

Review

Use of Simulation-Based Training to Aid in Implementing Complex Health Technology

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About the Author



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Abstract

Clinicians are adult learners in a complex environment that historically does not invest in training in a way that is conducive to these types of learners. Adult learners are independent, self-directed, and goal oriented. In today's fast-paced clinical setting, a practical need exists for nurses and clinicians to master the technology they use on a daily basis, especially as medical devices have become more interconnected and complex.

As hospitals look to embrace new technologies, medical device companies must provide clinical end-user training. This should be a required part of the selection process when considering the purchase of any complex medical technology. However, training busy clinicians in a traditional classroom setting can be difficult and costly.

A simple, less expensive solution is online simulation training. This interactive training provides a virtual, "hands-on" end-user experience in advance of implementing new equipment. Online simulation training ensures knowledge retention and comprehension and, most importantly, that the training leads to end-user satisfaction and the ability to confidently operate new equipment. A review of the literature revealed that online simulation, coupled with the use of adult learning principles and experiential learning, may enhance the experience of clinical end users.

In today's busy hospital environment, training clinicians on new equipment in the traditional classroom setting can be both difficult and costly. Online interactive simulation training offers a simple and less expensive way for clinical learners to gain hands-on end-user experience before new equipment is implemented for patient care. In addition, providing access to online simulation modules that allow the clinical end user to experience the equipment virtually—with guidance—can better prepare them for a hands-on live training and serve as a resource to review and refresh their skills at any time throughout the learning process.

Recent studies have suggested that simulation-based training is helpful in the mastery of complex clinical concepts.^{1,2} In addition, during an AAMI Foundation Industry Council meeting, the experts in attendance agreed that current training is based on past practices and needs to evolve.³ This lack of effective training is a cause for concern because a clinician's main focus is the patient and learning the many facets of a complex medical device can be overwhelming, if not impossible.³

According to the ECRI Institute's medical technology problem reporting system, approximately 75% of reported problems are related to user error specifically around the mastery of complex technology.⁴ In addition, when asked about required training, only

65% of hospitals surveyed by ECRI and the American Association of Critical Care Nurses (AACN) stated that they required clinical training with regard to patient monitor use.⁵

As hospitals embrace new technologies in a complex healthcare environment, ensuring appropriate staff training by medical device companies is paramount. Although advisable, many organizations do not factor in the cost of proper training during the selection and purchasing of health technology. The ECRI Institute's medical device reporting system indicates that the 75% user error correlates with lack of end-user understanding.⁴ In addition, research has reported that training has not improved since an ECRI study conducted in 1998.⁵ This is alarming given that today's medical devices are increasingly computerized and complex.⁶ Training for the safe and effective use of medical devices is in crisis, and the formation of alliances to leverage experts to develop effective training is recommended.⁷

Accordingly, the AAMI Foundation recently launched the National Coalition to Promote the Safe Use of Complex Healthcare Technology.⁸ The goal of the coalition is to bring together stakeholders from healthcare, industry, and regulatory environments to study the current state of clinical training and collaborate to solve this complex issue.

Framework

Clinicians are adult learners who are independent, self-directed, and goal oriented. Adult learners are most effective when the education they receive is applicable to their practice, as cognitive processes support learning and active learning requires engagement.⁹ Although the current article reviews several adult learning methods, including simulation, experiential learning principles, and the NLN/Jeffries Simulation Theory, no single method or theory can explain how all clinicians learn.⁹⁻¹²

Andragogy, which is the science of teaching adult learners, was originally described by Malcom Knowles. Clapper¹⁰ described Knowles' theory that adults learn differently compared with children. The author stated that "adult learners are self-directed and have a wealth of prior experiences that become resources for learning. Adult learners are

ready to learn and grow to fulfill their social roles related to learning. They apply their learning and leverage it toward problem solving." Further, Clapper said that "adult learners are intrinsically motivated and have a need to know what they are learning and receive instruction that promotes understanding and self-efficacy."

Experiential learning is one of the modalities of adult learning. Dernova¹³ concluded that "a key element of adult learning is experience, which further provides a real world understanding that can be used in problem solving and knowledge transfer in an environment where the instructor facilitates rather than instructs, ensuring a strong motivation to learn."

Because it encourages active learning, the NLN/Jeffries Simulation Theory supports the simulation aspect of the learning frameworks.¹⁴ The educational practices construct of the NLN/Jeffries theory states that learning is not a "spectator sport"; therefore, the active learning that occurs during simulation brings together multiple theories to guide an approach toward educating clinicians.¹⁵

Adult learning principles/andragogy, experiential learning, and NLN/Jeffries theory were used to provide a framework through which the literature related to the way adults (in this case, clinicians) learn could be evaluated. Knowles used the following principles for designing and implementing adult learning programs. The adult learner¹⁶:

- Has an independent self-concept and can direct his or her own learning.
- Has accumulated a reservoir of life experiences that is a rich resource for learning.
- Has learning needs closely related to changing social roles.
- Is problem centered and interested in immediate application of knowledge.
- Is motivated to learn by internal rather than external factors.

According to Merriam,¹⁶ effective adult learning "should involve learners in as many aspects of their education as possible and in the creation of a climate in which they can most fruitfully learn." Knowles' main focus in developing andragogy was ensuring that the material was learner centered and the learner was self-directed.¹⁷

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Review of the Literature

A review of the literature was conducted using the following databases: Fusion, Business Source Complete, Science Direct, and Education Source. Direct journal and website searches also were conducted. The search terms used were *knowledge, learning, medical devices, medical equipment, safety, key measures, and simulation*. To ensure that the findings used were recent, publications prior to 2010 were not considered (with the exception of one study from 1998). The initial literature search, which revealed several thousand articles, was refined to ensure that the reports were relevant to complex medical device training, adult learning, and/or education for complex technology. Expert opinion articles formed the majority of relevant sources, and a few research-based studies were found to be applicable. Searches of the AAMI, ECRI Institute, and The Joint Commission websites also revealed articles related to learning theories in healthcare. The sources used in the literature review are summarized in Table 1 in the data supplement (available online at <http://aami-bit.org>).

Critical Appraisal of the Evidence

Two additional studies, including a mixed-method study by Darragh,¹ centered on a gaming simulation to create a virtual home-like environment containing hazards relevant to multiple professions. Quantitative data from the Modified Home Healthcare Worker Questionnaire and the concept of usefulness, usability, and desirability were analyzed using SPSS version 21. Qualitative data were analyzed descriptively. The study sample was a multidisciplinary group of 68 home healthcare providers (HHPs), including nurses, home health aides, occupational therapists, administrators, and health and safety educators. The mixed-method design included an interdisciplinary, participatory design methodology used to develop a virtual systematic training system to train HHPs to identify and manage health safety hazards in the home using a gaming simulation.

The study yielded positive results, with the home healthcare workers identifying more than 350 potential hazards (e.g., overloaded electrical outlets, slip/trip hazards). No *P* value was expressed in this study, as the

review of data centered on the analysis of focus groups in which a pedagogical case-based design was used. The study resulted in training related to electrical safety, fire hazards, and environmental hazards such as slips, trips, and falls.¹

A nonexperimental explorative study by Eisert and Geers¹⁸ used self-developed instruments, including scenario description and time log sections. The researchers sought to understand the simulation process by looking at patterns of activity usage and quantifying time commitments related to simulation. Quality statistics were distributed via a nursing simulation design template that was distributed to healthcare and academic institutions. The data were subjective, as they were self-created tools. The participants provided documentation on paper copies of the tools. The response rates were between 80% and 100% and revealed that the most effective use of time was in the creation of the simulation. (Currently, healthcare organizations budget the bulk of time to working with learners.) This met the goal of the study, which was to identify the amount of time needed for simulation activities. Descriptive statistics were used to interpret data following simulation activities. The data were calculated using Microsoft Excel (version 2010). The limitations of this study were that the data were self-reported, some fields were left unanswered, the setting was specific to a simulation consortium in southeast Indiana, and the length of study was limited due to the academic year and federal holidays. In addition, this study only involved nurses, and the authors suggested that this topic be examined across other populations.¹⁸

The ECRI Institute and AACN collaborated to explore the extent to which continuum-of-care monitoring had been implemented in hospitals and to assess the impact of the monitoring on patient care, operations, patient mix, costs, staffing, and training.⁵ Surveys were sent to 1,278 vice presidents and directors of nursing or patient care services. A total of 141 responses were received from hospitals in 38 states. Because not all responses were complete, some of the data were “estimated.” Among hospitals, 68.3% provided continuum-of-care monitoring, 57.7% did not provide such monitoring

but were planning to do so, and 85.7% indicated that implemented monitoring reduced the demand for high-cost beds. Nearly two-thirds (65%) of hospitals required clinical training regarding monitor use, 71% required clinical training regarding clinical alarm use, and 48.2% reported that nurses had “good acceptance and adaption” to monitoring system implementation.

Observations from the data collected via the survey included that continuum-of-care monitoring has come to the forefront in the ever-changing clinical needs of patients. The author recommended that hospitals track and analyze the use of traditional monitored beds to determine how many patients could be moved to nontraditionally monitored areas. Another recommendation was that hospitals determine, based on projected use, a minimum required number of telemetry beds. Hospitals also should determine system configuration for the continuum of care and develop an implementation plan that incorporates operational and staffing adjustments. In addition, establishing alarm coverage protocols and providing sufficient training to all staff involved, as defined by their roles, should be part of a successful implementation. This study was limited by the low response rate and missing responses to survey items. In addition, although the study was published in 1998, it correlated with the current literature reviewed and therefore was included.⁵

Zulkosky et al.² used a quantitative mixed-factorial design to investigate clinical decision-making (CDM) accuracy. The study considered P values <0.05 to be considered statistically significant. A convenience sample of 120 fourth-semester nursing students in an associate degree program was used. The participants were voluntarily recruited to participate in a rotating role-based simulation, playing nurse, observer, or family member, with endpoints for conditions and treatments for which they were familiar. Two CDM stopping points were used: shortness of breath and cardiac rhythm change (atrial fibrillation)². Each CDM had a decision phase (cue acquisition, diagnosis, and actions). The raw data from the forms were scored independently by two study team members who were doctorally prepared, certified nurse educators and analyzed by SPSS version 23.

The study revealed that age was negatively related to cue acquisition in the shortness-of-breath situation ($P < 0.05$). Older students were less accurate with acquiring cues from patients. In addition, the authors recommended that nurse educators should give participants a chance to play each role, both active (i.e., nurse) and passive (i.e., observer, family member), to enhance the learning experience. Although clear stopping points were included, this study was limited by the exact timing of the scenario pause by researchers and limited number of active roles, as well as vague answers in CDM questions.

Conclusion

A review of literature revealed that simulation coupled with adult learning principles and experiential learning can improve the learning experience for clinical end users. Clinicians are adult learners in a complex environment that historically does not invest in training in a way that is conducive to adult learners.⁷ The lack of well-planned and targeted end-user training could lead to possible error and perhaps patient harm.⁶ A combination of simulation and active participation can improve learning and mastery of complex skills and concepts.² The literature is not specific with regard to implementing this approach for complex medical devices via simulation.

According to Doyle et al.,⁷ “The system for training and assessing competency with medical devices seem perfectly designed to harm patients. Hospitals have a mix of medical device company-supplied and internally developed in-services with brief in-person training sessions modeled after the ‘see one, do one, teach one’ paradigm.” Many constraints within the hospital (e.g., budget, human resources, vendors’ inability to assist, staff time away from direct care) can make it difficult to properly train staff and evaluate competency across clinical end users. “Staff turnover rates also make it difficult to maintain skills at the individual and team levels”⁷ on an ongoing basis after equipment implementation.

Leveraging adult learning principles and simulation in the hospital setting when implementing complex technology may improve mastery of complex concepts and

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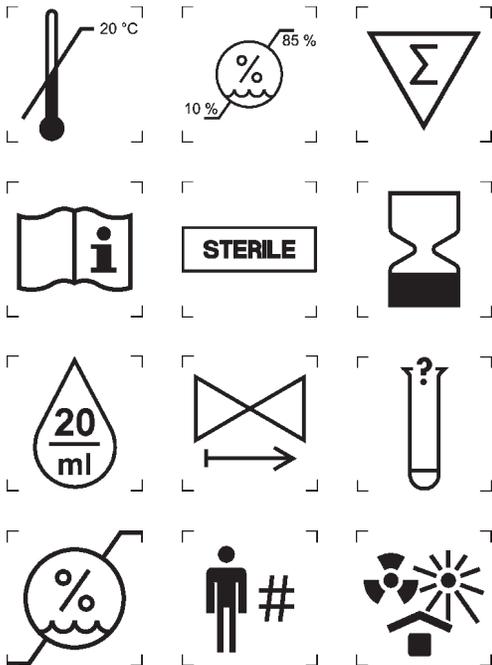
A clinician's focus should be on the patient, and that responsibility, coupled with the need to understand complex technology, can be overwhelming.

improve end-user satisfaction, as this is in keeping with the way this population learns. Recent studies suggest that simulation-based training is helpful in the mastery of complex clinical concepts.^{1,2} Online simulation training provides advanced education before health technology is implemented. Although medical devices have become more interconnected and complex, the AAMI Foundation suggests that current training is based on past practices and has not evolved. This is a cause for concern, as a clinician's focus should be on the patient, and that responsibility, coupled with the need to understand complex technology, can be overwhelming. Learning all facets of a device is not possible.³ Additional research into simulation-based training is needed to understand its benefits. ■

References

- Darragh AR, Lavender S, Polivka B, et al. Gaming Simulation as Health and Safety Training for Home Health Care Workers. *Clin Simul Nurs*. 2016;12(8):328–35.
- Zulkosky KD, White KA, Price AL, Pretz JE. Effect of Simulation Role on Clinical Decision-Making Accuracy. *Clin Simul Nurs*. 2016;12(3):98–106.
- Association for the Advancement of Medical Instrumentation. Industry, Nurses Address Barriers to Clinical Training on New Technologies. Available at: www.aami.org/newsviews/newsdetail.aspx?ItemNumber=2994. Accessed Nov. 20, 2017.
- ECRI Institute. Report a Device Problem. Available at: www.ecri.org/Pages/ReportADeviceProblem.aspx. Accessed Nov. 20, 2017.
- Pelczarski K. *Continuum of Care Monitoring: Its Time Has Come*. Plymouth Meeting, PA: ECRI Institute; 1998.
- Keller JP. Instructions Included? Make Safety Training Part of Medical Device Procurement Process. *Mater Manag Health Care*. 2010;19(4):26–9.
- Doyle PA, Gurses AP, Pronovost PJ. Mastering Medical Devices for Safe Use. *Am J Med Qual*. 2017;32(1):100–2.
- Bauer A. AAMI Foundation to Tackle Purchase and Use of Complex Healthcare Technology. Available at: www.aami.org/productspublications/pressreleasedetail.aspx?ItemNumber=4071. Accessed Nov. 20, 2017.
- Kolb DA. *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice Hall; 1984.
- Clapper TC. Beyond Knowles: What Those Conducting Simulation Need to Know About Adult Learning Theory. *Clin Simul Nurs*. 2010;6(1):e7–14.
- Jeffries PR, Rodgers B, Adamson K. NLN Jeffries Simulation Theory: Brief Narrative Description. *Nursing Education Perspectives*. 2015;36(5):292–3.
- Gewurtz RE, Coman I, Dhillon S, et al. Problem-Based Learning and Theories of Teaching and Learning in Health Professional Education. *Journal of Perspectives in Applied Academic Practice*. 2016;4(1), 59–70.
- Deronva M. Experiential Learning Theory as One of the Foundations of Adult Learning Practice Worldwide. Available at: www.degruyter.com/view/j/rpp.2015.5.issue-2/rpp-2015-0040/rpp-2015-0040.xml. Accessed Nov. 20, 2017.
- Adamson K. A Systematic Review of the Literature Related to the NLN/Jeffries Simulation Framework. *Nurs Educ Perspect*. 2015;36(5):281–91.
- Hallmark BF, Thomas CM, Gantt L. The Educational Practices Construct of the NLN/Jeffries Simulation Framework: State of the Science. *Clin Simul Nurs*. 2014;10(7):345–52.
- Merriam SB. Andragogy and Self-Directed Learning: Pillars of Adult Learning Theory. *New Directions for Adult & Continuing Education*. 2001;89(spring):3–14.
- Conlan J, Grabowski S, Smith K. Adult Learning. In: Orey M, ed. *Emerging Perspectives on Learning, Teaching and Technology*. In *Department of Educational Psychology and Instructional Technology*, University of Georgia. Available at: http://epltt.coe.uga.edu/index.php?title=Adult_Learning. Accessed Nov. 20, 2017.
- Eisert S, Geers J. Pilot-Study Exploring Time for Simulation in Academic and Hospital-Based Organizations. *Clin Simul Nurs*. 2016;12(9):361–7.

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