Clinical Simulation Issue Brief
AARC 2015 Sub Committee-Charge #2

Joseph Goss MS, RRT-NPS, AE-C, Lisa Shultis MEd, RRT, Lynda Goodfellow EdD, RRT, FAARC
Toni L. Rodriguez EdD, RRT, FAARC

Introduction
The use of simulation based instruction is playing a greater role in the training and evaluation of healthcare professionals. It provides a safe but realistic clinical environment that can be modified in complexity to facilitate critical thinking. The 2013-14 AARC 2015 Committee was charged with evaluation of clinical simulations for the preparation and continuing education of Respiratory Care practitioners.

CHARGE #2:
Explore models that validate the use of clinical simulations as a major tactic for increasing or upgrading the competency level of students and the current workforce for the purpose of 1) establishing the relevance of clinical simulation in the college/university setting as a substitute for actual clinical practice as requires by accreditation agencies 2) developing a "Standards of Quality Clinical Simulation" check list to guide hospital departments, educators and state affiliates in the development and effective use of clinical simulation projects.

The following Brief provides information related to the completion of this charge.

The Value of Simulation

The maintenance and development of clinical skills has become increasingly difficult to accomplish in the current hospital and educational arenas. The restructuring of our nation's health care system has resulted in reduced reimbursement while healthcare costs continue to rise. As a result employee workloads are on the increase and new hires must be brought up to speed quickly. Medical education has also been impacted noting less opportunity for onsite student instruction. Conditions are ripe for new practitioners and employees to further contribute to the considerable errors in providing advanced medical care. 'In a report by the Institute of Medicine entitled "To Err is human" (Corrigan, et al., 2000) it was reported that more Americans died because of medical errors than by automobile accidents or auto-immune deficiency syndrome' (Murray, Grant, Howarth, and Leigh, 2007, pp. 6). Simulation training can play a vital role in obtaining and evaluating clinical skills when access to the clinical environment is limited. Medical simulation may not exactly replicate actual clinical practice, but its use in the training of health service personnel can mirror the experience in a non-threatening and safe environment' (Murray, Grant, Howarth & Leigh, 2007, p. 6).

Validity of Simulation

There is a steady accumulation of studies and literature reviews, supporting the validity and utility of simulations for improving critical thinking skills in a variety of medical disciplines (Issenberg, 2006, Aucar, Groch, Troxel & Eubanks, 2005, Hall, Plant, Bands, Wall, Kang & Hall, 2005, Korndorffer, Dunne, Sierra, Stefanidids, Touchard & Scott, 2005, Stefandis, Korndorffer, Markley, Sierra, Heniford & Scott, 2007, and Wayne, Didwania, Feinglass, Fudala, Farsuk & McGaghie, 2008, and Cant & Cooper, 2009). Although much research has been written on the topic, a review of the literature has not supported a meta-analysis of the subject matter due to variably in the type and quality of research study design. As a result conclusions regarding the effectiveness of clinical simulation remain unconfirmed beyond the specific results obtained through individual research (Laschinger et al. 2008).
Researchers Sweet and McDougall studied simulations used to train physicians in the technical skills needed for urologic operating room procedures (2008). Their findings determined that both the cognitive and psychomotor domains could be supported using a high-fidelity manikin since 'It has been estimated that performing an operation properly is 75% decision-making and 25% dexterity' (Spencer, 1978, pp. 9). An essential skill taught to trainees is how to recognize error, why it is an error, and what to do to avoid and recover from the error' (Sweet & McDougall, 2008, pp.520). But clinical educators at the bed side cannot allow for misses and near misses in clinical skills acquisition. By using simulators, an instructor can allow for mistakes to play out followed by a debriefing session with an expert clinician to enhance the learning experience (DeMaria, Levine & Cohen, 2008). For these reasons high-fidelity simulation has become educational standard in many fields of practice. A survey of pre-licensure nursing programs identified that 87% of the participants use some form of simulation, and of that number 54% of the programs were using simulation in at least five clinical courses (Hayden, 2010, pp. 55).

The 2015 Sub-committee for Charge #2 contacted the Committee on Accreditation for Respiratory Care for a statement pertaining to the substitution of clinical simulation for real time clinical experience. Tom Smalling, COARC Executive Director in an email received Friday, Sep 20, 2013 at 8:45 AM commented as follows:

CoARC does not have any Standard or Accreditation Policy addressing specific time spent in a simulation lab vs. clinical time. Since we have an outcomes-based approach to accreditation, it is up to the program to determine their methods for instruction. The use of simulation technology should only be used to augment the clinical experiences (for example, augmenting a clinical involving airway management with some time in an a simulator lab). CoARC does not address the relationship of high-fidelity patient simulation to clinical patient hours or the ability to substitute the former for the latter. CoARC encourages the use of patient simulation as an adjunct to clinical training, but simulation cannot replace patient contact.

In light of this statement simulation as an instructional strategy for Respiratory Care will most likely increase in usage. Although it will not replace direct patient contact, it has value in the development of higher levels of learning mastery. This will be increasingly important in a healthcare environment where real time opportunities for such teaching and learning are becoming limited.

Outside of academic application clinical simulation can be used to maintain practice skills within medical institutions. Currently advanced clinical skills are obtained through continuing education sessions/lectures, conferences or by clinical educators employed by the vendors that sell new technology. However, these forms of pedagogy may no longer be sufficient to meet the educational needs of those who require training. Preferred learning styles are also changing. ‘Today’s generation of trainees being raised in a multimedia environment, prefer to learning by electronic methods (online, internet) instead of reading books’ (Sahu & Lata, 2010). Several studies have identified manikin-based simulation as a means producing higher learning outcomes for new graduates and veteran practitioners when technology based interactive learning is preferred (Lammers, Byrwa, Fales & Hale, 2009, and Sweet & McDougall, 2008).

In conclusion a review of the literature in regard to the effectiveness of clinical simulation remains inconclusive but reached the following common conclusions:

1) Simulation training by high-fidelity manikins resulted in high learner satisfaction in learning clinical skills. (Laschinger et al. 2008)
2) Simulation training should be used as an adjunct for real time clinical practice and not a replacement. (Laschinger et al. 2008)
3) Study results regarding the effectiveness of simulation in facilitating clinical learning are for the most part favorable but not conclusive (Hayden et al. 2010)

Simulation has been demonstrated to lead to improvements in medical knowledge, comfort in procedures, and improvements in performance during retesting in simulated scenarios. Simulation has also been shown to be a reliable tool for assessing learners and for teaching topics such as teamwork and communication

The Variety of Simulation:

There four major categories of simulation that either use standardized patients or technologies to replicate a clinical scenario:

1. Task training simulation which provides the ability to practice a unique skill such as arterial blood gas puncture, intubation, and suturing and line placement.
2. Manikin-based simulation which utilizes manikins of varying degrees of technological ability from static to high fidelity to model human behavior.
3. Standardized Patient Simulation which utilizes real people trained to act as patients.
4. Virtual reality simulation that uses computerized, 3D technology to simulate real patient scenarios. (Chakravarthy et al. 2011)

Please refer to Addendum A for a review of information related to the levels of technological simulation, a comparison of simulation to problem based learning, a typology of the fidelity elements in simulation and a comparison of standard versus portable simulation

A major advantage of clinical simulation is the ability to custom design a scenario to approximate unique clinical experiences at varying levels of complexity. This diversity lends itself to accomplishing a broad range of educational goals at any level of participant expertise. Gaba (2004) identified eleven attributes of simulation that can be manipulated to make its application multidimensional.

Gaba's 11 Dimensions of Simulation

1. Purpose and aim of the simulation:
    a. To assess performance
    b. Training
    c. Rehearsals
    d. Pt care protocols
    e. Application and operations of medical equipment
2. The unit of participation in the simulation
    a. Individual training
    b. Team training
    c. Multidisciplinary training
3. The experience level of the simulation participants
    a. Students (apprenticeship)
    b. Interns and residents
    c. Experienced clinical practitioners
4. Health care domain in which the simulation is applied:
    a. Primary Care
    b. In hospital
    c. Home care
    d. ICU
5. Healthcare discipline:
    a. Allied health
    b. Nursing
    c. Physicians
6. Type of knowledge, skill, attitudes or behavior to be addressed:
    a. Conceptual
    b. Technical skills
    c. Decision making skills
    d. Attitudes and behaviors
7. Age of the patient being simulated:
    a. Neonates

    b. Pediatrics
    c. Adults
    d. Elderly
8. Technology applicable or required
    a. Verbal role playing
    b. Actor as patient
    c. Computer patient
    d. Mannequin
9. Site of simulation participation
    a. Multimedia computer based
    b. Simulation lab
    c. Actual work site
10. The extent of direct participation in the simulation
    a. Remote viewing only
    b. Direct on site hands on
11. The feedback method accompanying the simulation
    a. Instructor critique
    b. Video based play back

Gaba, D M,(2004). The Future Vision of Simulation in Health Care. Quality and Safety Health Care, 1, i2-i10. doi:10.1136/qshc.2004.009878

Standards of Best Practice for Medical Simulation

In 2009 the International Nursing Association for Clinical Simulation and Learning (INACSL), was charged with establishing performance standards for simulation in healthcare education. Over 3 years, seven standards were identified to reflect the best practices in health care and health science education.

Standard I: Terminology

Consistent terminology enables clear communication, reflects shared values, and permits the sharing of knowledge and ideas through research and publications. A compendium of the common terminology utilized in the planning, participation and conducting of clinical simulations is to be found in the following reference:

Decker, S., Fey, M., Sideras, S., Caballero, S., Rockstraw, L. (R.), Boese, T., Franklin, A. E., Gloe, D., Lioce, L., Sando, C. R., Meakim, C., & Borum, J. C. (2013, June). Standards of Best Practice: Simulation Standard VI: The debriefing process. Clinical Simulation in Nursing, 9(6S), S27-S29.

Standard II: Professional Integrity of Participant(s)

For simulation based instruction or evaluation to be of value participants must maintain professional integrity related to the simulation. There must be mutual respect and professionalism demonstrated between all participants. Information related to the simulation process should be kept confidential. Guidelines:

1. Keep confidential all phases of the simulation process to protect the content of the scenario from bias that could alter future learning experiences.
2. Participants are expected to exhibit professional behavior. It is the role of the facilitator to recognize and put an end to any behavior that is unprofessional and inappropriate.
3. During debriefing feedback should be constructive and delivered with mutual respect.

Gloe, D., Sando, C. R., Franklin, A. E., Boese, T., Decker, S., Lioce, L., Meakim, C., & Borum, J. C. (2013, June). Standards of Best Practice: Simulation Standard II: Professional Integrity of Participant(s). Clinical Simulation in Nursing, 9(6S), S12-S14

Standard III: Participant Objectives

The foundation for all simulation based learning experiences should be well developed, clearly stated objectives.
Guidelines:

1. Participant objectives should speak to all learning domains to include knowledge, cognitive and affective domains.
2. Participant objectives should be appropriate to the knowledge level of the participant (ie novice, beginner, advanced) and achievable.
3. Participant objectives should align with overall educational goals.
4. Participant objectives should incorporate evidence-based practice.
5. Participant objectives should promote holistic client care (ie: physical assessment, communication, mental health assessment, spiritual/cultural sensitivity).
6. Participant objectives should be achievable within the designated time frame.

Lioce, L., Reed, C. C., Lemon, D., King, M. A., Martinez, P. A., Franklin, A. E., Boese, T., Decker, S., Sando, C. R., Gloe, D., Meakim, C., & Borum, J. C. (2013, June). Standards of Best Practice: Simulation Standard III: Participant Objectives. Clinical Simulation in Nursing, 9(6S), S15-S18.

Standard IV: Facilitation

It is important to use a method of facilitation the meets the learning needs of the participant(s) and achieves the expected outcomes.
Guidelines:

1. Use facilitation methods that align with the simulation objectives guiding: preparation before the simulation, facilitating activity during the simulation, as well as, determining feedback/debriefing post simulation.
2. Facilitation methods should be in line with participants achieving expected outcomes.

Franklin, A. E., Boese, T., Gloe, D., Lioce, L., Decker, S., Sando, C. R., Meakim, C., & Borum, J. C. (2013, June). Standards of Best Practice: Simulation Standard IV: Facilitation. Clinical Simulation in Nursing, 9(6S), S19-S21.

Standard V: Facilitator

The simulation facilitator guides and supports the participant through the simulation process. The facilitator has been trained to be proficient in the management of all aspects of the simulation.

Guidelines:

1. The facilitator should prepare the participant by communicating expected objectives and outcomes to the simulation participant.
2. The facilitator ensures a safe learning environment that encourages active learning and reflection.
3. The facilitator should demonstrate up to date knowledge related to simulation pedagogy, and design, technology and scenario content.
4. Facilitator assures the simulation based learning experience is at a level appropriate for the participant.
5. The facilitator assesses and evaluates acquisition of knowledge and skills.
6. The Facilitator models professionalism and integrity.

Boese, T., Cato, M., Gonzalez, L., Jones, A., Kennedy, K., Reese, C., Decker, S., Franklin, A. E., Gloe, D., Lioce, L., Meakim, C., Sando, C. R., & Borum, J. C. (2013, June). Standards of Best Practice: Simulation Standard V: Facilitator. Clinical Simulation in Nursing, 9(6S), S22-S25.

Standard VI: Debriefing

A planned debriefing is a key component of any simulation experience. It should be aimed at promoting reflective thinking which includes the meaning and implications of actions, assimilation of knowledge and correlation with previously learned information.

Guidelines:

1. Debriefing should be facilitated by someone competent in the process.
2. The environment for debriefing should be safe promoting: confidentiality, trust, open communication, self-analysis and reflection.
3. The role of the facilitator during the debriefing process is to guide participants as they reflect on their actions in comparison to stated objectives.

4. Debriefing should have structure and include optimal time to achieve the objective.
5. Debriefing should focus on the participant objectives and outcomes.

Decker, S., Fey, M., Sideras, S., Caballero, S., Rockstraw, L. (R.), Boese, T., Franklin, A. E., Gloe, D., Lioce, L., Sando, C. R., Meakim, C., & Borum, J. C. (2013, June). Standards of Best Practice: Simulation Standard VI: The debriefing process. Clinical Simulation in Nursing, 9(6S), S27-S29.

Standard VII: Participant Assessment and Evaluation

Formative or summative evaluation of the simulation participant is a key element of the simulation based experience.

Guidelines:

1. Formative assessment should be given to participants providing information for the purpose of improving performance and behaviors associated with cognitive, affective and psychomotor learning domains.
2. Summative evaluation should be provided to inform participants on the achievement of stated goals.
3. Evaluation of participants should be based upon standards of interrater objectivity and reliability to avoid observer bias and to decrease subjectivity.

Sando, C. R., Coggins, R. M., Meakim, C., Franklin, A. E., Gloe, D., Boese, T., Decker, S., Lioce, L., & Borum, J. C. (2013, June). Standards of Best Practice: Simulation Standard VII: Participant Assessment and Evaluation. Clinical Simulation in Nursing, 9(6S), S30-S32.

References:

Alinier, G., Hunt, W.B. & Gordon, R. (2004). Determining the value of simulation in nurse education: study design and initial results. Nurse Education in Practice. 4, 200-207.

Arthur, C., Levett-Jones, T. & Kable , A.(2013 November) Quality indicators for the design and implementation of simulation experiences: A Delphi study. *Nurse Education Today.* 33(11): 357–1361 Retrieved from

http://www.sciencedirect.com/science/article/pii/S0260691712002511

Aucar, J.A., Groch, n.R., Troxel, S.A. & Eubanks, S.W. (2005). A review of surgical simulation with attention to validation methodology. Surg Laparosc Endosc Percutan Tech. 15, 82-89.

Cant R.P. & Cooper S.J. (2010) Simulation-based learning in nurse education: systematic review. Journal of Advanced Nursing 66(1), 3–15. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1365-

2648.2009.05240.x/abstract;jsessionid=0DB6847315B23D1D511AD7EB94DFF860.f01t04?deniedAccessCustomisedMessage=&userIsAuthenticated=false

Chakravarthy,B. Haar, E. Bhat,S. McCoy, C. Denmark T. Lotfipour, S. Simulation in Medical School Education: Review for Emergency Medicine, Western Journal of Emergency Medicine Volume 466 XII, NO. 4: November 2011

DeMaria, S, Levine, AI, Lawrence & Cohen, B. (2008 October). Human Patient Simulation and its Role in Endoscopic Sedation Training. Gastrointestinal Endoscopy Clinics of North America. 18 (4) : 801–813 Retrieved from http://www.sciencedirect.com/science/article/pii/S105251570800055X

Felder, R.M. & Brent, R. (1994). Cooperative learning in Technical Courses: Procedures, pitfalls, and payoffs. Raleigh, NC: North Carolina State University

Hall, R.E., Plant, J.R., Bands, C.J., Wall, A.R., Kang, J. & Hall, C.A. (2005). Human patient simulationis effective for teaching paramedic students endotracheal intubation. Acad Emerg Med. 12, 850-855.

Hayden, J. (2010 October). Use of Simulation in Nursing Education: National Survey Result. Journal of Nursing Regulation. 1 (3): 52-57. Retrieved from http://jnr.metapress.com/content/m3g73t2207615756/

Hogg, G., Pirie, E.S., Ker, J. (2006). The use of simulated learning to promote safe blood transfusion. Nurse Education in Practice. 6, 214-223.

Issenberg, S.B. (2006). The scope of simulation-based healthcare education. Simul Healthc. 1, 203-208.

Korndorffer, J.R., Dunne, J.B., Sierra, R., Stefanidis, D., Touchard, C.L. & Scott, D.J. (2005). Simulator training for laparoscopic suturing using performance goals translates to the operating room. J Am Coll Surg. 201, 23-29.

Lammers,RL, Byrwa, MJ, Fale, WD. (2009). Simulation-based assessment of paramedic pediatric resuscitation skills. Prehospital Emergency Care. 13 (3): 345-356. Retrieved from

http://informahealthcare.com/doi/abs/10.1080/10903120802706161

Lapkin, S. Levett-Jones, T. Bellchambers,H. Fernandez, R. Effectiveness of Patient Simulation Manikins in Teaching Clinical Reasoning Skills to Undergraduate Nursing Students: A Systematic Review, Clinical Simulation in Nursing, Volume 6, Issue 6, November–December 2010, Pages e207–e222

S. Laschinger, J. Medves, C. Pulling, D. McGraw, B. Waytuck, M. Harrison, *et al.* Effectiveness of simulation on health profession students' knowledge, skills, confidence and satisfaction International Journal of Evidence-Based Healthcare, 6 (3) (2008), pp. 278–302

Mole, L.J., McLaffery, I.H.R. (2004). Evaluating the simulated ward exercise for third year student nurses. Nurse Education in Practice. 4, 91-99.

Murray, C., Grant, MJ, Howarth, ML, Leigh, J. (2008 January). The use of simulation as a teaching and learning approach to support practice learning. Nurse Education in Practice. Volume 8, Issue 1, Pages 5–8. Retrieved from http://www.sciencedirect.com/science/article/pii/S1471595307000789

Rystedt, H. & Lindstrom, B. (2001). Introducing simulation technologies in nurse education: a nursing practice perspective. Nurse Education in Practice. 1, 134-141.

Sahu, S & Lata,I. (2010 Oct-Dec). Simulation in resuscitation teaching and training, an evidence based practice review. J Emerg Trauma Shock.3(4): 378–384. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2966571/

Schoening, A.M. (2006). Simulated clinical experience: nursing students' perceptions and the educators' role. Nurse Education in Practice. 31(6), 253-258.

Spencer, F. (1978). Teaching and measuring surgical techniques: the technical evaluation of competence. Bull Am Coll Surg 63: 9-12.

Stefandis, D., Korndorffer, J.R., Markley, S., Sierra, R., Heniford, B.T. & Scott, D.J. (2007). Closing the gap in operative performance between novices and experts: does harder mean better for laparoscopic simulator training? J Am Coll Surg. 205, 307-313.

Wayne DB, Didwania A, Feinglass J, Fudala MJ, Barsuk JH, McGaghie WC. Simulation-based education improves quality of care during cardiac arrest team responses at an academic teaching hospital: a case-control study. Chest. 2008 Jan;133(1):56-61. Epub 2007 Jun 15.

Addendum A

Technological simulation levels	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
Simulation Technique	Written simulations includes pen and paper simulations or "Patient Management Problems" and latent images	3-D models which can be a basic mannequin, low fidelity simulation models, or part-task simulators	Screen-based simulators. Computer simulation, simulation software, videos, DVDs, or Virtual Reality (VR) and surgical simulators.	Standardized patients. Real or simulated patients (trained actors), role play.	Intermediate fidelity patient simulators. Computer controlled programmable full body size patient simulators not fully interactive.	Interactive patient simulators or computer controlled model driven patient simulators, also known as high fidelity simulation problems.
Mode of delivery	Usually student led	Student or trainer led	Student or trainer led	Student or trainer led	Preferably trainer led	Preferably student led
Type Skills addressed	Passive Cognitive	Psychomotor	Interactive Cognitive	Psychomotor, cognitive, and interpersonal	Partly interactive psychomotor, cognitive, and interpersonal	Interactive psychomotor, cognitive, and interpersonal
Type Skills addressed	Classroom	Clinical skills room or classroom	Multimedia/Computer laboratory or classroom	Depends on the scenario requirements	Clinical skills room or simulation center realistic setting (simulated theatre, ICU, A&E or ward	Simulation center with realistic setting (simulated theatre, ICU, A&E or ward) usually set up with audio and video recording equipment
Typical use	Patient management problems. Diagnosis mainly for assessment	Demonstration and practice of skills	Cognitive skills Clinical management. Sometimes interpersonal skills (software allowing for a team to interact over networked computers)	Same as Level 2 plus patient physical assessment, diagnostic, or management problems Interpersonal skills	Same as Level 3 plus procedural skills. Full-scale simulation training sometimes used for demonstrations	Same as Level 4
Disadvantages	Unrealistic feedback cannot be given instantaneously after the exercise	Limited range of training functions. No or little interactivity	Unrealistic setting. Students and trainers have to be familiar with the software/equipment. Software has to be kept up to date with the relevant medical regulations/procedures VR sometimes requires very high computational power	For small groups of students only. Patients have to be trained and briefed. Inconvenient if the exercise has to be repeated many times. Not valid for any invasive practice unless used in conjunction with a part-task trainer	May require programming of scenarios. Several trainers required for a relatively small group of students. Trainers have to be familiar with the equipment. Requires an emulated patient monitor for most parameters.	Cost (mannequin and facility). Several trainers required for a relatively small group of students. Trainers have to be familiar with the equipment. Not very portable.
Advantages	Low cost (no special equipment required in most cases). One academic may be sufficient for a large number of students	Equipment relatively mobile and always available. One academic may be sufficient for a class of students working on the same skill. Spares patient discomfort	Relatively low cost, except for VR. One academic may be sufficient for a large number of students. Students can use it on their own (self-learning). Software often provides feedback on performance	Can be very realistic. A must for communication skills and patient history taking. Allows for truly multi-professional training	Provides a fairly realistic experience. Can be used to apply a broad range of skills. Students' performance sometimes recorded. Allows for truly multi-professional training. Usually portable	Realistic experience. Can apply a broad range of skills. Students' performance recorded for debriefing. Allows multi-professional training. Can be used with real clinical monitoring equipment

A Typology of Educationally Focused Medical Simulation Tools: Gillaume Aliner, Medical Teacher, 2007, 29: e243- e250

How merging problem-based learning and simulation matches learning outcomes.	PBL	Simulation	Achievable Learning Outcomes
	Trigger presented stimulates discussion to frame the problem. Learner-directed knowledge inventory.	Shared, realistic, active participation in a critical patient care situation in a safe environment. Generates contextual constructivist learning. Physical and psychological safety.	Manage clinical nursing situations. Apply knowledge in response to trigger. Anticipate and use technical equipment. Acknowledge the extent of student's own abilities to manage the problem.
	IT-equipped tutorial room. Tutor guidance. Resource people: expert clinical nurses, allied health care professionals. Online material: library, databases, Web, DVD. Librarian support.	Clinical skills simulation center (CSSC)–multipurpose facility. Resource people: role players, actors, AV and IT technicians and CSSC staff. Mid- to high-fidelity manikins. A talkback facility. A return video & audio circuit. Patient biometrics analysis. Patient documentation. Digital Archive System.	Demonstrate the ability to conduct a nursing systematic patient assessment. Recognize, interpret and respond to alteration in patient status.
	Dialogue and debate, sharing and integrating information. Knowledge discovery. Problem solving. Critical and creative thinking. Clinical reasoning. Transforming knowledge. Documenting problem log. Teamwork.	Students adapt their learning process based on discoveries from the real environment. Choose and prioritize activities to inform decision making. Skills execution in a realistic environment.	Demonstrate ability to conduct systematic patient assessment. Communicate and perform professionally. Recognize, interpret, and respond to alterations in patient status. Make informed clinical decisions. Manage clinical situations.

Merging Problem Based Learning and Simulation as an Innovative Pedagogy, Clinical Simulation in Nursing, ppe141 – e148, Vol 7, Issue 4

Fidelity Elements in Simulation: A Typology	
Description	Definition
Partial tast trainers (simulators – low tech)	Basic models or manikins used for the development of simple techniques and procedures e.g. a birthing pelvis.
Peer to peer learning	Collaboration between peers for the development of skills e.g. abdominal assessment
Screen-based computer simulators	Computer based programs for the development of knowledge and critical thinking skills e.g. advanced life support.
Virtual reality	A combination of computer-generated images with auditory, tactile and visual trainers e.g. surgical skills.
Haptic systems	A combination of real-world and virtual reality exercises which enables the device or procedure to be 'touched' and 'felt' and for practitioners performance to be tracked.
Standardized patients	Role-playing of a case study using students or actresses in a realistic and consistent approach.
Full-scale simulation (medium to high fidelity)	Full body computerized manikins programmed to provide physiologic responses to practitioner actions e.g. full body obstetric birthing simulators.

Simulation Based on Learning in Midwifery Education: A Systematic Review, S Cooper et al.

Comparison of Select Features of Standard And Portable Acute Care Simulation	Standard Simulation	Off-site	On-site (In Situ)	Mobile (Including Progressive)
Education				
Location	Simulation Center	Nonclinical setting (e.g., conference space)	Live clinical environment	Transitive settings (e.g., medical clinic to ambulance to ED
Accessibility for learners	Scheduled events	Scheduled events	Impromptu or scheduled	Impromptu or scheduled
Interdisciplinary training	Limited (scheduling)	Session-dependent	Session-dependent	Integral
Continuity of care				
Multi-department/multi-facility learning	Facility-dependent	Possible	Possible	Integral
Prolonged scenario	Possible	Possible	Possible (often limited)	Possible (often limited)
Opportunity for didactic/ debrief component	Session-dependent	Session-dependent	Limited (time, AV, equipment)	Limited (time, AV, equipment)
AV support	Facility-dependent	Location-dependent	Limited	Limited
Session finding source	Direct (learner/department)	Direct (learner/department)	Indirect (department/institution)	Indirect (department/institution)
Costs (including infrastructure)	Center-dependent	Session-dependent	Session-dependent	Session-dependent
Staff clinical release	Required	Required	Institution-dependent	Institution-dependent
Supplies + equipment	Provided by center	Provided for session	Existing on-site materials	Existing on-site materials
Research				
Primary methodological benefit	Improved control over SIM/environment	Improved access to specific subject cohorts	Live clinical environment	Live clinical environment
Potential challenges	Subject scheduling	Subject scheduling	Obtaining consent for impromptu simulation	Subject scheduling
Example	Pre- and post-training assessment of ACLS skills and teamwork behavior retention via detailed observational study of resident physician trainees	Difficult airway simulation scenario performance comparison across large cohort of physicians with similar backgrounds at a national conference	Quality management study to assess resuscitation team response to simulation patient cardiac arrest on medical floor	Assessment of CPR care delivery during unstable out-of-hospital patient transport simulation

Portable Acute Care Simulation: Kobyashi et al