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Simulation in education for health care professionals

Both technical skills such as wound closure and nontechnical skills such as communication can be taught using simulation technologies that range from low-fidelity segmented clinical task trainers to high-fidelity full-body manikins.

ABSTRACT: Simulation-based training has had positive impacts on safety and efficiency in a number of industries, including aviation, and is now being applied to education for health care professionals. Simulation can involve a person, a device, or set of conditions, and permits repetitive practice of skills to a prescribed level of proficiency in a risk-free environment. The debriefing step at the conclusion of any simulation activity allows trainees to clarify and consolidate the insights and lessons learned from the experience. As well as task training, skills training, and procedure training, simulation can be used to provide error-response and group training for the high-reliability teams working in the operating room, emergency room, and intensive care unit. Globally, simulation is fast being incorporated into professional assessment and programs for maintenance of certification. Such programs may become more efficient with the use of crowdsourcing to evaluate video-recorded performance of procedures. Next steps may be to link assessments from performance evaluation systems that rely on crowdsourcing to clinical outcomes, and to use these systems to evaluate nontechnical skills such as communication for health care professionals and teams. In BC the Provincial Simulation Coordination Committee works with health authorities and postsecondary institutions to advance the development of simulation education through an integrated approach that improves access to facilities, technologies, and resources.

Simulation-based training has been defined as the use of "a person, device, or set of conditions…to present evaluation problems authentically. The simulation participant is required to respond to the problems as he or she would under natural circumstances."[1] Simulation has been used extensively and has had positive impacts on safety and efficiency in a number of fields and industries, including economics, the military, mechanics, nuclear power, aviation, and aeronautical space development. Similarly, simulation is now being applied to education for health care professionals. Deliberate practice of a skill through multiple repetitions and constructive feedback are key to developing expertise and ensuring the skill is being learned correctly.[2] This applies to technical skills such as suturing wounds as well as to nontechnical skills such as communication.

The training of a competent health care professional is a complex multidimensional process. As in any learning process, educational activi-

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ties must address objectives in the cognitive, affective, and psychomotor domains.[3] Simulation is but one teaching strategy and should be integrated into a well-developed health care professional training curriculum. Proponents of simulation must be careful not to consider it a panacea for all training challenges. For some training objectives, simulation may not provide the requisite experience needed to achieve competency. For other objectives, simpler and more cost-effective instructional methods may be better for achieving the educational outcome. It is critical that educators understand the benefits and advantages of simulation-based training over other teaching strategies and implement such methods accordingly.[4] Simulation is best implemented to reinforce a principle of learning or to practise a specific skill such as suturing and knot tying or safe patient handover.

Simulation is an ideal educational and practice platform for the adult learner because it provides an opportunity to build on an existing knowledge base. Good simulation-based practice addresses the health care professional's needs in a practical and clinically relevant way that has immediate application to daily professional activities. Simulation-based training permits repetitive practice of skills to a prescribed level of proficiency away from the patient and in a risk-free environment. Simulation provides immediate feedback and gives the health care professional a chance to complete the task using knowledge of errors or complications experienced during the first practice session. For health care trainees, simulation permits a uniquely learner-centred educational experience rather than a patient-centred experience in which the trainee is attempting to acquire complex clinical skills while caring for a patient. The simulation activity should have clearly delineated performance expectations that are defined by an expert and can be objectively measured and used to provide very specific feedback. The debriefing step at the conclusion of a simulation activity is crucial to clarify and consolidate the insights and lessons learned from the experience. This requires educators skilled in the debriefing process to ensure a constructive review follows the simulated event or activity so that participants can explore, analyze, and synthesize their actions and thought processes, emotional states, and other information from the simulation activity to improve performance in clinical practice. Participant engagement is a hallmark of strong debriefings because it leads to deeper levels of understanding and increases the likelihood of the knowledge gained being used in a clinical setting.[5]

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Simulation types

Many simulation formats require the use of manikins, which have a wide range of training capabilities. A manikin can help health care professionals engage in patient assessment through simulated vital signs such as pupil dilation, rate of breath shown with chest rise and fall, or circulatory deficiency shown with cyanotic discoloration. A manikin can also help health care professionals learn to safely administer medications and to treat patients suffering from heart failure, a blocked airway, or massive blood loss.

A low-fidelity manikin is a segmented clinical task trainer used for a small number of specific skills or procedures. Examples include an IV arm used for practising injections, a pig's foot used for practising wound closure techniques, and a manikin used for practising CPR (e.g., the Resusci Anne simulator). A mid-fidelity manikin is usually a full-body simulated patient with few computer components (e.g., the Harvey heart sounds simulator). A high-fidelity manikin incorporates the latest in computer technology, is commonly wireless, and can be programmed to provide a very realistic full-body patient presentation.

High-fidelity manikins are typically used in a variety of high-stakes learning scenarios, such as a mock code (e.g., the SimMan G simulator), a postpartum hemorrhage (e.g., the NOELLE simulator), or a mass-casualty incident (e.g., the Simulaids casualty simulation kit). While low-

fidelity simulation requires instructor or mentor oversight, more complex and computerized high-fidelity simulators can incorporate a virtual instructor. Other high-fidelity simulations can involve cadaveric materials, live animals, or standardized patients.

Simulation for high-reliability teams

As well as task training, skills training, and procedure training, simulation can be used to provide error-response and group training for the high-reliability teams working in the operating room, emergency room, and intensive care unit. In fact, high-reliability team training in situ is one of the newest additions to simulation education. Much can be learned by the team experiencing errors and practising responses in their daily work environment.[6] Health care simulation scenarios are usually digitally recorded through a learning management system so that participants can examine their performance in the debriefing session afterwards. As in the aviation industry, where team simulation training is used to ensure passenger safety, the health care sector can improve medical safety and efficiency by having entire health care teams take part in a simulation-based practice and debriefing process.

Simulation use in BC

The BC Provincial Simulation Coordination Committee (PSCC) was established in June 2012 to function as a central coordinating and advisory organization. The PSCC works with health authorities and postsecondary institutions province-wide to advance the efficient development of simulation education through an integrated approach that improves access to facilities, technologies, and resources. A survey of simulation stakeholders undertaken by the PSCC in 2013 determined that many simulation-based activities are already available for training and maintenance of certification, and that "existing equipment in simulation facilities will need to be replaced within the next few years as new technology becomes available."[7] Access to simulation facilities was reported to be a key need; however, simulation facilities were also reported to be in use less than 50% of the available time. This suggests that partnerships need to be built with health care professions, health authorities, postsecondary institutions, and others in the province to effectively share resources, space, and simulation expertise. It may also be important to provide support staff at some centres with information on how to assist educators with the effective use of simulation equipment as learning and teaching tools that support curriculum goals and objectives.

A top priority has been to organize and conduct train-the-educator sessions for developing curricula and identifying curriculum areas that will benefit from simulation-based teaching strategies. Recently the Provincial Health Services Authority has had Dr Chris Chin provide simulation learning courses for interested groups around the province.

The Simulation Technology Working Group established in January 2010 continues to undertake strategic initiatives and is actively engaged in developing and issuing provincial requests for proposals (RFPs) for patient simulation debriefing solutions, supporting provincial simulation-based education activities, and serving as a resource for all simulation-based health care education in BC. Most recently the Ministry of Health and Ministry of Advanced Education have recommended the development of a new body, the Partnership Committee on Health and Education, to act as a strategic group that will be responsible for an integrated provincial approach to all aspects of practice education, simulation, and other issues. This committee will likely replace the Provincial Simulation Coordination Committee in the future.

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Simulation for assessing technical skills

Simulation is now a well-accepted teaching strategy for training health care professionals, and globally it is fast being incorporated into professional assessment programs for certification, recertification, and

maintenance of certification. For example, the Fundamentals of Laparoscopic Surgery (FLS), a comprehensive web-based education module that includes a hands-on skills training component and assessment tool, was initially developed by researchers at McGill University. Today all US general surgery residency training programs require that surgeons document their competency using FLS, and many Canadian surgery training programs mandate the use of FLS.[8] Since 2009, the American Board of Surgery has required all candidates applying for certification to complete the FLS exam.[9] Just as the airline industry requires pilots to demonstrate their proficiency using flight simulators, Israel and Denmark now use simulation as a part of their anesthesia certification process,[10] and the American Society of Anesthesiologists requires anesthesiologists to complete training at an accredited simulation centre to maintain their certification in anesthesia.[11]

The health care industry is gradually shifting to performance-based assessment of physicians and focusing on quality improvement. A recent study published in the *New England Journal of Medicine* used blinded video assessment of the technical performance of laparoscopic surgeons and found that greater surgical skill was associated with better bariatric outcomes.[12] Given the obvious importance of surgical skills to patient outcomes, efforts have been made to use global surgical performance-rating scales such as the Objective Structured Assessment of Technical Skills (OSATS) and its derivatives, the Global Evaluative Assessment of Robotic Skills (GEARS), and the Global Objective Assessment of Laparoscopic Skills (GOALS) tools.[13,14] While considered the gold standard for evaluation, these methods are labor- and time-intense and can be impractical.

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An option to increase efficiency when using surgical performance-rating scales is crowdsourcing—"the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people and especially from the online community."[15] Recent studies have shown crowds to be as effective as expert surgeons at evaluating surgeon technical skill in a dry-lab robotics suturing performance.[16,17] Not only did the crowds perform as effectively as the expert surgeons in providing skill assessment, but the cost, efficiency, and practicality of use were all improved with the crowd graders.

One performance evaluation system, called Crowd-Sourced Assessment of Technical Skills (C-SATS), uses a web-based tool to grade a surgeon's video-recorded performance of a task (www.csats.com). Surgeons submitting video recordings for C-SATS assessment can receive level II continuing medical education credits from the American College of Surgeons for an activity, and the American Board of Surgery has recently determined that C-SATS assessments can be used for MOC credit by surgeons being evaluated for ongoing certification. Next steps may be to link assessments from performance evaluation systems such as C-SATS to clinical outcomes and to use these systems to evaluate nontechnical skills such as communication for health care professionals and teams.

Simulation for assessing nontechnical skills

The complex medical issues seen in the 21st-century patient often demand the cooperation of a large number of health care professionals. Medical management increasingly involves communicating patient-specific information from one caregiver to another or from one team of caregivers to another team or from one health care organization to another.[18] Communication is essential to patient handover—the transfer of professional responsibility and accountability for some or all aspects of care for a patient or group of patients, on a temporary or permanent basis, to another person or professional group.[19] Despite the importance of communication during patient handovers, communication tends to be unstructured, informal, and error prone, with no standard or formal procedures.[20] A

concerted effort is now being made to develop standardized curricula for teaching effective patient handover techniques in the routine and urgent care settings. Interprofessional participation in simulation-based practice of such nontechnical skills can ultimately improve health care delivery for all patients.

Summary

Simulation is now well established in training programs for health care professionals and high-reliability teams. Because manikins and other devices can be used to objectively assess performance, simulation is also fast becoming a valid and reliable method for certification, recertification, and maintenance of certification. Given that good simulation-based practice addresses training requirements for health care professionals in a practical and clinically relevant way, the need for simulation facilities, technologies, and resources in BC can be expected to continue.

Competing interests

None declared.

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