergency.
4. Develop a means to communicate effectively using a "closed-loop" communication model, which includes repeating orders and informing when particular orders are completed.
5. Develop a means to remain aware of any and all changes that occur to the patient and staff in an emergency situation.
6. Quickly and accurately develop a differential diagnosis for seizure that includes anaphylaxis and provide timely and effective treatment for the actual diagnosis as well as the most likely threats to the patient's well being.

Standardized Patient Script for Anaphylaxis with GI Symptoms Scenario

Scene: Clinic in a general pediatric office. Patient is sitting on examination table. Mother is standing beside the patient. Nurse enters room to administer immunotherapy. Of note, she has two separate vials in her hand (medications for two separate patients).

Nurse: Are you ready for your shots?

Patient: As ready as I'll ever be!

Nurse draws up to syringes of medication and sets them down on the counter.

Overhead: Nurse Betty to room 3.

Nurse: Oh, sorry! I'll be right back. This won't take long.

Patient: No problem.

*Nurse leaves room leaving two unlabeled syringes in the room.
Mom and daughter are talking about daily activities.
Nurse returns several minutes later.*

Nurse: I am terrible sorry about that. The doctor wanted me to get a patient discharged from clinic. Now... how about that shot??

Nurse looks at both syringes with a worried look on her face. Goes back and forth between which shot to give. Decides on the one in her right hand.

Patient: Everything ok?

Nurse: Everything is perfect!

Nurse administers immunotherapy.

Nurse: Now you know the rules... you have to wait here for thirty minutes.

Patient: No problem!

Nurse leaves the room. Within 30 seconds, the patient begins to complain of pain and itching around the injection site. Mother begins to worry.

Mother: You've never done anything like this before...

Patient: Oh, mom... it's fine!

30 seconds later

Patient: I'm not feeling so well... *Patient grabs her abdomen and cannot find a comfortable position.*

Patient begins to vomit and passes out.

Mother: Someone please help us! My daughter!!

TRANSITION TO MANNEQUIN.

Team that arrives may ask questions- answers given by mother according to history as follows:

Approximately 5 minutes into the scenario, the nurse returns and tells the team that it is possible that she gave the wrong dosage of immunotherapy.

History for Anaphylaxis with GI Symptoms Scenario (must be elicited)

HPI: 14 yo WF with h/o wasp allergy diagnosed 4 weeks ago after she had an anaphylactic reaction to a sting. Patient was seen in the emergency department. Her reaction consisted of swelling of her tongue and throat, hives, and wheezing. She was given epinephrine, ranitidine, albuterol, and steroids with improvement in her symptoms. She was monitored in the ED for several hours and was sent home with an Epi pen. She was followed up in Allergy clinic 2 weeks later, and it was decided that she should start immunotherapy. She had her first dose last week, which she tolerated well. She returns to clinic today for immunotherapy. After her shot today, she first developed itching and pain around the injection site. She then started complaining of abdominal pain and started vomiting. When the team arrives, she is unconscious. She is wheezing and hypotensive.

PMHx: Wasp Allergy

PSHx: None

Medications: Claritin 10 mg daily

Flonase

Benadryl 25 mg at night

Epi pen

Allergies: Wasps, no foods

Social: Lives with mom and dad. No sick contacts.

Immunizations: Up to date

FmHx: No significant problems

Debriefing

Ask open-ended questions to begin the conversation such as:

1. How do you think the scenario went?
2. What did you do well?
3. What do you think could have been done better?
4. Did everyone feel as though they had a job during the scenario?
 - a. Who was the leader?
5. Was there effective communication during the scenario?
 - a. Was the room quiet enough to hear all orders?
 - b. Was there closed-loop communication?
 - c. Did you need to use the "two-challenge" rule? (A safety mechanism designed to allow staff to challenge something that is incorrect during the emergency which requires two members to question the leader then a third party source has to be consulted.)

It is also important to ask the standardized patient if they felt cared for during the emergency. If you have the ability to tape the scenario, it is important for the team to watch the emergency situation so they are able to critique each step along the way.

A Hybrid Simulation using Standardized Patients and High-Fidelity Mannequins for a Severe Asthma Exacerbation

Asthma Scenario 3

Goals and Objectives:

1. Enable an office to prepare for an in-office emergency involving a severe asthmatic in an organized and safe fashion.
2. Establish an effective leader that is able to delegate responsibilities to other members of the team.
3. Provide members of the team with particular roles in the care and treatment of the patient and their family and ensure that these members stay on task throughout the emergency.
4. Develop a means to communicate effectively using a "closed-loop" communication model, which includes repeating orders and informing when particular orders are completed.
5. Develop a means to remain aware of any and all changes that occur to the patient and staff in an emergency situation
6. Quickly and accurately develop a differential diagnosis for chest pain that includes asthma and provide timely and effective treatment for the actual diagnosis as well as the most likely threats to the patient's well being.

Standardized Patient Script for Asthma Scenario

Scene: Front office of clinic- child does not have to be present- patient's father is checking in child for routine health supervision visit.

Arrives at front desk- checks in with Office Staff.

Office staff: Please sign in. Which doctor are you here to see?

Patient's father: *Breathless, holding chest.* Dr. Graham...

Office staff: She is running on time today and someone will be with you shortly.

Please have a seat.

Patient's father returns to seat with wife- his pain is getting worse. Wife is becoming more concerned.

Wife/Girlfriend: Can someone please help us??

Office staff notices work of breathing and pain increasing and calls in IOEP staff.

Office staff: Harvey team to front please!

When staff arrives:

Wife: Is he having a heart attack? Do you think this could be the Mexican food he ate last night?

Patient's father continues to have tremendous respiratory difficulty and eventually passes out.

TRANSITION TO MANNEQUIN.

Team that arrives may ask questions- answers given by wife according to history as follows:

History for Asthma Scenario (must be elicited)

HPI: Mr. R is a 35 yo WM with past medical history of asthma who presents to clinic with increased work of breathing, wheezing, and chest pain. He is here with his wife and son who is being seen for a routine health maintenance exam. The chest pain is sharp, mid-chest with no radiation. 5/10 in intensity, but worsens to 10/10 when he attempts to take deep breaths. He is not having any diaphoresis or nausea with the pain. He currently takes montelukast, albuterol, and beclomethasone inhaler, but he has been out of these medications except for Albuterol for the last one-week. He reports that he was outside mowing the lawn last night and has had intermittent wheezing since that time. He has used his albuterol inhaler "a ton" since last night. Usual triggers for asthma include grasses, trees, pollen, and exercise. He reports eating Mexican food last night with some lingering "heartburn" after the meal. He is currently very short of breath and unable to complete sentences.

PMHx: Asthma

PSHx: None

Allergies: grasses, trees, pollen- runny nose, itchy, watery eyes, sneezing- by allergy testing 2 years ago

Medications: montelukast 10mg po daily

Albuterol prn cough/wheeze

Beclomethasone 2 puffs BID

Social: No alcohol, tobacco, drugs. Works as an office supply salesman.

FamHx: Father and Uncle with myocardial infarction at 55 and 65 respectively

Debriefing

Ask open-ended questions to begin the conversation such as:

1. How do you think the scenario went?
2. What did you do well?
3. What do you think could have been done better?
4. Did everyone feel as though they had a job during the scenario?
 - a. Who was the leader?
5. Was there effective communication during the scenario?
 - a. Was the room quiet enough to hear all orders?
 - b. Was there closed-loop communication?
 - c. Did you need to use the "two-challenge" rule? (A safety mechanism designed to allow staff to challenge something that is incorrect during the emergency which requires two members to question the leader then a third party source has to be consulted.)

It is also important to ask the standardized patient if they felt cared for during the emergency. If you have the ability to tape the scenario, it is important for the team to watch the emergency situation so they are able to critique each step along the way.

A Hybrid Simulation using Standardized Patients and High-Fidelity Mannequins for Respiratory Syncytial Virus in a Pediatric Patient

RSV Scenario 4

Goals and Objectives:

1. Enable an office to prepare for an in-office emergency involving respiratory syncytial virus in an organized and safe fashion.
2. Establish an effective leader that is able to delegate responsibilities to other members of the team.
3. Provide members of the team with particular roles in the care and treatment of the patient and their family and ensure that these members stay on task throughout the emergency.
4. Develop a means to communicate effectively using a "closed-loop" communication model, which includes repeating orders and informing when particular orders are completed.
5. Develop a means to remain aware of any and all changes that occur to the patient and staff in an emergency situation.
6. Quickly and accurately develop a differential diagnosis for seizure that includes respiratory syncytial virus and provide timely and effective treatment for the actual diagnosis as well as the most likely threats to the patient's well being.

Standardized Patient Script for RSV Scenario

Scene: Clinic in a general pediatric office. Mother is standing beside the patient. Doctor for team should enter first and recognize need to call for help from staff.

Mother is not terribly upset to begin the scenario, but as things move forward, she begins to become more and more worried. She is asking questions like: "He's ok... right?" "He's going to be ok?" "What's wrong with him?" "Is he turning blue?"

Doctor and team that arrives may ask questions- answers given by mother according to history as follows:

History for RSV Scenario (must be elicited)

HPI: 6m/o WM with no significant past medical history presents to clinic with mom secondary to difficulty feeding. Mom says he has been "congested all week." She has tried lots of OTC meds to no avail including cough medicine, acetaminophen, and ibuprofen. He has had a fever up to 101 for the last 2 days. He has a "raspy" cough that is worse at night, and mom thinks that he has been wheezing over the same time period. He has never had wheezing prior to this illness. Mom thinks that he is very congested, and she has been trying to suction him with bulb suction, but she has not been able to get anything back. Mom thinks that his breathing is much worse today. He has not been eating well, and he has only had one wet diaper today. Upon exam in clinic, infant is tachypneic, stridorous, and wheezing.

PMHx: Term Newborn at 39 weeks by spontaneous vaginal delivery; no complications to labor or delivery, and the child went home with mother 2 days after delivery. Mom says all maternal labs were normal. Otitis media (ear infection) x1

PSHx: Circumcision

Medications: Triaminic (in the gold box)- unknown dose

Cough medicine

Acetaminophen

Motrin

Allergies: None

Social: Lives with mom and dad. Does go to daycare, no sick contacts, no smoking.

Immunizations: Up to date

FmHx: Asthma in cousin

Debriefing

Ask open-ended questions to begin the conversation such as:

1. How do you think the scenario went?
2. What did you do well?
3. What do you think could have been done better?

4. Did everyone feel as though they had a job during the scenario?

a. Who was the leader?

5. Was there effective communication during the scenario?

a. Was the room quiet enough to hear all orders?

b. Was there closed-loop communication?

c. Did you need to use the “two-challenge” rule? (A safety mechanism designed to allow staff to challenge something that is incorrect during the emergency which requires two members to question the leader then a third party source has to be consulted.)

It is also important to ask the standardized patient if they felt cared for during the emergency. If you have the ability to tape the scenario, it is important for the team to watch the emergency situation so they are able to critique each step along the way.

Date: _____
Initials: _____**Clinical Emergency Preparedness
Team Performance Evaluation****Scenario** Peanut Allergy/Anaphylaxis
Sequence # _____ **Case 1** _____

Please score the following:		Not Done ☹	Attempted ☺	Done 😊
ROLE CLARITY				
1. Establish the leader	1.	()	()	()
2. Assign roles and responsibilities	2.	()	()	()
3. Communicate essential team-related information	3.	()	()	()
4. One member documents/records events	4.	()	()	()
5. Execute protocol or team-established plan	5.	()	()	()
6. Communicate decision and actions to team members	6.	()	()	()
7. Re-plan patient care in response to new information	7.	()	()	()
COMMUNICATION		☹	☺	😊
1. Call out critical information during emergent events	1.	()	()	()
2. Use check backs to verify information transfer	2.	()	()	()
3. Address family members and their concerns	3.			
SUPPORT		☹	☺	😊
1. Call for help appropriately	1.	()	()	()
2. Balanced workload within the team	2.	()	()	()
3. Team members take responsibility for assigned tasks	3.	()	()	()
4. Team members stay on task	4.	()	()	()

FIGURE E1. Clinical Emergency Preparedness Team Performance Evaluation (CEPTE) form for Scenario 1 (pre-instruction, Anaphylaxis).

Date: _____
Initials: _____

GLOBAL ASSESSMENT				
1. Request situational awareness updates	1.	()	()	()
2. Provide situational awareness updates	2.	()	()	()
SCENARIO SPECIFIC ASSESSMENT				
Peanut Allergy/Anaphylaxis- Case 1				
1. Open airway	1.	()	()	()
2. Assess breathing	2.	()	()	()
3. Give O ₂	3.	()	()	()
4. Recognize anaphylaxis	4.	()	()	()
5. Give epinephrine (IM) early	5.	()	()	()
6. Check for pulse	6.	()	()	()
7. Start CPR in a timely manner	7.	()	()	()
8. Adequate compressions	8.	()	()	()
9. IM/oral diphenhydramine	9.	()	()	()
10. IV fluids	10.	()	()	()
11. Elevate feet	11.	()	()	()

FIGURE E1. (Continued)

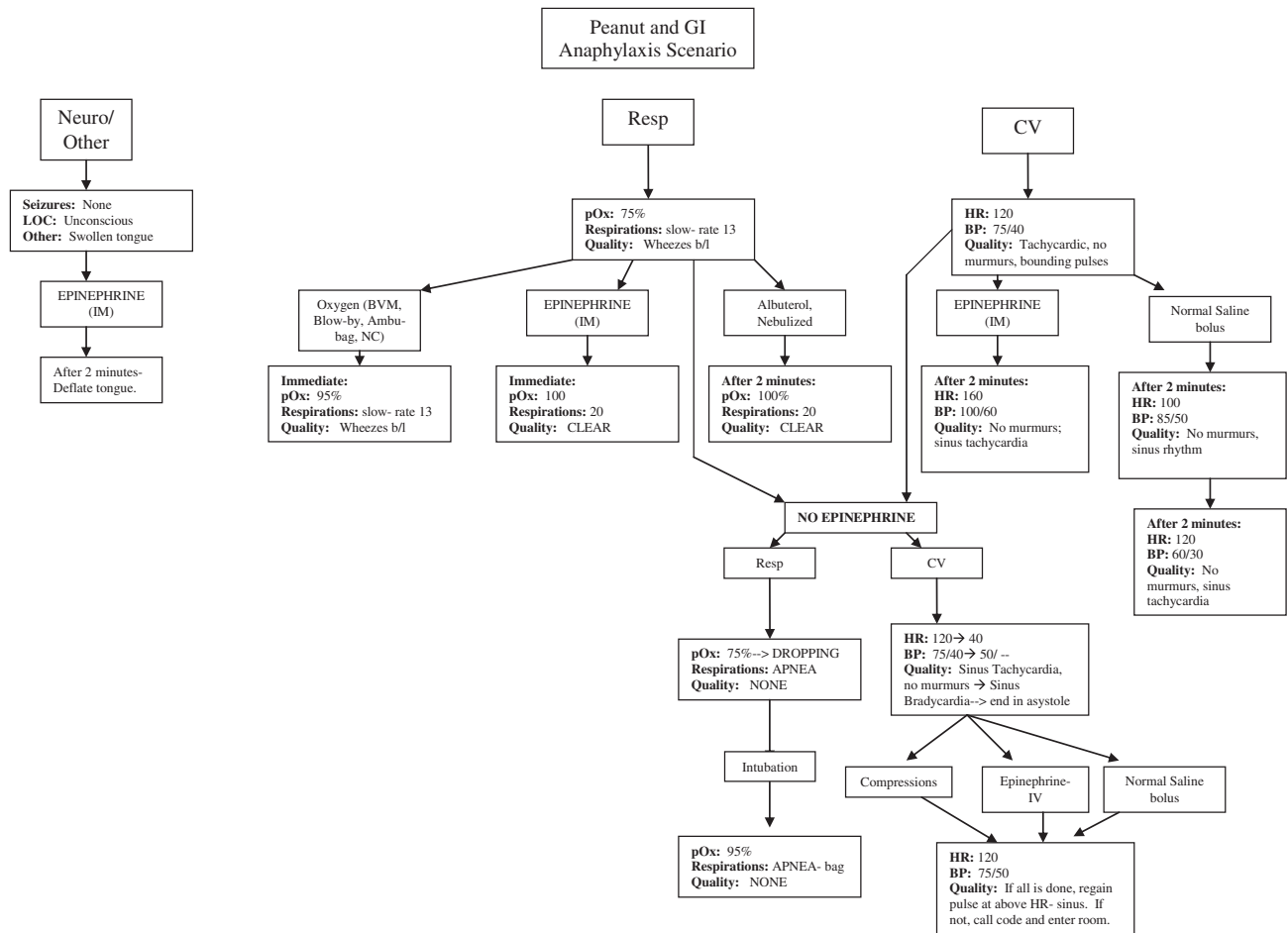


FIGURE E2. Algorithm followed for the high fidelity mannequins indicating specific changes to the overall health of the simulator based upon participant interventions or lack of interventions during both Scenario 1 and Scenario 2.

Date: _____
Initials: _____**Clinical Emergency Preparedness
Team Performance Evaluation**Scenario: GI Anaphylaxis
Sequence #: _____ Case #2

Please score the following:		Not Done 	Attempted 	Done 
ROLE CLARITY				
1. Establish the leader	1.	()	()	()
2. Assign roles and responsibilities	2.	()	()	()
3. Communicate essential team-related information	3.	()	()	()
4. Documents and records events	4.	()	()	()
5. Execute protocol or team-established plan	5.	()	()	()
6. Communicate decision and actions to team members	6.	()	()	()
7. Re-plan patient care in response to new information	7.	()	()	()
COMMUNICATION				
1. Call out critical information during emergent events	1.	()	()	()
2. Use check backs to verify information transfer	2.	()	()	()
3. Address family members and their concerns	3.	()	()	()
SUPPORT				
1. Call for help appropriately	1.	()	()	()
2. Balanced workload within the team	2.	()	()	()
3. Team members take responsibility for assigned tasks	3.	()	()	()
4. Team members stay on task	4.	()	()	()

FIGURE E3. Clinical Emergency Preparedness Team Performance Evaluation (CEPTE) form for Scenario 2 (GI anaphylaxis).

Date: _____
Initials: _____

GLOBAL ASSESSMENT				
1. Request situational awareness updates	1.	()	()	()
2. Provide situational awareness updates	2.	()	()	()
SCENARIO SPECIFIC ASSESSMENT				
Allergy shot/Medication Error/ GI anaphylaxis- Case 2				
1. Open airway	1.	()	()	()
2. Assess breathing	2.	()	()	()
3. Give O ₂	3.	()	()	()
4. Recognize anaphylaxis	4.	()	()	()
5. Give Epi early in case	5.	()	()	()
6. Check for pulse	6.	()	()	()
7. Start CPR in a timely manner	7.	()	()	()
8. Adequate compressions	8.	()	()	()
9. Give IM/Al Benadryl	9.	()	()	()
10. Start IV fluids	10.	()	()	()
11. Elevate feet	11.	()	()	()
12. Communicated with team members in a professional manner	12.	()	()	()
13. Advocate or assert a corrective action	13.	()	()	()
14. Resolve conflicts constructively	14.	()	()	()
15. Systematic hand-off of responsibilities during team transitions	15.	()	()	()

FIGURE E3. (Continued)

Date: _____
Initials: _____**Clinical Emergency Preparedness
Team Performance Evaluation****Scenario:** Chest Pain/ Non-compliance/ Status Asthmaticus**Sequence #** _____ **Case #3** _____

Please score the following:		Not Done 	Attempted 	Done 
ROLE CLARITY				
1. Establish the leader	1.	()	()	()
2. Assign roles and responsibilities	2.	()	()	()
3. Communicate essential team-related information	3.	()	()	()
4. Document and records events	4.	()	()	()
5. Execute protocol or team-established plan	5.	()	()	()
6. Communicate decision and actions to team members	6.	()	()	()
7. Re-plan patient care in response to new information	7.	()	()	()
COMMUNICATION				
1. Call out critical information during emergent events	1.	()	()	()
2. Use check backs to verify information transfer	2.	()	()	()
3. Address family members and their concerns	3.	()	()	()
SUPPORT				
1. Call for help appropriately	1.	()	()	()
2. Balance workload within the team	2.	()	()	()
3. Team members take responsibility for assigned tasks	3.	()	()	()
4. Team members stay on task	4.	()	()	()

FIGURE E4. Clinical Emergency Preparedness Team Performance Evaluation (CEPTE) form for Scenario 3 (Asthma).

Date: _____
Initials: _____

GLOBAL ASSESSMENT				
1. Request situational awareness updates	1.	()	()	()
2. Provide situational awareness updates	2.	()	()	()
SCENARIO SPECIFIC ASSESSMENT				
Chest Pain/ Non-compliance/ Status asthmaticus- Case #3				
1. Open airway	1.	()	()	()
2. Assess breathing	2.	()	()	()
3. Give O ₂	3.	()	()	()
4. Recognize status asthmaticus	4.	()	()	()
5. Elicit correct history from family member	5.	()	()	()
6. Give Albuterol nebulizer or MDI	6.	()	()	()
7. Give steroids	7.	()	()	()

FIGURE E4. (Continued)

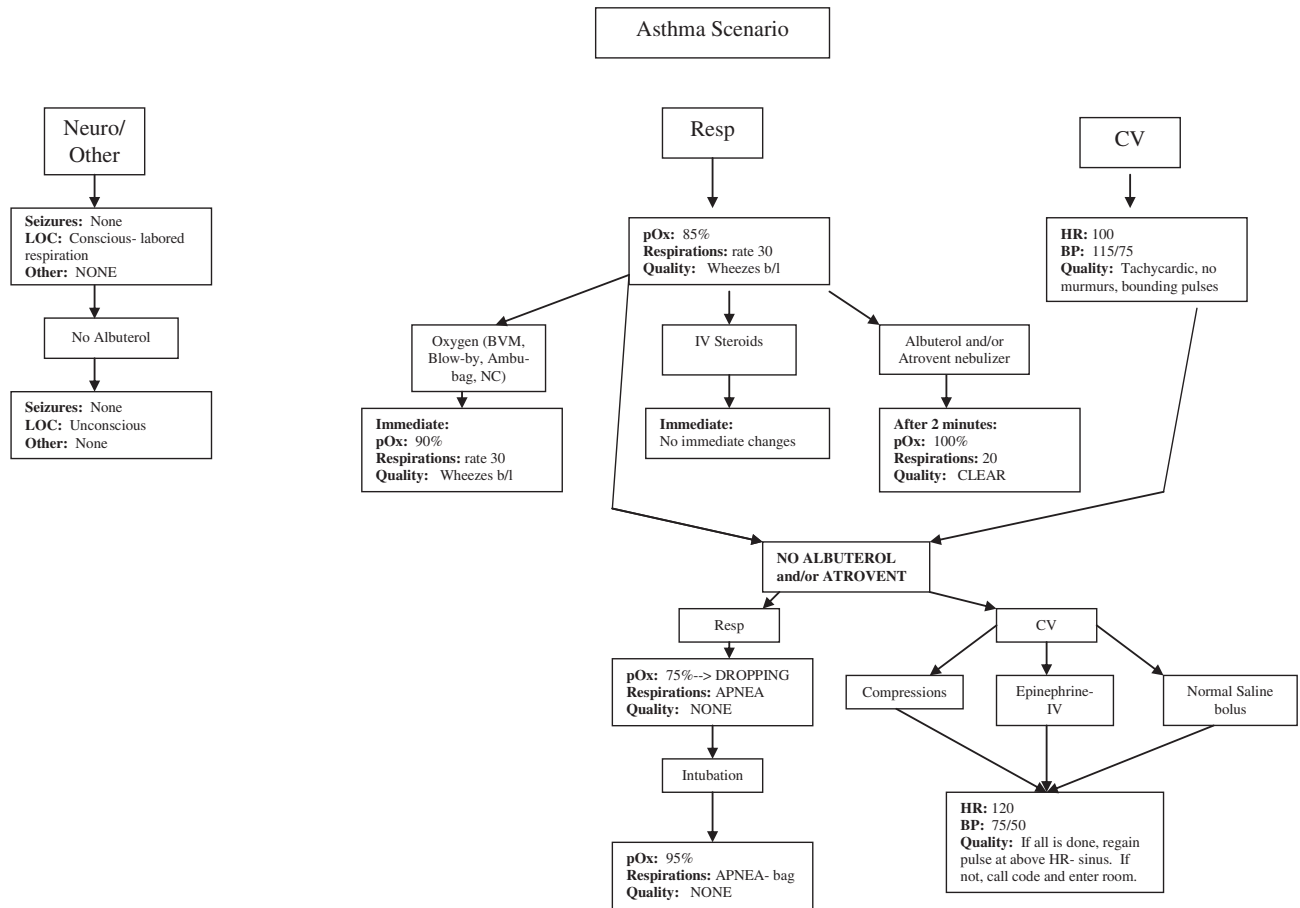


FIGURE E5. Algorithm followed for the high fidelity mannequins indicating specific changes to the overall health of the simulator based upon participant interventions or lack of interventions during Scenario 3.

Clinical Emergency Preparedness Team Performance Evaluation

Scenario: RSV case

Sequence #: _____ **Case #4**

Please score the following:		Not Done 	Attempted 	Done 
ROLE CLARITY				
1. Establish the leader	1.	()	()	()
2. Assign roles and responsibilities	2.	()	()	()
3. Communicate essential team-related information	3.	()	()	()
4. Document and records events	4.	()	()	()
5. Execute protocol or team-established plan	5.	()	()	()
6. Communicate decision and actions to team members	6.	()	()	()
7. Re-plan patient care in response to new information	7.	()	()	()
COMMUNICATION				
1. Call out critical information during emergent events	1.	()	()	()
2. Use check backs to verify information transfer	2.	()	()	()
3. Address family members and their concerns	3.	()	()	()
SUPPORT				
1. Call for help appropriately	1.	()	()	()
2. Balance workload within the team	2.	()	()	()
3. Team members take responsibility for assigned tasks	3.	()	()	()
4. Team members stay on task	4.	()	()	()

FIGURE E6. Clinical Emergency Preparedness Team Performance Evaluation (CEPTE) form for Scenario 4 (RSV).

GLOBAL ASSESSMENT				
1. Request situational awareness updates	1.	()	()	()
2. Provide situational awareness updates	2.	()	()	()
SCENARIO SPECIFIC ASSESSMENT				
Bronchiolitis/Copious Secretions/ Airway Obstruction/Loss of Team Leader- Case #4				
1. Open airway	1.	()	()	()
2. Assess breathing	2.	()	()	()
3. Suction airway	3.	()	()	()
4. Give O ₂	4.	()	()	()
5. Intubate when oxygenation ineffective	5.	()	()	()
6. Re-intubate or check equipment/tube when stats don't improve	6.	()	()	()
7. Check pulse	7.	()	()	()
8. Start CPR in a timely manner	8.	()	()	()
9. Perform adequate compressions	9.	()	()	()
10. Systematic hand-off of responsibilities during team transitions	10.	()	()	()

FIGURE E6. (Continued)