NEW RESEARCH

JCSM
Journal of Clinical Sleep Medicine

http://dx.doi.org/10.5664/jcsm.1672

SCIENTIFIC INVESTIGATIONS

High-Fidelity Simulation Training for Sleep Technologists in a Pediatric Sleep Disorders Center

Kristin T. Avis, Ph.D., CBSM[1]; David J. Lozano, M.D.[1]; Marjorie L. White, M.D., MPPM, M.Ed.[1,2]; Amber Q. Youngblood, B.S.N., R.N.[2]; Lynn Zinkan, M.P.H., R.N.[2]; Julia M. Niebauer, M.D.[1]; Nancy M. Tofil, M.D., M.Ed.[1,2]

[1]*University of Alabama at Birmingham, Department of Pediatrics, Birmingham, AL;*
[2]*Pediatric Simulation Center, The Children's Hospital of Alabama, Birmingham, AL*

Study Objectives: Severe events of respiratory distress can be life threatening. Although rare in some outpatient settings, effective recognition and management are essential to improving outcomes. The value of high-fidelity simulation has not been assessed for sleep technologists (STs). We hypothesized that knowledge of and comfort level in managing emergent pediatric respiratory events would improve with this innovative method.
Methods: We designed a course that utilized high-fidelity human patient simulators (HPS) and that focused on rapid pediatric assessment of young children in the first 5 minutes of an emergency. We assessed knowledge of and comfort with critical emergencies that STs may encounter in a pediatric sleep center utilizing a pre/post-test study design.
Results: Ten STs enrolled in the study, and scores from the pre- and posttest were compared utilizing a paired samples *t*-test. Mean participant age was 42 ± 11 years, with average of 9.3 ± 3.3 years of ST experience but minimal experience in managing an actual emergency. Average pretest score was 54% ± 17% correct and improved to 69% ± 16% after the educational intervention ($p < 0.05$). Participant ratings indicated the course was a well-received, innovative educational methodology.
Conclusions: A simulation course focusing on respiratory emergencies requiring basic life support skills during the first 5 min of distress can significantly improve the knowledge of STs. Simulation may provide a highly useful methodology for training STs in the management of rare life-threatening events.
Keywords: Simulation, education, pediatric, sleep technologist, emergencies, basic life support skills
Citation: Avis KT; Lozano DJ; White ML; Youngblood AQ; Zinkan L; Niebauer JM; Tofil NM. High-fidelity simulation training for sleep technologists in a pediatric sleep disorders center. *J Clin Sleep Med* 2012;8(1):97-101.

Severe events of respiratory insufficiency are seemingly rare events in some clinical outpatient centers, such as sleep centers.[1] Nevertheless, they can and do occur. These life-threatening events must be identified quickly and effectively managed to ensure the best chance for survival. The American Association of Technologists in Sleep (AATS) mandates performance of certain duties of sleep technologists (STs). These include: (1) the ability to recognize and respond to critical events occurring during the polysomnographic monitoring of variables such as cardiac arrhythmias, oxygen desaturation, breathing distress, and other medical emergencies; and (2) the ability to perform or assist with basic cardiopulmonary resuscitation (CPR) if required and ensure the simultaneous alerting of on-call responders or emergency services personnel.[2] In addition, the American Academy of Sleep Medicine (AASM) requires that STs complete such a course on a yearly basis to meet accreditation standards.[3] However, there are no data to suggest the most efficacious method of teaching CPR skills to STs.

Currently, many STs prepare for these emergencies by taking a designated health care course, such as the Basic Life Support (BLS) for Healthcare Providers for training in CPR.[4] Although beneficial, such didactic curriculums are dedicated to teaching acute recognition and management of a broad set of patient problems. The majority of the curriculum is unlikely to be applicable to STs and the emergencies they may encounter. In addition, there is literature documenting the rapid decay of skills and knowledge of BLS, Advanced Cardiac Life Support (ACLS), and Pediatric Advanced Life Support (PALS) for physicians, residents, and nurses. This decay may be even more substantial in settings in which opportunities to practice the skills are often infrequent.[5-10] Since STs tend to be faced with identification of and the need to respond to emergent situations much less often than residents, it would be expected that STs have an equal or greater decline in these skills.

Alternative forms of emergency training, such as high-fidelity simulation scenarios depicting high acuity events, may improve the immediate and long-term performance during actual rare emergency events. Simulation can involve a combination of actors who portray patients and healthcare professionals and/or high-fidelity full-body human patient simulators. Thus, simulated activities offer an additional method of building and

BRIEF SUMMARY
Current Knowledge/Study Rationale: To date, methods of training in emergent procedures for sleep technologists have not been evaluated. We assessed the impact of a high-fidelity simulation training for sleep technologists that may be faced with severe events of respiratory insufficiency.
Study Impact: Life threatening emergencies are rare in sleep centers, yet do occur. Simulation for sleep technologists may be a beneficial method of training to bridge the gap between opportunity to practice emergency management skills and reality.

retaining application skills. For example, Edgar reported that lectures and other passive forms of teaching have only a 10% to 20% retention rate after 6 weeks, whereas active forms of learning, such as simulation, improve retention rates to as high as 70%.[11,12] High-fidelity simulation is gaining acceptance as an effective tool to train medical personnel and students in many disciplines and has acquired applications in laparoscopic surgery, ophthalmology, emergency medicine, pediatrics, and other high acuity settings.[13-19] Simulation cases can be created to be context specific, to allow for application in various less traditional areas such as radiology and pharmacy.[20,21]

To date, efficient, innovative, and successful methods of training in emergent procedures for STs have not been evaluated. Emergency policies and procedures are documented and reviewed routinely as part of AASM accreditation requirements for sleep centers; however, methods for ensuring sleep technologists are confident and able to respond in rare emergencies have not been reported. The utilization of HPS in a sleep center, particularly one that focuses on pediatrics has not been reported. Our hypotheses were that (1) simulation would be well-received by STs as an innovative educational opportunity, and (2) simulation would be an effective methodology for STs to improve the identification of and immediate critical actions for severe respiratory insufficiency that can occur in medically complex children undergoing nocturnal polysomnography.

METHODS

This study was approved by the Institutional Review Board of Human Studies at University of Alabama at Birmingham.

Course Conceptualization

The Pediatric Sleep Disorders Center at the Children's Hospital of Alabama is an 8-bed center with 2 inpatient portable monitoring units. The center studies approximately 1600 pediatric patients per year. Of these 1600, approximately 20% are patients with multiple medical complexities. For example, the center routinely studies patients with severe pulmonary complications to evaluate the need or settings for supplemental oxygen, ventilation, and noninvasive ventilation, as well as tolerance of capping of the tracheostomy tube and readiness for decannulation in medically complex children. After debriefing a recent emergency in our pediatric sleep center, our STs expressed concerns with their confidence and ability to identify and manage critical situations, particularly respiratory distress in infants and children. Specifically, STs identified infants as the most difficult age to assess and treat. Given the high acuity of our patient population coupled with our staff concerns, we designed and evaluated an innovative simulation sleep medicine curriculum for the sleep center staff in collaboration with the Pediatric Simulation Center at the Children's Hospital of Alabama. This center has extensive simulation experience, having conducted pediatric simulation training with more than 12,000 participants, ranging from students to advanced learners.

Course Design

The course emphasized observable signs of respiratory distress as well as treatment decisions and the actions required to carry out these decisions during emergent events. Since most STs would call an emergency response or code team for assistance with a crisis situation, we focused on those treatments important during the first 5 minutes of an emergency, prior to the arrival of help. In groups of 3 to 4 STs, participants took part in a simulation course with additional time for completion of the pretest, posttest, and post course-survey (Appendices A & B). Course objectives included that the learner would be able to (1) assess a patient prior to a sleep study and know the proper procedures to call for help, (2) determine a Pediatric Early Warning System (PEWS) score[22] for each participant and follow an escalation algorithm, and (3) initiate proper BLS skills, including bag-valve-mask ventilation and chest compressions.

All simulation sessions were conducted at the Pediatric Simulation Center utilizing high-fidelity simulator mannequins including SimBaby (Laerdal, Wappingers Falls, NY) and Pediatric Hal 1-year-old (Gaumard Scientific, Miami, FL). The SimBaby can cough, cry, or grunt to indicate distress, while the Pediatric Hal uses early toddler words to answer simple questions. During the simulations a "parent" was with each child and could also describe or express concern over the patient's level of respiratory distress. The simulators also have pulses, chest rise, heart sounds and lung sounds, an intravenous line, and an intramuscular injection site. These mannequins provide a platform to carry out a number of procedures from basic intravenous fluid administration, bag-valve-mask ventilation, and chest compressions, to more advanced techniques such as endotracheal intubation. Monitors can reflect various vital sign changes, including heart rate, blood pressure, oxygen saturation, and respiratory rate based on the decisions made and treatment administered during the simulations. Scenarios began with the STs recognizing a patient problem and calling for help. Each scenario included an actor who played a family member to add to the realism of the experience. Each room had oxygen delivery devices which could be connected to an oxygen flow meter, simulated medications which could be drawn up and given in the appropriate dosage, and a code cart for any needed supplies. The level of assistance that needed to be called depended on the severity of each scenario. Options for help included notifying the sleep attending physician, the rapid response team, or the code team. When help arrived, efficient and concise handoffs were necessary to transfer care adequately.

The course consisted of a 10-min introduction to the simulation center and the simulators' features. This was followed by a 10-min standard lecture presentation of a rapid pediatric assessment, specifically focusing on signs and symptoms of respiratory distress and poor circulation in children with appropriate interventions. STs then participated in 3 simulation scenarios involving different levels of respiratory distress. Each scripted scenario lasted approximately 10-15 minutes and was followed by a 15-min debriefing by simulation personnel. All simulation activities were led by the same instructor in order to decrease the variability of the experiences.

The first scenario involved a 6-month-old with mild respiratory distress scheduled for a sleep study to evaluate oxygen requirement. The participants interacted with the child's mother and assessed the patient. Participants determined if they should notify the sleep study physician. Afterwards, debriefing allowed for participants to self-reflect, and a discussion of infant assessment followed. Emphasis was placed on calling the sleep attending physician whenever the STs were concerned regarding a patient. The PEWS score was introduced.[22]

The second scenario involved a 1-year-old with a tracheostomy admitted for a sleep study to evaluate for possible decannulation. This patient had vital signs at the upper limits of normal for his age. By talking with the child's mother, assessing the patient and using the PEWS scoring,[22] the participants needed to determine if interventions or calling the physician were warranted. Debriefing followed and included reviewing PEWS scoring[22] and introducing the algorithm for activating the rapid response team in the hospital.

The third scenario involved a 9-month-old infant with a tracheostomy who was admitted for a sleep study to be conducted while the tracheostomy was capped to evaluate possible decannulation. Once the obturator was placed, he had increased respiratory distress, manifested by grunting, retractions, increased respiratory rate, decreased oxygen saturation, and coughing. Upon further questioning of the patient's mother, it was discovered that the child had an upper respiratory infection as well. The participants needed to assess the patient and recognize that the patient needed the obturator on his tracheostomy tube removed, and the physician needed to be notified. If this process was delayed, the patient further deteriorated, manifesting as apnea the need for the code team to be called. Debriefing allowed ample time for participants' self-reflection. A discussion regarding the procedure for calling a code then ensued. Effective communication during hand-off with the code team was reinforced.

All sessions were videotaped and were followed by an immediate debriefing session utilizing the model of debriefing with good judgement.[23] This model is taught at the Center for Medical Simulation, Boston, MA, and is anchored in organizational behavioral science. This model aims to identify and clarify the reasoning behind decisions that result in actions or inaction during a simulated case.

Data Analysis

Data were analyzed using SPSS Version 11.5 (SPSS, Inc, Chicago, IL). Data are presented as means and standard deviations. Mean differences for pre- and posttests and comfort scales were examined using paired samples *t*-tests (2-tailed); and a p value < 0.05 was considered significant.

RESULTS

Fifteen STs participated in the simulation course in 3 groups of 4 and one group of 3 as part of routine yearly training. All participants participated in the educational component with 10/15 (66%) agreeing to enroll in the research component. Demographics and prior exposure to codes are reported in **Table 1**. Only one participant had significant experience with emergencies due to prior job experience as a respiratory therapist with a primary duty of responding to critical events. Overall, the simulation course resulted in significant improvement in knowledge. The average pretest score was 54% ± 17% and improved to 69% ± 16% after the educational intervention ($p = 0.05$). When examining specific items, the greatest improvement was seen in basic CPR skills. For example, an improvement of 60% was seen on question 10 ("When performing CPR, make sure your compression rate is approximately…"), which improved from 40% to 100%. In addition, great improvement was seen on question 5 ("A baby is breathing 120 times per minute with supracostal retractions, you could assess all of the following except…"), which improved from 50% to 80%. In addition, a 30% improvement from 10% to 40% on question 3 was seen ("What is the normal breathing rate for an infant under the age of 1 year?"). The pre and posttest items can be seen in **Appendix A** (appendices are available online at www.aasmnet.org/jcsm).

Table 1—Demographic information for sleep technologists (n = 10)

Average Age (years)	42 ± 11 years
Average Duration of ST Experience (years)	9.3 ± 3.3 years
Degrees (Frequency)	High School = 3 Bachelor's Degree = 2 Associate's = 5
# Emergencies Experienced in Career (Frequency)	
0	3
1-2	6
> 40	1*

*Participant had prior employment in respiratory therapy responding to distress/codes.

Finally, the mean score on the Simulation Course Comfort Scale (**Appendix B**) prior to the course was 20.2. After the course, the score increased to 21.1 ($p = 0.24$). Course evaluations were overwhelmingly positive. There was 100% agreement that both the simulation scenarios and debriefing exercises were a valuable learning experience. Themes of learning included the "realism of the experience" and the "opportunity to practice emergent scenarios occasionally encountered in the sleep center." One ST commented, "I think this is the best experience for patient care workers. We really get a chance to fine tune and improve our skills here."

DISCUSSION

Based on our outcome measures, the simulation course for STs, focusing on the first five minutes of emergent events, was effective at increasing knowledge. While there was not a significant improvement in comfort level, the STs improved in their knowledge and management of the first five minutes of an emergent event. The initial moments of a crisis are the most critical and were described by STs as the most challenging and difficult time frame. This course was designed specifically for this time period and appears to have been successful.

Our data show that most STs do not have enough actual experience to be proficient at these events. Simulation allows reproduction of rare events, such as medical emergencies in the sleep center, providing an opportunity for active learning. In our initial emergency debriefing with the STs, confidence and ability to respond to critical situations was shown to be extremely low, which negatively impacted job satisfaction. Confidence and ability during emergent events were perceived by STs as barriers to their implementation of emergency management skills. Opportunities for the application of this material are rare in a sleep center, yet actual emergencies do occur. Without practice and feedback, staff are at risk for failing to identify distress and failing to respond appropriately to a life-threatening emergency. Simulation offered a valuable tool for addressing an expressed need for further training and experience in identification of distress and effective response management. In addition, simulation provided an opportunity to practice and apply this knowledge in a "real world" setting. Like other studies, high-fidelity simulation learning activities in the context of STs were well received and complemented other forms of instruction currently offered, such as BLS.

In addition, it should be noted that respiratory emergencies are only one type of emergency that STs could encounter in the sleep laboratory. For example, seizures and cardiac arrhythmias require emergency responses by the staff. Thus, simulation also offers a possible educational method for improving the knowledge and management skills of STs regarding other emergencies (such as recognizing seizures), such as when to contact emergency response teams and immediate management until a response team arrives.

The simulation center relies heavily on the six core adult learning principles introduced by Malcolm Knowles: (1) adults need to know why they need to learn something before learning it; (2) adults want to be self-directing in their learning; (3) adults have rich past experiences which shape their current learning; (4) learning needs to be temporally related to real-world application; (5) orientation to learning needs to be task-centered not subject-centered; and (6) internal motivators are important for adult learners.[24] The center also focuses on reflective learning by utilizing debriefing with good judgement.[23,25] This cycle begins with an experience (either actual patient encounter or simulation), followed by reflective observation, abstract conceptualization, and finally, active experimentation. Debriefing augmented their learning by allowing instructors the opportunity to point out correct and incorrect actions and to further explain concepts experienced in the simulation. The post-simulation assessment in this study showed that all STs recognized the importance of this process to further their understanding of the scenarios.

Simulation was shown not only to be a useful and well received method for training in the ***identification*** of an emergent situation, but also beneficial for training in the ***response*** process during the acute event. The course was designed to provide additional training in the call for help and hand-off processes that technologists rarely encounter. The technologists overwhelmingly indicated that the realism of simulating communication procedure in these two situations was extremely valuable. Prior to this training, STs felt they were minimally familiar with the hospital emergency response team and the desired information that needed to be disseminated upon their arrival. Providing structure and training in this process has been shown to significantly reduce medical error, patient harm, and staff communication errors often encountered in such high-risk situations.[26,27]

Similar to other studies, our project further demonstrates that simulation is an effective, well received, and a useful method for a group of pediatric healthcare providers who otherwise may not be included in mainstream simulation activities. As a result of this project, the sleep technologists requested that this training be conducted on a regular basis, and the program is now required yearly for all STs and sleep center staff. Furthermore, the AAST advocates that training and continuing education in emergency procedures is required for sleep technologists,[2] and the AASM requires CPR training as a necessary component for accreditation of sleep centers.[3] Simulation centers may allow for expanded application activities augmenting and improving a didactic curriculum.

As this project evolved from a quality improvement needs assessment, there are limitations of our design. First, we did not assess individual learning or performance. Second, we evaluated knowledge of emergency skills but did not assess actual management, for example, during a "mock code" assessment. Third, we did not evaluate the optimal time period in between teaching and retraining. With the positive learner feedback, future studies are being designed to help determine the optimal time needed for each learner of each session and frequency of retraining that might be needed to prevent decay of skills and knowledge. In addition, checklists of required actions are being developed to behaviorally evaluate the STs during a "mock code." Thus, further research is needed before we can confidently advocate that the inclusion of a simulation course should be mandated in the training of all STs and sleep center staff. For example, direct comparisons of simulation and other traditional learning methods should be conducted.

In conclusion, although simulation requires significant resources, it offers an exemplary and valuable technique to improve sleep technologists' critical thinking and application skills. This report describes the first known use of high fidelity simulation for STs. Significant improvement in knowledge of respiratory distress in children occurred. Further study is needed to better characterize learning patterns and to identify the optimal frequency of need for training.

REFERENCES

1. Pennsylvania Safety Advisory Authority. Clinical emergency: Are you reading in any setting? *Pa Patient Saf Advis* 2010;7:52-60.
2. American Association of Sleep Technologists: Scope of practice of the sleep technology profession. http://www.aastweb.org/sleep technologist.aspx. Accessed February 17, 2011.
3. American Academy of Sleep Medicine. Standards for accreditation of sleep disorders centers. http://www.aasmnet.org/resources/pdf/dec2008centerstandards.pdf. Accessed August 10, 2010.
4. American Heart Association. American Heart Association. 2005 American Heart Association (AHA) guidelines for cardiopulmonary resuscitation (CPR) and emergency cardiovascular care (ECC) of pediatric and neonatal patients: pediatric basic life support. *Pediatrics* 2006:117(5). Available at: www.pediatrics.org/cgi/content/full/117/5/e989. Accessed on November 16, 2010.
5. Berden HJ, Willems FF, Hendrick JM, et al. How frequently should basic cardiopulmonary resuscitation be repeated to maintain adequate skills? *BMJ* 1993;306:1576-7.
6. Dracup K, Doering LV, Moser DK, Evangelisata L. Retention and use of cardiopulmonary resuscitation skills in parents of infants at risk for cardiopulmonary arrest. *Pediatr Nurs* 1998;24:219-25.
7. Wolfram RW, Warren CM, Doyle CR. Retention of pediatric advanced life support (PALS) course concepts. *J Emerg Med* 2003;25:475-9.
8. Chamberlain D, Smith A, Wollard M. Trials of teaching method in basic life support: comparison of simulated CPR performance after training and at 6 months with a note on the value of retraining. *Resuscitation* 2002;53:179-87.
9. Moser DK, Coleman S. Recommendations for improving cardiopulmonary resuscitation skills retention. *Heart Lung* 1992; 21:372-80.
10. Eisenberg M, Bergner L, Hallstrom A. Epidemiology of cardiac arrest and resuscitation in children. *Ann Emerg Med* 1983;12:672-4.

11. Edgar, D. *Audio-visual methods in teaching*. Hinsdale, IL: Dryden Press Professional Books in Education, 1954.
12. Weinberg ER, Auerbach MA, Shah NB. The use of simulation for pediatric training and assessment. *Curr Opin Pediatr* 2009;21:282-7.
13. Solverson DJ, Mazzoli RA, Raymond WR, et al. Virtual reality simulation in acquiring and differentiating basic ophthalmic microsurgical skills. *Sim Healthcare* 2009;4:98-103.
14. Gurusamy K, Aggarwal R, Palanivelu L, Davidson BR. Systematic review of randomized controlled trials on the effectiveness of virtual reality training for laparoscopic surgery. *Br J Surg* 2008;95:1088-97.
15. Nishisaki A, Hales R, Biagag K, et al. A multi-institutional high-fidelity simulation "boot camp" orientation and training program for first year pediatric critical care fellows. *Pediatr Crit Care Med* 2009;10:157-62.
16. Robertson B, Schumacher L, Gosman G, et al. Simulation-based crisis team training for multidisciplinary obstetric providers. *Sim Healthcare* 2009;4:77-83.
17. Lammers RL, Byrwa MJ, Fales WD, Hale RA. Simulation-based assessment of paramedic pediatric resuscitation skills. *Prehosp Emerg Care* 2009;13:345-56.
18. Weinberg ER, Auerbach MA, Shah NB. The use of simulation for pediatric training and assessment. *Curr Opin Pediatr* 2009;21:282-7.
19. McLaughlin S, Fitch MT, Goyal DG, et al. Simulation in graduate medical education 2008: a review for emergency medicine. *Acad Emerg Med* 2008;15:117-29.
20. Tofil NM, Grant MJ**,** White ML, et al. Severe contrast reaction emergencies: high-fidelity simulation training for radiology residents and technologists. *Acad Radiol* 2010;17:934-40.
21. Tofil NM, Benner KW, Worthington M, Zinkan L, White ML. Enhancing pharmacy student learning through the use of simulation during a pediatric elective. *Am J Pharm Educ* 2010;74:1-5.
22. Duncan H, Hutchison J, Parshuram CS. The pediatric early warning system score: a severity of illness score to predict urgent medical need in hospitalized children. *J Crit Care* 2006;21:271-8.
23. Rudolph, JW, Simon, R, Dufresne RL, Raemer DB. There's no such thing as "nonjudgmental" debriefing: a theory and method for debriefing with good judgment. *Sim Healthcare* 2006;1:49-55.
24. Knowles MS, Holton EF, Swanson RA: *The adult learner*. Woburn, MA: Butterworth-Heinemann; 1998.
25. Kolb DA. *Experiential learning: experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall; 1984.
26. Cook RL, Render M, Woods DD. Gaps in the continuity of care and progress on patient safety. *BMJ* 2000;320:791-4.
27. Slagle JM, Kuntz A, France D, et al. Simulation training for rapid assessment and improved teamwork: Lessons learned from a project evaluating clinical handoffs. In: Proceedings of the Human Factors and Ergonomics Society 51st Meeting. Baltimore, MD: Human Factors and Ergonomics Society 2007:668-72.

SUBMISSION & CORRESPONDENCE INFORMATION

Submitted for publication February, 2011
Submitted in final revised form July, 2011
Accepted for publication July, 2011

Address correspondence to: Kristin T. Avis, Ph.D., CBSM, UAB Department of Pediatrics, Division of Pulmonary Medicine, 1600 7th Avenue South, ACC 620, Birmingham, AL 35233; Tel: (205) 939-6908; Fax: (205) 939-6905; E-mail: kavis@peds.uab.edu

DISCLOSURE STATEMENT

This was not an industry supported study. The authors have indicated no financial conflicts of interest.

Appendix A—Simulation Course Pre and Post-Test

Sleep Technologist Pre and Post Test

1. Which of the following children is experiencing respiratory distress?
   A. 3-month-old breathing 35 times a minute with normal heart rate
   B. 1-year-old with tracheostomy breathing comfortably with O_2 sat 94%
   C. 12-year-old breathing 32 times per minute
   D. 9-month-old breathing 34 times per minute with mild retractions, parent feels that is their baseline
2. A 10-year-old with asthma is undergoing a sleep study. They are apneic and have no pulse. What is the correct ratio of chest compressions to ventilation?
   A. 30:2
   B. 15:2
   C. 5:1
   D. 10:1
3. What is the normal breathing rate for an infant under the age of 1 year?
   A. 12-16
   B. 60-90
   C. 20-30
   D. 30-60
4. All of the following are signs of respiratory distress except:
   A. Tachypnea
   B. Nasal flaring
   C. Loud coughing
   D. Wheezing or grunting
5. A baby is breathing 120 times per minute with supracostal retractions. You would assess all of the following except:
   A. Airway is clear
   B. Color
   C. Responsiveness
   D. Respiratory rate
   E. Parent report of medicines taken in the past 24 hours
6. At Children's Hospital, we have a CHAT team, otherwise known as the rapid response team. In which of these scenarios would you need to call CHAT?
   A. 10-year-old with mild wheezing, no respiratory distress
   B. 2-year-old with temperature 103, sore throat, increased heart rate
   C. 5-year-old with tracheostomy who has increased secretions of dark color
   D. 6-month-old with increased work of breathing, oxygen saturation 90%
7. A 2-year-old boy with tracheostomy presents for sleep study. The sleep technologist places the cap on the tracheostomy tube prior initiating the study. Within 10 minutes, you notice the child's face is cyanotic, the oxygen saturation is 65%, and mental status is altered. What do you do first?
   A. Remove cap
   B. Call CHAT
   C. Give nebulizer
   D. Call attending MD on call for the sleep center
8. Which of the following best describes the PEWS?
   A. A scale to determine if the patient needs to be admitted to the hospital
   B. A prioritized assessment of patient status to avoid events leading to respiratory distress
   C. A coma scale used in the Intensive Care Unit
9. A fellow sleep technologist is nervous and is bagging a 14-year-old child at the rate of 50-60 times per minute. You recommend they bag at what rate?
   A. 20-30 breaths per minute
   B. 12-16 breaths per minute
   C. 32-40 breaths per minute
   D. 8-12 breaths per minute
10. When performing CPR, make sure your compression rate isapproximately:
    A. 50 times per minute
    B. 75 times per minute
    C. 80 times per minute
    D. 100 times per minute

Appendix B—Simulation Course Comfort Scale Pre and Post Course

Comfort Scale

Time (circle one): Pre Post

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
5	4	3	2	1

I am comfortable communicating with a physician during a crisis.	5	4	3	2	1
I am comfortable obtaining help with a sick patient.	5	4	3	2	1
I can recognize a patient whose condition is worsening.	5	4	3	2	1
I am comfortable caring for patients whose condition is worsening.	5	4	3	2	1
I am comfortable with the first five minutes of a code.	5	4	3	2	1