Healthcare Simulation Education

EVIDENCE, THEORY AND PRACTICE

EDITED BY
DEBRA NESTEL
MICHELLE KELLY
BRIAN JOLLY
MARCUS WATSON

WILEY Blackwell

SECTION I
Introduction

CHAPTER 1

An introduction to healthcare simulation

Debra Nestel & Michelle Kelly

KEY MESSAGES

- Healthcare simulation plays a critical role in patient safety.
- There are benefits of integrating simulation in all phases of education and training of individuals involved in the provision of healthcare.
- Although simulation modalities are diverse, there appear to be commonalities in designing for learning using simulation.
- The focus of this book is on simulation as an educational method.

Overview

This chapter introduces essential concepts for simulation-based education (SBE) in healthcare. The role of patient safety as an endpoint for many healthcare simulation practices is highlighted. The chapter also orientates readers to the book. There are six sections, this chapter being the first, the second on theoretical perspectives and frameworks, the third on contemporary issues, the fourth on elements of simulation practice, the fifth on innovations in simulation and, finally, the sixth, crystal ball gazing 20 years from now. We invite readers to work through the book sequentially. However, it is also designed so that each section and chapter can be reviewed independently.

Introduction

Simulation offers an important route to safer care for patients and needs to be more fully integrated into the health service.
Sir Liam Donaldson (2009)

In 2009, the Chief Medical Officer in the United Kingdom, Sir Liam Donaldson, wrote that *simulation* was one of the top priorities of the health services for the next decade [1]. He emphasized the role of simulation in rehearsal for emergency situations, for the development of teamwork and for learning psychomotor skills in settings and at times that do not place patients at risk. He also questioned the logic of charging clinicians to undertake training to make their practice safer. Although progress has been made in some areas, much remains to be done. In this book we share some of these advances, offer guidance in others and explore new ideas and practices.

Professor David Gaba, a pioneer in healthcare simulation, is widely quoted for the following definition: 'Simulation is a technique – not a technology – to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner' [2]. This definition sits well in the educational context for which it was developed. Like Donaldson, Gaba argues for integrated training approaches where 'clinical personnel, teams, and systems should undergo continual systematic training, rehearsal, performance assessment and refinement in their practice' [2].

Most healthcare simulation has patient safety as its ultimate goal. The drivers for SBE are well reported and include the expanding numbers of health professional students and clinicians balanced with constraints on work time. There is a shift to competency-based education and growing evidence supporting SBE as a strategic instructional approach [3, 4]. Healthcare simulation has a long history that includes images, layered transparencies, tactile models and simulated (standardized) patients [5–7]. Developments in computer-driven technologies such as task trainers, mannequin simulators

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

and virtual environments have increased access to SBE for all health professions. New modalities are developing and blending and refinement of existing ones are occurring. To facilitate SBE, health services and academic institutions around the world have invested in infrastructure in the form of skills labs, simulated clinical settings and mobile training spaces [4]. Faculty development programmes have emerged to support the quality of simulation educational practices [8, 9]. There is a vibrant research community, witnessed by the proliferation of healthcare simulation–oriented scholarly journals and publications.

Since the visions of Donaldson and Gaba, professional and regulatory organizations have begun to accept time spent in SBE as a proxy for some clinical placements [10, 11] and to provide credentialing for simulation-based operative skills [12]. SBE has also emerged as a valuable approach for preparing students across the health disciplines for upcoming clinical placements and for supporting the development of effective interprofessional practice and respectful team-based cultures.

Healthcare simulation also has limitations and information on these is shared across the book. Assumptions are often made about learning in simulation being *safe*. Although it is *patient* safe, it is not necessarily safe for participants. High levels of stress, anxiety, different power relationships and the same sorts of physical risks of working in a clinical setting may all be present during SBE. Clinician safety is essential and in this educational context largely refers to the creation of a *safe learning environment* in which clinicians (and students) can learn and/or improve their practice without psychological and/or physical harm.

Origins of this book

When in the role of Chair of the Australian Society for Simulation in Healthcare (ASSH), one of the editors (DN), in conversation with the Chair Elect (MK), reflected on the extraordinary contribution of the Society's members to the Australian and international healthcare simulation communities, especially offerings showcased annually at the SimHealth conference [13]. Acknowledging this contribution, we proposed a book that would be jointly edited by four consecutive Chairs of the ASSH. This book is the product of that conversation. It is intended to be a valuable resource for simulation educators, technicians, simulated participants and administrators. However, it is likely to have a wider reach in two directions: to those interested in patient safety, policy and governance of healthcare professionals; and to those interested in educational and training methods.

Editors and authors

The editors all hold academic appointments and work to varying degrees in healthcare simulation education and research. Although many of the authors are very experienced researchers, the common thread is that they all use simulation in their practices. Contributions are truly international, with authors' current workplaces located in Australia, Canada, China, Denmark, Hong Kong, Ireland, Malaysia, New Zealand, Saudi Arabia, Singapore, Switzerland, the United Kingdom and the United States.

Structure of the book

The book is divided into six sections. The first consists of this introduction. The remaining sections *lightly* hold an exciting and thoughtful range of topics. We use the term *lightly* because inevitably there is overlap between sections. For example, Emmerich et al.'s contribution on the ethics of simulation practice (Chapter 16) would sit well within the sections on *contemporary issues* and *elements of simulation practice*, but we have located it in the latter as we envisage it will increasingly become core to any SBE.

Theoretical perspectives in healthcare simulation

The second section addresses *theoretical perspectives in healthcare simulation*. Bearman et al. write: 'Theories can be considered coherent frameworks of ideas, which inform learning and other simulation practices' (Chapter 2). Frameworks or structures help organize, situate and make meaning, so are an obvious way to start a book. We then look to the past to make sense of current healthcare simulation practices. In Chapter 3, Owen is clear that we have not leveraged the learning of pioneers in healthcare simulation. If so, 'we would not have had to reinvent the tools and rediscover the value of it in education and training'. Centuries-old simulation-based curricula have gone unnoticed. We then shift to a discussion of the contested notion of *realism* in simulation by Nestel et al. (Chapter 4). Synonyms of realism are presented and the concept considered outside of healthcare. The authors then place *realism* against *meaningfulness*, focusing on educational goals rather than aspiring to heightened realism. The section closes with an alternative structure from a social science framework of micro, meso and macro levels, first applied to healthcare simulation by Arora and Sevdalis [14]. This framework shifts the focus of much educational work at the micro level to opportunities at meso and macro levels. In Chapter 5, Watson shares several examples from his practice to illustrate this framework.

Contemporary issues in healthcare simulation

The third section explores *contemporary issues in healthcare simulation*. Nestel and Kelly describe research agendas and programmes of research in healthcare simulation (Chapter 6). They draw on work from several simulation or discipline-specific communities where agendas provide strategic direction. In Chapter 7, Nestel et al. use the overarching term *simulated participants* to refer to various roles that individuals may be asked to portray in scenarios (e.g. patients, relatives, healthcare professionals etc.). They describe ways in which simulated participants contribute to healthcare simulations and the importance of *caring* for them. From Crea et al. we are given insights into ways in which narrative arts offer insights to the complexity of clinical practice (Chapter 8).

Wei et al. direct attention to the role of haptics in simulation training, and particularly the benefits of visual-haptic systems in training healthcare professionals (Chapter 9). Heinrichs et al. orientate readers to the expanding role of virtual environments and virtual patients (Chapter 10). Jolly offers guidance on issues of consistency in simulation from a measurement perspective (Chapter 11). Watson looks beyond simulation in healthcare to its application in other industries in an effort to inform our practice (Chapter 12). From Andreatta et al. we learn about the critical role of professional communities in developing simulation practices (Chapter 13) and the related topic of faculty development is addressed by Edgar et al. (Chapter 14). The section closes with a chapter from Bajaj et al. on the role of the simulation centre in programme development and its positioning within the landscape of education and the health service (Chapter 15).

Elements of simulation practice

The fourth section focuses on *elements of simulation practice*. Ethical practices in education are increasingly being made explicit. Such practices deserve particular attention in healthcare simulation, as we have the ability to manipulate elements, which is in stark contrast to teaching and learning opportunities in the clinical practice setting. Ethical issues relate to learners, faculty and simulators too – especially in the form of simulated patients (and as Nestel et al. in Chapter 7 discuss, are relevant to the broader roles of simulated participants). Emmerich et al. apply four principles of bioethics to SBE and extend considerations to include virtue ethics and the role of building character through simulation (Chapter 16). From Weller and Civil we learn how simulation can support the development of effective teamwork (Chapter 17). Nestel and Gough share basic structures for healthcare simulation practice and draw on those used in a national simulation educator programme, NHET-Sim. Phases of simulation include preparing, briefing, simulation activity, debriefing, reflecting and evaluating (Chapter 18). The next two chapters explore in greater detail elements of these phases. Kelly and Guinea focus on the role of facilitation across each simulation phase and also consider the characteristics of facilitators (Chapter 19). Marshall and McIntosh offer guidance on dealing with unexpected events in simulations (Chapter 20). Finally, Cheng et al. review approaches to debriefing – a cornerstone of effective SBE (Chapter 21). Using evidence and theory, they suggest frameworks that provide structure to this important conversation. We are reminded that debriefing approaches are characterized by particular methods of questioning, flow of discussion, overarching goals and contextualizing learning to clinical practice.

Simulation applied to practice

The fifth section contains ten innovations of simulation practices. Each innovation is drawn from challenges that the authors have faced when introducing or trying to sustain healthcare simulation. The micro, meso and macro framework from Chapter 5 has been used to order the case studies. For example, at a micro level, that of individual behaviours and actions, Kumar and Nestel share experiences of using simulation to enhance safe practices of home birthing in Australia (Chapter 22); Gough describes her experiences of video-reflexivity to amplify learning through simulations (Chapter 23); and Gatward et al. document the outcomes of SBE to augment the national organ and tissue donation requestor training programme (Chapter 24).

At the meso level, from a curriculum perspective, Han writes about his journey in reconfiguring and integrating SBE into a medical degree in China (Chapter 25). Next, Atan et al. provide their collective experience of using simulation to help junior doctors identify critical elements of transporting critically ill patients in Malaysia (Chapter 26). Koh and Dong share their success in creating a programme to extend the role of simulation technicians (Chapter 27). This initiative in Singapore and Malaysia has led to increased job satisfaction and retention and continuity of simulation centre operations.

Finally, we feature four macro-level initiatives that focus on the organizational or systems level of healthcare practice and delivery. Labibidi offers insights into the challenges of planning simulation for a unique healthcare facility in Saudi Arabia – the King Fahad Medical City – comprising four hospitals, four specialized medical centres and a Faculty of Medicine (Chapter 28). An integrated approach to simulation was adopted through central governance and funding, which still allows a level of independence in educational content and delivery in separate facilities. So and Ng write about the importance and benefits of establishing partnerships early in the process of developing a new simulation centre (Chapter 29). The example, from Hong Kong, highlights a tripartite relationship with leaders from the simulation centre, the hospital and the broader health authority. The impact of simulation on groups and their interactions is illustrated by Eddie et al., who report on the benefits of testing workflow and patient care processes in a new paediatric emergency department (Chapter 30). And finally, from Macleod and Moody comes a case study from simulation modelling showing how the configuration of space design features can be manipulated to maximize work efficiencies and patient flow (Chapter 31). In summary, these innovations illustrate the diversity of the application of simulation in healthcare contexts.

In the final section we look to the future of healthcare simulation. Crystal ball gazing, we consider directions for practice drawing on the contents of this book and our own experiences. We are enormously grateful to our colleagues for sharing their expertise in healthcare simulation to advance our practices.

References

1 Donaldson, L. (2009) *150 years of the Chief Medical Officer's Annual Report 2008*, Department of Health, London.

2 Gaba, D. (2007) The future vision of simulation in healthcare. *Simul Healthc.*, **2**, 126–35.

3 Bearman, M., Nestel, D. and Andreatta, P. (2013) Simulation-based medical education, in *The Oxford book of medical education* (ed. K. Walsh), Oxford University Press, Oxford, pp. 186–97.

4 Nestel, D., Watson, M., Bearman, M. *et al.* (2013) Strategic approaches to simulation-based education: a case study from Australia. *J Health Spec*, **1** (1), 4–12.

5 Owen, H. (2012) Early use of simulation in medical education. *Simul Healthc*, **7** (2), 102–16.

6 Bradley, P. (2006) The history of simulation in medical education and possible future directions. *Med Educ*, **40** (3), 254–62. doi: 10.1111/j.1365-2929.2006.02394.x

7 Howley L, Gliva-McConvey G, Thornton J. Standardized patient practices: initial report on the survey of US and Canadian medical schools. *Med Educ Online*. 2009;**14**(7), 127. doi: 10.3885/meo.2009.F0000208

8 Nestel, D., Bearman, M., Brooks, P. *et al.* (2016) A national training program for simulation educators and technicians: evaluation strategy and outcomes. *BMC Med Educ.*, **16**, 25. doi: 10.1186/s12909-016-0548-x

9 Navedo, D. and Simon, R. (2013) Specialized courses in simulation, in *The comprehensive textbook of healthcare simulation* (eds A. Levine, S. DeMaria, A. Schwartz and A. Sim), Springer, New York, pp. 593–7.

10 Watson, K., Wright, A., Morris, N. *et al.* (2012) Can simulation replace part of clinical time? Two parallel randomised controlled trials. *Med Educ*, **46** (7), 657–67. doi: 10.1111/j.1365-2923.2012.04295.x

11 Hayden, J., Smily, R., Alexander, M. *et al.* (2014) The NCSBN National Simulation Study: a longitudinal, randomized, controlled study replacing clinical hours with simulation in prelicensure nursing education. *J Nurs Regul*, **5** (2 Supplement), S1–S64.

12 Rosenthal, M., Ritter, E., Goova, M. *et al.* (2010) Proficiency-based fundamentals of laparoscopic surgery skills training results in durable performance improvement and a uniform certification pass rate. *Surg Endosc.*, **10**, 2453–7. doi: 10.1007/s00464-010-0985-2

13 Simulation Australasia. SimHealth conference [cited 2 February 2016]. Available from: http://www.simulationaustralasia.com/events/simhealth

14 Arora S, Sevdalis N. HOSPEX and concepts of simulation. *J R Army Med Corps*. 2008;**154**(3):202–5. PubMed PMID: 19202831.

SECTION II

Theoretical perspectives and frameworks for healthcare simulation

CHAPTER 2

Theories informing healthcare simulation practice

Margaret Bearman, Debra Nestel & Nancy McNaughton

> **KEY MESSAGES**
>
> - Learning theories are guides rather than prescriptions.
> - Learning theories align with different ways of understanding the nature of knowledge.
> - Behaviourism emphasizes the achievement of an external standard through demonstrated behaviours; elements of 'deliberate practice' reflect behaviourist principles.
> - Constructivism is a broad umbrella term for theories concerned with individual and social constructions of knowledge, many with great relevance to simulation-based education.
> - Critical theory approaches focus outward on society and its effect on simulation practices.

Overview

Theories can be considered coherent frameworks of ideas, which inform learning and other simulation practices. This chapter provides a brief overview of different types of theories, illustrated by selected theorists and examples of application to practice. The first section provides a short overview of behaviourism and some of the key debates, as well as expanding on an additional theory, *deliberate practice*, which draws from behaviourist principles. The next section starts by describing constructivist approaches associated with theories such as *reflective practice*, before going on to explore a social learning theory, *situated learning*. The final section articulates the broad premise of critical theories, before focusing on one theorist, *Michel Foucault*, and providing an exploration of simulated patient (SP) practice through a critical theory lens. The development of patient-focused simulation is presented as an example of how theory can be applied to develop simulation practice.

Introduction

Ideas about how people learn underpin simulation-based education (SBE) in the health professions. When these ideas are formalized into coherent frameworks, they are referred to as *learning theories*. Learning theories permit educators to identify teaching approaches that can optimize the opportunity afforded by the simulation encounter, and thereby assist learners to acquire new knowledge or skills. They can be purely conceptual or derived from the rigorous collection of qualitative and quantitative data. Learning theories are not absolute; they guide rather than prescribe. Educators draw on them for different reasons. For example, theories can support the initial educational design such as making decisions about what simulation method to choose and why; they can assist with resolving specific dilemmas such as how to manage underperforming learners; or they can challenge accepted practices such as a longstanding approach to debriefing.

This overview of theories that inform healthcare simulation practice can assist in guiding simulation design, development, implementation and facilitation. It is by no means comprehensive, but gives an indication of both the value and the diversity of theories informing SBE. We provide our perspectives as SBE practitioners, researchers and scholars, noting that this is an area in which there is no definite expert consensus.

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

Learning theories are often very abstract. Educators may find theory most helpful by considering its value within local professional and environmental contexts. For example, the legacy of Western political domination may seem irrelevant to SBE, but thinking about this in theoretical terms can prompt educators to review whether their simulators and SP represent the skin colour and physical appearance of the local community.

We suggest that learning theories can be aligned with ways of understanding knowledge (epistemology) and reality (ontology). This chapter presents three overlapping categories of learning theories, which align with particular notions of knowledge and reality. *Behaviourist* learning theories align most easily with worldviews that are concerned with objective truths and measurement. These theories are less concerned with the internal mechanisms of learners, and more with their behaviours, which can be observed. *Constructivist* theories are focused on the learner's role in learning, while *social learning* theories extend this to consider the role of the learning environment. Both of these approaches are concordant with a worldview that is concerned with individual and social constructions of knowledge. Finally, *critical theories* consider the broader questions of society and social behaviours. These are not learning theories per se, but provide valuable lessons on understanding how the broader sociocultural context may influence learning. It is worth noting that there is little consensus on the categorization of learning theories and that educators draw from multiple theories for diverse reasons. We will present some of this complexity in our discussion while maintaining the focus on the practical value of learning theories to SBE.

Behaviourism

Behaviourism, unlike the other categories in this chapter, can be considered a coherent theory as well as a pedagogy. Behaviourism's dominance of the educational literature has waxed and waned over the last 80 years. Its current place in the learning theory landscape is controversial. Some people consider it to be primarily a notion of learning as response to a stimulus, and certainly Ivan Pavlov, a notable historical influence, studied stimulus and response in animals [1]. Rote learning, such as memorizing the sum '$7 \times 8 = 56$', is a simple example of this. In this instance, '7×8' is the stimulus and '56' is the learnt response. Behaviourism was once seen as being superseded by a cognitive view of learning [2], but over time discourses about behaviourism have continued to develop. Those who draw on it today distinguish a range of more nuanced features, although they still hold to the basic premise of stimulus and response [1].

We broadly define contemporary behaviourism as those approaches to learning that focus on achieving an external standard that must be achieved through demonstrated behaviours. This aligns with Woollard's view [1] that 'behaviourism, in terms of learning, considers that it is through modifying behaviour and ensuring learners' preparedness for learning that the best outcomes will be achieved. Behaviourism embraces a pedagogy built upon precision, rigour, analysis, measurement and outcomes' (p. 22). These notions provide the foundation for many of our historical educational practices. For example, the writing of learning objectives focuses on demonstrable change in behaviours, as proposed by Ralph Tyler in 1949 [3]. Equally, accreditation of learning with its concerns about valid and reliable assessment also aligns with behaviourist principles.

There are some areas where we think behaviourism is most valuable in SBE. In particular, health professional practice is full of simple and complex practices, which should occur automatically without the practitioner thinking deeply about how to complete the tasks as they do them. These activities can be psychomotor skills such as suturing, cognitive tasks such as pattern recognition, or even communication skills, such as always introducing oneself to the patient or healthcare consumer by name. These activities are also often well taught in simulation, due to the emphasis on repetitive practice to ensure automaticity.

McGaghie et al. [4], in their 2011 critical review, noted a number of 'best practices' in SBE that draw from behaviourist principles. One of these is *deliberate practice*, which is presented as an example of a theory with particular relevance to SBE. *Deliberate practice* was conceptualized by Anders Ericsson, a cognitive psychologist, who sought to understand how elite performers achieved excellence [5]. From this empirical basis, he concluded that a necessary part of excellence was the notion of focused, repetitive practice. He described essential elements: a highly motivated individual can develop expertise through repetitive practice that also involves receiving feedback on performance, goal setting that continuously seeks to extend performance, individual coaching and practice occurring under different conditions. Like many approaches, this is not purely behaviourist in its approach, but there are key elements – 'well-defined learning objectives' and 'rigorous precise measurements' of demonstrated behaviours [4] – that align with behaviourism. See Box 2.1 for an example of how deliberate practice can be integrated into simulation educational design.

Box 2.1 Theory in Action: Patient-Focused Simulation

> Deliberate practice, reflective practice and situated learning were developed in real rather than simulated settings and are appropriated with caution to the world of healthcare simulation. Drawing on these three theories, Roger Kneebone, a surgeon educator, and Debra Nestel, a communications educator, developed the concept of patient-focused simulation for learning procedural skills [11]. Patient-focused simulation involves a learner performing a procedural skill while working with a simulated (standardized) patient (SP) aligned with a task trainer (bench-top simulator). Kneebone and Nestel had noticed that teaching basic procedural skills on a task trainer was effective inasmuch as correct sequencing of psychomotor skills could be observed, but the experience was out of context. When the learner was required to perform the procedure on a patient in a clinical setting, the bench-top simulator experience alone was insufficient because it was not situated. That is, there was little resemblance to the setting in which the learner would be required to practise. Notably, there was no patient, no human interaction. Nestel and Kneebone argued that safe training approaches need to include ways in which learners can integrate complex sets of skills (psychomotor and professional) as they will be required in clinical settings. At a minimum, patient-focused simulation comprised a SP trained to respond as if undergoing the procedure in a simulated clinical setting. The learner in patient-focused simulation was offered the opportunity to perform the whole procedure in simulation and to receive feedback on their performance – from the SP and experienced clinicians and further individual reflection, to make sense of the experience from the learner's perspective. Elements of deliberate practice included motivating individuals, encouraging goal setting, multiple repetitions in different contexts and feedback. From situated learning, patient-focused simulation located the procedural skill in a clinical context with a SP; and from reflective practice, reflection-on-action was adopted, most commonly as facilitated dialogue between the learner, SP and observers after the simulation.

Constructivism and associated social learning theories

Constructivist theories of learning argue that individuals construct knowledge and meaning based on their experiences and ideas. Fosnot [6] claims that educators adopting constructivist theories enable learners to use 'concrete, contextually meaningful experience through which they can search for patterns, raise their own questions, and construct their own models, concepts, and strategies' (p. ix). Adopting this stance, educators may be seen to be orienting their role to that of facilitator rather than teacher. Using Sfard's metaphors [7], constructivists sit more comfortably within the metaphor of learning as participation than within that of learning as acquisition. Education is seen as what the learner can learn rather than what the teacher can teach.

Constructivism is an umbrella term for many theories that acknowledge the role of the learner in constructing their own meaning from experiences. *Cognitive* constructivism respects traditions of cognitivist theories, of acknowledging individuals' characteristics such as their stage of development, motivation, engagement and preferences for learning. *Social* constructivism emphasizes how understanding and meaning emerge from social encounters. Imagine a simulation educator who has been asked to design an activity for medical students to safely *put in a drip* (that is, establish a peripheral intravenous infusion, IVI). Adopting a constructivist stance, the educator is likely to use some of the following techniques:

- Finding out what other similar procedures students have been learning and how.
- Asking students about their relevant knowledge, prior experiences and practices relevant to IVI.
- Demonstrating, talking through and inviting questions from students on IVI performed on a task trainer.
- Encouraging students to set goals related to performing the IVI.
- Providing opportunities for students to perform the IVI on a task trainer.
- Providing opportunities for students to observe others performing the IVI on a task trainer and then share their observations.
- Providing opportunities for students to receive feedback on their performance on the task trainer from experts and peers.

- Promoting students' reflections on their performance of IVI on the task trainer.
- Asking students to identify what they found easy and why, and what they found difficult and why.
- Discussing how the level of skill experienced by the student on the task trainer may align with performing IVI in a clinical setting.
- Discussing the links between IVI and other clinical procedures that students need to be able to perform.
- Promoting students' reflections on the feedback offered.
- Encouraging students to set goals that enable them to use their learning.

Each of these techniques acknowledges that individuals make sense of designed learning activities in their own way, based on their own ideas, prior experiences and practices. Conversation or dialogue is heavily weighted. The simulation educator's role is to help surface these ideas and experiences, offer new experiences through the designed learning activity, and support students in locating the (new) experiences in their existing knowledge and practice.

Also widely cited in health professions educational literature is the work of Donald Schön [8]. His concepts of *reflection-in-action* (immediate 'thinking on your feet') and *reflection-on-action* (later analysis of actions in light of outcome, prior experience and new knowledge) characterize ways in which practitioners react to unexpected experiences in their work. Schön argued that practitioners seek to place new and unexpected experiences within a personal framework by identifying similar past experiences and then giving consideration to possible outcomes by selecting new actions. In SBE, *reflection-on-action* can usually be facilitated by clinicians, teachers or peers. However, *reflection-in-action* requires an immediate response, especially in time-urgent clinical scenarios. Techniques that simulation educators use such as *pause and discuss* (stopping the scenario at certain points) enable access to learners' thoughts and feelings and discussion of their proposed actions. Where *pause and discuss* is used in simulation, there is no consequence for patients. Using the IVI simulation example, the educator could implement both *in* and *on* action reflective discussions.

The last constructivist learning theory to be presented is *situated learning*, which locates learning in a social context [9]. This shifts the focus of learning from the individual to the community. Using observational methods from social anthropology and education, key theorists Jean Lave and Etienne Wenger studied ways in which practitioners learnt their practices in apprenticeships [10]. They coined the term *legitimate peripheral participation* to describe how newcomers to a practice were provided with meaningful tasks that contribute to the work of the community. In the simplest form of this, learners were drawn more centrally to the community as they participated, gaining a sense of identity. Lave and Wenger recognized that learning in work settings through participation provided powerful opportunities to learn critical elements of practice and created the term *living curriculum* to describe this apprenticeship-style learning.

Critical theories in education

Popkewitz and Fendler [12] suggest that '[c]ritical theory in education is concerned with the workings of power in and through pedagogical discourses and … addresses the relations among schooling, education, culture, society, economy and governance' (p. xiii). There are many critical theories, such as Marxian, post-colonial and feminist approaches, and as a group they hold in common a questioning stance to the status quo. *Critical* does not refer to negative critique, but rather to questioning taken-for-granted notions about the way things are in the hope of shedding new light on accepted practices. The tangle of educational jargon related to epistemologies and ontologies aside, at the core of a critical perspective is an understanding that truth is not a given, but is responsive to different contextual and historical conditions that may benefit some people at the cost of others. Critical scholars share a restlessness to break free from assumptions about what is said to be 'true' and a desire to try to see the world with fresh eyes [13]. The ideas and practices that critical theories explore can vary significantly depending on context, cultural setting and historical period. As such, critical theories are located within a social theory category.

Although critical theories in SBE have been embraced by a few brave scholars, such as Alan Bleakley [14], Janelle Taylor [15], Brian Hodges [16] and Nancy McNaughton [17], they are far less prominent than behaviourist or constructivist theories in the simulation field. Perhaps this is because critical theories tend to focus outwards on society and its effect on our simulation practices, rather than on individuals and their knowledge, skills or experience.

One critical theory scholar, Michel Foucault (1926–84), wrote about the birth of clinical medicine and medical education, public health, psychiatry, schools and examinations, the body, physical and laboratory examination, sexuality and ethics. Indeed, some of his notions – *discourse, bio-power, technologies of the self* and the *clinical gaze*, just to name a few – have major importance for medical education today [13]. Discourse is an idea that has relevance for exploring SBE. According to Foucault [18], discourses refer to language and ways of speaking as well as 'practices that systematically organize what it is possible to say and do' (p. 49). Many different discourses support SBE. They exist coextensively – at the same time and in the same place – and they compete for dominance over knowledge claims. In other words, some ideas are seen to be truer than others. The competition between ideas has material implications in that human resources, space and funding get allocated according to how compelling the rationale is for investment.

From a critical theory perspective, SBE is an important form of knowledge production within health professional education. It is a methodology through which we learn and produce new knowledge and ideas about competence and what this looks like in training and practice. Critical theory helps understand how prevalent ideas about simulation as a methodology become embedded in learning processes, which in turn shape our understanding about what is acceptable within the simulation field.

Consider the case of SPs as an example. By the inclusion of SPs, a power differential between patients, learners and different types of educators is created. SPs are lay people but not 'real' patients, and in many educational activities they represent the clinical educator's ideas about specific patient cases. As proxies for the 'real thing', SPs are often 'used' as tools by clinician educators [19], effectively reproducing prevailing professional ideas about appropriate physician/patient interactions. We can see this reflected in language that historically has described SPs as being 'used' for different activities. 'Used' is a small word and easily missed; however, this discourse locates SPs within a medical hierarchy as clinical outsiders and part of an educational apparatus.

In addition, SP scenarios are most often written by clinician educators and loosely based on real stories that are then modified for educational purposes [11]. There is often no contact between the person whose story and experience are being enacted and the SP enacting it. SPs are recruited and trained according to an educational need (teaching or assessment) and suitability to the patient scenario. 'The person whose story is being enacted' is a phantom. Rather, SPs, their roles and portrayals are vehicles for the transmission and reproduction of professional values, attitudes, clinical knowledge and skills. In this analysis, SPs are 'subjects of' and 'subjected to' prevailing ideas about medical competence and professionalism; and from a critical theory perspective, they are constituted as particular tools (assessment instruments, physical models) within a larger medical education enterprise. The notion of SPs as tools or a technology supports practices related to standardization and OSCEs (objective structured clinical examinations) and is maintained by many within the field of human simulation, extending back to its inception by neurologist Howard Barrows [20].

Over many years and in conjunction with changes in societal expectations about physicians' professional responsibilities to communicate with patients differently, and patients' increasing demand for accountability and a greater say in their own care, a professionalizing SP group has developed expertise in different domains of clinical knowledge as well as pedagogical and assessment practices. From this location, they have negotiated strategically a valued place from which to contribute to clinical knowledge production. The various subjectivities and power relations authorized by the ideas that support the 'use' of individuals in live simulation teaching are complex. Implicated in this complexity are unspoken ideas that shape the work in which SP educators engage [17].

This example illustrates how a critical theory approach to SBE is not interested in describing simulation modalities or techniques per se, or whether they are good or bad. Rather, critical theory scholars in SBE are engaging in analyses that on the one hand attempt to shed light on taken-for-granted notions about a myriad of different factors affecting healthcare training and practice, such as changing conceptions of professionalism, the role of patients in healthcare and the inclusion of performance as an important competence. At the same time, critical explorations are also interested in how different simulation practices are affected by taken-for-granted notions and ideas about SBE that live inside our varied training cultures and how these may be producing and reproducing expectations within the simulation field.

Engaging simulation for teaching and/or assessment is a cultural and political undertaking. As mentioned at the beginning of the chapter, the local cultural and political environment needs to be taken into account when designing simulation activities in order to prevent the reproduction of stigmatizing stereotypes. For example, when simulation experiences are codesigned with consumers, this can provide a depth of understanding around being a patient [21]. Critical theory assists us to view the health professions as a social undertaking as well as a clinical one; and to see that simulation experiences have the potential to influence professional values and attitudes in practice.

Conclusions

This brief exploration indicates the breadth of theories that inform SBE in healthcare. Behaviourist, constructivist, social learning and critical approaches stem from a range of different traditions and this is apparent in the applications described in this chapter. Behaviourism and associated theories are suited to the consideration of designing SBE that enhances skills requiring automaticity. Constructivist approaches focus on learners, providing opportunities through SBE to direct their own learning. Critical theory prompts educators to challenge their assumptions and conventions. Specific theories such as deliberate practice, reflective practice and situated learning are used to illustrate broad ideas, but we urge educators to investigate theories relevant to their own practice in further detail.

Key term definitions

Behaviourism: an educational theory and pedagogical approach, stemming from framing learning as a response to external stimuli.

Constructivism: a broad approach to education, inclusive of many learning theories, stemming from framing learning as belonging to the learner, rather than to the teacher.

Critical theory: a theory that considers the contextual and historical perspectives of society and seeks to challenge assumptions about power and practice.

Epistemology: philosophy concerned with the nature of knowledge.

Learning theory: a coherent framework of ideas that describe how people learn.

Ontology: philosophy concerned with the nature of reality.

Simulated patient: a well person role-playing a patient, for the purposes of learning and/or assessment.

Social learning theory: one of a group of associated theories that frame learning as a social rather than an individual endeavour.

Worldview: a stance that represents particular epistemological and ontological positions.

References

1 Woollard, J. (2010) *Psychology in the classroom: behaviourism*, Routledge, London.
2 Jonassen, D.H. (1985) Learning strategies: a new educational technology. *Innov Educ Train Int*, **22** (1), 26–34.
3 Morcke, A., Dornan, T. and Eika, B. (2013) Outcome (competency) based education: an exploration of its origins, theoretical basis, and empirical evidence. *Adv Health Sci Educ*, **18** (4), 851–63.
4 McGaghie, W.C., Issenberg, S.B., Petrusa, E.R. and Scalesa, R.J. (2010) A critical review of simulation-based medical education research: 2003–2009. *Med Educ*, **44** (1), 50–63.
5 Ericsson, K.A., Krampe, R.T. and Tesch-Römer, C. (1993) The role of deliberate practice in the acquisition of expert performance. *Psychol Rev*, **100** (3), 363.
6 Fosnot, C.T. (2013) *Constructivism: theory, perspectives, and practice*, Teachers College Press, New York.
7 Sfard, A. (1998) On two metaphors for learning and the dangers of choosing just one. *Educ Res*, **27** (2), 4–13.
8 Schön, D. (1983) *The reflective practitioner*, Basic Books, New York.
9 Brown, J.S., Collins, A. and Duguid, P. (1989) Situated cognition and the culture of learning. *Educ Res*, **18** (1), 32–42.
10 Lave, J. and Wenger, E. (1991) *Situated learning: legitimate peripheral participation*, Cambridge University Press, Cambridge.
11 Nestel, D. and Kneebone, R. (2010) Perspective: authentic patient perspectives in simulations for procedural and surgical skills. *Acad Med*, **85** (5), 889–93.
12 Popkewitz, T.S. and Fendler, L. (1999) *Critical theories in education: changing terrains of knowledge and politics*, Routledge, New York.

13 Hodges, B.D., Martimianakis, M.A., McNaughton, N. and Whitehead, C. (2014) Medical education … meet Michel Foucault. *Med Educ*, **48** (6), 563–71.

14 Bleakley, A., Bligh, J. and Browne, J. (2011) *Medical education for the future: identity, power and location*, vol. **1**, Springer, New York.

15 Taylor, J. (2011) The moral aesthetics of simulated suffering in standardized patient performances. *Cult Med Psychiatr*, **35** (2), 134–62.

16 Hodges, B.D. (2009) *The objective structured clinical examination: a socio-history*, Lambert Academic Publishing, Saarbrücken.

17 McNaughton, N. (2013) *The role of emotion in the work of standardized patients: a critical theoretical analysis*, Lambert Academic Publishing, Saarbrücken.

18 Foucault M. *The archaeology of knowledge abd the discourse on language*. Trans. A.M. Sheridan Smith. New York: Pantheon Books. 1972.

19 Nestel, D., Burn, C.L., Pritchard, S.A. *et al.* (2011) The use of simulated patients in medical education: guide supplement 42.1 – viewpoint. *Med Teach*, **33** (12), 1027–9.

20 Barrows, H.S. (1993) An overview of the uses of standardized patients for teaching and evaluating clinical skills. *Acad Med*, **68** (6), 443–51.

21 Orr F, Kellehear K. Armari E, Pearson A, Holmes D. The distress of voice-hearing: the use of simulation for awareness, understanding and communication skill development in undergraduate nursing education. *Nurse Educ Pract*. 2013;**13**(6):529–35.

CHAPTER 3

Historical practices in healthcare simulation: What we still have to learn

Harry Owen

KEY MESSAGES

- Immersive simulation was used in teaching obstetrics in many parts of Europe more than 250 years ago.
- Important concepts of simulation, including avoiding the learning curve on patients, repeated practice, expert supervision and feedback, preparing for rare events and simulator fidelity, were developed in the eighteenth century.
- Cadavers were widely used as obstetric and surgical simulators in the nineteenth century.
- A report of a US government audit of trauma care published in 1876 recommended the adoption of simulation in surgical training.

Overview

Simulation has been used in healthcare education for at least 1500 years and in the eighteenth, nineteenth and early twentieth centuries was widely used to help students learn new skills before performing procedures on patients. Often the use of simulation was a deliberate choice to reduce the risk of harm to patients, but in some areas, for example obstetrics training in the USA, simulation was used because there was very limited access to patients. Some of the early simulators were equivalent to task trainers and were used for learning basic principles and technical skills, but many simulators were developed for immersive training, where trainees could practise the management of rare conditions and serious complications. Simulation fidelity, the need to suspend disbelief and feedback were all well understood by the pioneers of simulation. Use of simulation in healthcare training declined significantly in the twentieth century and has only recently been rediscovered.

Introduction

The history of medicine has been a victim of the crowded medical curriculum and is no longer routinely taught. However, had we learnt from the pioneers of simulation in healthcare education, we would not have had to reinvent and rediscover how and when to use this most valuable training tool.

Background

Simulation has been used in training healthcare professionals for at least 1500 years, but the early examples of simulation were isolated geographically and temporally and were not sustained. This changed in the middle of the eighteenth century, when simulation became widely used in healthcare training in Europe and was then introduced to the USA. This was a time of great change in the world that would later be called the Age of Reason. Before this time the clergy preached the power of God and astrologers claimed that the stars could predict future events. However, when new ways of thinking were applied to daily living, it became apparent that most phenomena were governed by natural laws and that these could be deduced through experiment and careful observation. The natural philosophers in the universities of Europe described bodily systems as

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

machines governed by the same laws and considered that there was a scientific basis for diseases and their treatments. The beginning of modern medicine can be traced to the recognition that medication or a procedure can change the outcome of an abnormal condition. One of the first areas of healthcare to be affected by this was childbirth.

Simulation in obstetrics

In the seventeenth century, some physicians and surgeons applied themselves to what was originally called man-midwifery, before it became known as obstetrics. For example, William Harvey, better known for discovering the circulation, and who in 1649 also described how to make and use a pulse simulator and a percussion simulator for teaching, was a man-midwife. A man-midwife was often able to determine the cause of a prolonged labour and intervene as required, for which they received a higher fee than that of a midwife. Obstetric forceps were added to the armamentarium of man-midwives early in the eighteenth century. There was increased interest in midwifery as a profession and courses on obstetrics began to appear. In Paris, Grégoire the Younger was one of the first obstetrics teachers to use simulation to teach how to use forceps. Despite the slowness of travel at that time, Grégoire's course and his method of teaching were widely known and attracted many students.

In 1739 William Smellie, who had been practising as a surgeon-apothecary near Glasgow in Scotland, travelled to Paris on the advice of a friend to learn from Grégoire the Younger. Smellie had performed embryotomies to save mothers' lives when the pelvis was too small for the foetus to pass through, and he hoped that with forceps he could deliver a live child in such cases. Smellie was not impressed by the teaching he received from Grégoire, nor by the construction of the simulator, which was made of basket-work and covered with black leather. It contained a female pelvis and was used with a cadaver foetus, but, as Glaister notes [1], was too crude for Grégoire to use it to explain the difficulties that might be encountered (p. 26).

In Leiden, Herman Boerhaave had developed the concept of the hospital teaching round, which transformed medical education. Denman [2] records that in 1738, Sir Richard Manningham established the first obstetric teaching hospital in London (p. 567). Most women at that time gave birth at home and few were admitted to a lying-in hospital, but Manningham had a solution – simulation. In an advertisement for his course in the *London Evening Post* [3], Manningham explained how lectures on the theory and practice of midwifery would be enhanced by demonstrations and practice on simulators, so that 'each Pupil [will] become in a great measure proficient in his business before he attempts a real delivery' and 'all the inconveniences which might otherwise happen to women from pupils practising too early on real objects will be entirely prevented'.

Manningham actually developed two simulators for teaching, which he referred to as the 'glass machine' and the 'great machine'. The glass machine was used for

> illustration of the best and proficient methods of performing difficult deliveries with all possible ease and safety, a small glass matrix is contriv'd (in which is enclosed an artificial child) to be fix'd on ivory frames, imitating the various shapes of the bones forming the pelvis, in that every position the matrix or child can any way take and the hindrance either may meet from the said bones and the easiest and most effectual ways of performing all difficult deliveries, (as is taught on the great machine) together with the realms of the rules, will hereby in a most instructive manner be beautifully and clearly represented to the eye.

The 'great machine' was a life-size simulator 'made on the bones or skeleton of a woman, with an artificial matrix [uterus]' that was used for 'the performance of deliveries of all kinds, with the utmost decency and dexterity'. Manningham observed that to become proficient students needed repeated practice under supervision on this machine, 'where every case that can happen may be represented, and repeated as often as we see necessary'. He explained [4] that the cognitive load was managed by teaching 'first the most natural and easy; and then those which are more difficult; and lastly, to the most difficult and praeternatural Deliveries that can possibly happen' (p. 5). He was not the first to demonstrate birth on a simulator, as Van Hoorn had used a simulator with an artificial foetus to demonstrate childbirth during lectures at the beginning of the eighteenth century, but Manningham was the first to integrate simulation into a clinical teaching programme, and he deserves to be recognized for this.

It was Grégoire's simulator that gave Smellie the idea that simulators 'should so exactly imitate real women and children as to exhibit to the learner all the difficulties that happen in midwifery'. Smellie established an obstetric practice in London and taught both man-midwives and female midwives. None of Smellie's simulators has survived, but there are several descriptions of them, which attest that they were lifelike in form, feel and function. Camper wrote they were 'made out of leather with such remarkable skill that not only is the structure as natural as possible but the necessary functions of parturition are performed by working models' [5].

Smellie recognized that few labours required active intervention, so students would encounter few if any of the many complications they might meet later in clinical practice and be expected to manage. He suggested [6]:

> In order to acquire a more perfect idea of the art, he ought to perform with his own hands upon proper machines, contrived to convey a just notion of all the difficulties to be met with in every kind of labour; by which means he will learn how to use the forceps and crotchets with more dexterity, be accustomed to the turning of children, and consequently be more capable of acquitting himself in troublesome cases that may happen to him when he comes to practise among women; he should also embrace every occasion of being present at real labours. (p. 429)

In the middle of the eighteenth century simulation was also used in Germany [7] and Italy [8] and soon afterwards was introduced into the USA [9].

However, the expansion in midwifery training took place in the cities of Europe and left rural areas underserved. In the second half of the eighteenth century a national rural simulation-based midwifery training programme was developed in France by Angélique Marguerite Le Boursier du Coudray. There were actually two courses delivered in regional centres across France: one to train new midwives and another train-the-trainer course for rural surgeons. Students attended lectures in the mornings and practised on simulators in the afternoons. Writing about her midwifery teaching [10], du Coudray noted: 'We have the advantage of students practicing on the machine and performing all the deliveries imaginable. Therein lies the principle merit of this invention' (p. 16). Simulators were left at each centre for the surgeons to teach new midwives and for annual refresher courses. Simulators made of better materials or with a system of sponges that could dispense clear or opaque red liquids could be ordered at extra expense. Students were taught the importance of calling for help in emergencies and of the handover procedures (p. 70). This programme was very successful and was copied, which led to an industry in manufacturing and repairing obstetric simulators.

Use of simulation in obstetrics and midwifery expanded in the nineteenth century and simulator design reflected new techniques and procedures. A change in position of the body for delivery, from upright to supine, is evident in the design of obstetric simulators. When Pinard established guidelines to determine orientation of the foetus by external palpation [11], a simulator with a rubber abdominal wall was developed to practise the skill.

A low point in medical education was the use of female cadavers as obstetric simulators, which began in Vienna and spread across Europe and to the USA. Unfortunately, the transmission of infection was poorly understood and this practice resulted in tens of thousands of deaths. Only now is simulation used to promote and improve hand hygiene. Another low point was the use of the poor as teaching material. Osiander in Göttingen called them 'living phantoms' [12] and he used forceps for teaching more often than was clinically necessary to assist delivery.

Many medical schools in the USA adopted obstetric simulation at this time (Figure 3.1), although sometimes this was to remedy a shortage of patients. This was the case at Long Island College Hospital (LICH), Brooklyn, New York [13], but simulation was used extensively 'so that notwithstanding the paucity of clinical material, when a Long Island man was confronted with an obstetric proposition, he was qualified to deal with it' (p. 5). A building at LICH that opened in 1897 included four simulation rooms with facilities for observation. Also, a dynamometer was used with the simulators to measure the force being applied to them. In an article on the teaching in this simulation suite it was noted that '[t]he student is drilled in diagnostic methods and in the various obstetric manoeuvres' [14].

At the Obstetric Institute of Philadelphia, medical students were paired up with pupil nurses for simulation training. These teams were then expected to demonstrate in front of the whole class every manipulation and operation necessary from the beginning of labour, including washing and dressing the baby and putting

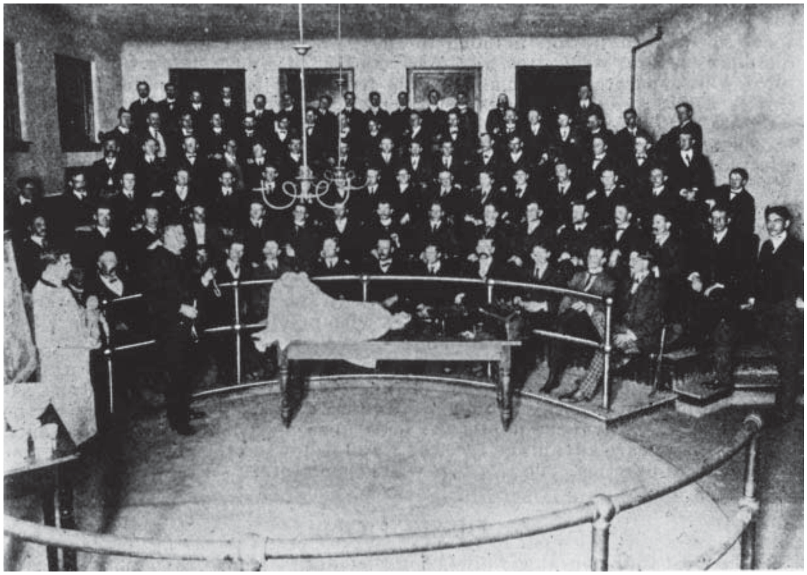

Figure 3.1 Mannequin-based obstetric teaching at the Chattanooga Medical College, circa 1903. Source: Courtesy US National Library of Medicine.

it to the mother's breast. Students had to demonstrate proficiency on a patient simulator before they were given permission to perform those procedures on patients.

Several studies published early in the twentieth century identified a need for obstetric simulation in US medical curricula. For example, a report by the Committee on Maternal Welfare of the American Association of Obstetricians, Gynecologists and Abdominal Surgeons observed that didactic instruction was not sufficient and that practical skills needed to be taught to small classes first on a simulator and later by the combined use of simulator and patient. One of the most influential reports of the time, by Abraham Flexner [15], was quite silent on the topic. Simulation in obstetric training underwent a significant decline in the second half of the twentieth century.

Simulation in bronchoscopy

Anaesthesia was discovered in the middle of the nineteenth century and this facilitated the development of many new surgical procedures. Up to the end of the century inhalation of a foreign body had serious consequences, but that was completely changed by Gustav Killian's invention of bronchoscopy. Killian developed the technique on cadavers and in 1897 used it to examine the bronchial tree of a live subject and to remove foreign bodies. Two years later he demonstrated the technique on what were called 'living simulators' at a conference in Germany. There was intense interest in bronchoscopy, but operating the long, slender instruments was hard to learn. In a lecture given in 1902, Killian observed: 'Their manipulation at so great a depth is not an easy matter, but may be learned and practised on a phantom. I have constructed one for this purpose' [16].

Early in the twentieth century simulation was widely recommended for learning bronchoscopy. Jackson, for example, recommended a few hundred hours' practice on a simulator to develop the required skills [17], and Walgett advised [18]: 'When the nature of the foreign body is known, actual practice should be made with its duplicate placed in the phantom' (p. 313).

Jackson included a chapter on acquiring skills in a book on per-oral endoscopy published in 1922 [17], in which he recommended practice using the equipment on a 'Rubber-tube Manikin', cadavers and dogs. The rubber-tube mannequin was readily available and

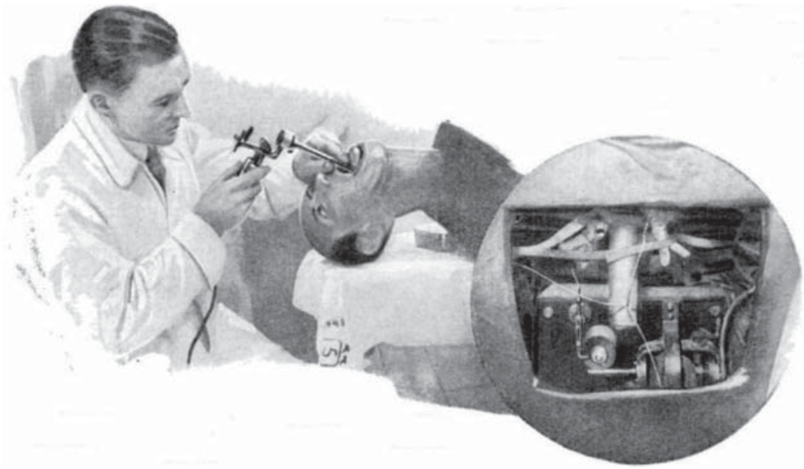

Figure 3.2 A per-oral endoscopy simulator developed in the Hajek Clinic in Vienna [20]. The text explained: 'This robot makes a nervous patient for the medical student and lights up or rings a bell if the probe goes right or wrong. At right, the insides of the model that cause it to respond to stimuli.'

was very useful for learning to use the equipment. When endoscopy was performed on a cadaver, Jackson recommended that the whole surgical team, including the assistant who holds the head and the one who passes the instruments, should practise together, as 'in no other way can the pupil be taught to avoid killing his patient'. He added that '[l]aryngeal growths may be simulated, foreign body problems created and their mechanical difficulties solved and practice work with the forceps and tube perfected' (ch. 11). Jackson noted that it was necessary to maintain flexibility of the cadaver and recommended a special embalming solution containing arsenic and alcohol. Bronchoscopy on dogs provided experience of the procedure on a live subject with respiration, cardiac pulsation and secretions, but Jackson reported the need to suspend disbelief, or 'the endoscopist will lose much of the value of his dog practice if he fails to regard the dog as a child'.

In 1928, Alper described 'a breathing, pulsating man-sized phantom for bronchoscopic and esophagoscopic manipulations' that had been developed in the Hajek clinic in Vienna (Figure 3.2). This simulator provided feedback to the endoscopist and it was later reported [19] that the simulator was useful in medical education because:

- It could be operated on at convenient times for any number of diseases.
- A novice can operate on the simulator for serious conditions without increased risk to patients.
- The same operation can be repeated many times on the same day.
- It can be used to practise treating patients with an infectious disease without spreading the illness.
- Unusual cases and their treatment can be demonstrated and practised.

Unfortunately, it seems that the use of simulation in learning bronchoscopy declined in the second half of the twentieth century. A review of complications from bronchoscopy in a US teaching hospital published in 1978 revealed a higher rate of complications than was generally reported [21], and this was attributed to procedures performed by trainees who were inexperienced. A study of bronchoscopy training published in 2006 [22] confirmed an increased rate of complications among novice bronchoscopists. At the institution concerned, trainees received lectures on bronchoscopy but no formal training on a simulator, even though one was available. It was concluded that '[f]uture research is needed to determine the role of advanced educational techniques, including the use of simulators, in facilitating bronchoscopy education' [22].

The lost history of simulation in healthcare

Over 250 years ago it was acknowledged that risk of harm to patients could be greatly reduced by having students and trainees learn procedures through simulation. It was also recognized that simulation could be used to prepare for uncommon conditions that are difficult to manage and to learn new procedures. In 1876, the US government published a national audit of treatment of abdominal injuries during the American Civil War. One of the recommendations made in the report [23] was that newer and 'more complicated methods and modifications … should not be attempted on the living subject until the operator has acquired some experience by practicing, as M. Fano used to require his pupils to do, either using the fingers of a glove, or, better still, upon a recent subject, or on intestines placed in a manikin' (p. 121). The introduction of laparoscopic surgery in the last quarter of the twentieth century was associated with increased injuries to patients and has been described as 'the biggest unaudited free for all in the history of surgery' [24].

Around 100 years ago it was recommended that healthcare teams should practise together using simulation. Quite recently training courses using simulation have been re-established in many healthcare disciplines, but simulation has not been formally integrated into training and most procedures are still learnt on patients. It was in the middle of the nineteenth century that Semmelweis discovered that using cadavers as obstetric simulators was the source of puerperal fever then endemic in the main hospital in Vienna [25]. Many of his colleagues refused to integrate his methods to control the infection in their practice, and Semmelweis responded by calculating the number of deaths they caused through their indifference to improving patient care. Today we could calculate the harm and costs arising from training on patients instead of on simulators, since it appears that we have not learnt much from the historical practices of healthcare simulation. The work of the pioneers of simulation should not be ignored and we should use their legacy to the fullest possible extent.

References

1 Glaister, J. Dr., (1894) *William Smellie and his contemporaries; a contribution to the history of midwifery in the eighteenth century*, Glasgow, Maclehose.

2 Denman T. *An introduction to the practice of midwifery*. New York: G. & C. & H. Carvill [u.a.]; 1782.

3 Manningham R. Lectures advertisement. London Evening Post. 1740; p. 4.

4 Manningham, R. (1744) *An abstract of midwifry*, T. Gardner, London.

5 Van Heiningen, T. (2014) *Wouter Van Doeveren and Petrus Camper in Paris: travel diaries kept in the years 1752–1753, 1777 & 1787 and related correspondence*, Den Haag, Digitaal Wetenchapshistorisch Centrum.

6 Smellie, W. (1766) *A treatise on the theory and practice of ,idwifery*, 5th edn, London.

7 Börner, F. (1752) *Die gebährende Frau*, Frankfurt.

8 Fabbri GB. Antico museo ostetrico di Giovanni Antonio Galli, restauro fatto alle sue operazioni in plastica e nuova conferma della suprema importanza dell'ostetricia sperimentale: discorso letto nella sessione del 2 maggio 1872 dell'Accademia delle Scienze dell'Istituto di Bologna. Bologna: Tipi Gamberini E Parmeggiani; **1872**. pp. 129–166.

9 Owen, H. (2016) *Simulation in healthcare education: an extensive history*, Springer, New York.

10 Gelbert, N.R. (1998) *The king's midwife: a history and mystery of Madame du Coudray*, University of California Press, Berkeley, CA.

11 Dunn, P. (2006) Adolphe Pinard (1844–1934) of Paris and intrauterine paediatric care. *Arch Dis Child Fetal Neonatal Ed.*, **91**, F231–F232. doi: 10.1136/adc.2005.074518

12 Schlumbohm, J. (2012) *Lebendige Phantome – ein Entbindungshospital und seine Patientinnen 1751–1830*, Goettingen, Wallstein.

13 Polak, J.O. (1925) The history and development of the Department of Obstetrics and Gynecology. *Long Island Coll Alumni J.*, **2**, 4–6.

14 Jewett, C. (1905) Teaching methods in gynecology and obstetrics. *Brooklyn Med J*, **19** (9), 337–9.

15 Flexner, A. (1910) *Medical education in the United States and Canada: a report to the Carnegie Foundation for the Advancement of Teaching*.

16 Killian, G. (1902) On direct endoscopy of the upper air passages and oesophagus; its diagnostics and the therapeutic value in the search for and removal of foreign bodies. *BMJ*, **2** (2174), 569–571.

17 Jackson, C. (1922) *Bronchoscopy and esophagoscopy: a manual of peroral endoscopy and laryngeal surgery*.

18 Waggett E. *Direct laryngoscopy, tracheoscopy, bronchoscopy, oesphagoscopy and gastroscopy*. In: Allbutt C, Rolleston H, editors. *A system of medicine by many writers*. 1910. pp. 299–322.

19 Unknown. Vienna Robot so human it suffers from illness. Milwaukee Sentinel; 1930:19.

20 Unknown. Young doctors' robot rings bell at error. Pop Sci. 1930:**30**.

21 Dreisin, R., Albert, R., Talley, P. *et al.* (1978) Flexible fiberoptic bronchoscopy in the teaching hospital: yield and complications. *Chest*, **74** (2), 144–9.

22 Ouellette, D.R. (2006) The safety of bronchoscopy in a pulmonary fellowship program. *Chest*, **130** (4), 1185–90. doi: 10.1378/chest.130.4.1185
23 Otis, G. (1879) *Medical and surgical history of the War of the Rebellion. Vol. 2, Part 2: Surgical history*, Govt. Print. Office, Washington, DC.
24 Cuschieri, A. (1995) Wither minimal access surgery: tribulations and expectations. *Am J Surg*, **169** (1), 9–19.
25 Owen, H. (2014) Unexpected consequences of simulator use in medical education: a cautionary tale. *Simul Healthc.*, **9**, 149–52.

CHAPTER 4

Exploring realism in healthcare simulations

Debra Nestel, Kristian Krogh & Michaela Kolbe

> **KEY MESSAGES**
>
> - Realism is a contested topic in many disciplines.
> - Realism is a perception and therefore individualized.
> - Meaningfulness is a perception and therefore individualized.
> - Realism and meaningfulness are separate concepts.
> - Meaningfulness is perhaps a more valuable concept than realism for simulation educators.

Overview

In this chapter we explore the contested notion of realism and consider its application in simulation-based education. We argue for flexible approaches to realism, since there are no hard-and-fast rules about what needs to be real, when and for whom, for optimal learning. We introduce the concept of meaningfulness to help simulation educators make sense of decisions about realism. Strategies are proposed for simulation educators that help to manage realism and meaningfulness in relation to learning. We offer four examples that demonstrate the complexity of realism in healthcare simulations.

Introduction

> '"Tell me one last thing," said Harry. "Is this real? Or has this been happening inside my head?"
>
> Dumbledore beamed at him, and his voice sounded loud and strong in Harry's ears even though the bright mist was descending again, obscuring his figure.
>
> "Of course it is happening inside your head, Harry, but why on earth should that mean that it is not real?"'
>
> *J.K. Rowling,* Harry Potter and the Deathly Hallows *[1]*

Individuals determine for themselves what is and is not real. Realism is defined as 'the attitude or practice of accepting a situation as it is and being prepared to deal with it accordingly' [2].

This sets the stage for the individualized and contested notion of *realism* in healthcare simulation. It also raises a parallel issue of *meaningfulness*. There are no hard-and-fast rules about what needs to be *real*, when and for whom. What seems to be important is clarity about the purpose of the simulation, from which *considered* decisions about realism can be made. First, we explore a range of terms used to describe realism and then reflect on realism in other spheres. We explore key elements of realism in healthcare simulation, especially for supporting learning. We propose that realism and meaningfulness are independent concepts. We then share four examples of realism in simulations reflecting this independence. The terms *simulation educator* and *participants* are used to describe teachers and learners respectively.

Realism and its synonyms

Several synonyms are used for *realism* and are employed in simulation practice. These include *fidelity*, meaning 'the degree to which a sound or picture reproduced or transmitted resembles the original' [2]. Fidelity is commonly used to describe technologically advanced simulators that can be programmed to accurately reflect physiological parameters or represent particular organs.

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

For example, with SimMan 3G and iStan being described as *high fidelity*, reference is being made to the dynamic physiological (often audiovisual) metrics and wireless technology rather than to the physical appearance of the mannequin. Inconsistent use of the term fidelity in the healthcare simulation literature has been noted [3, 4]. Additionally, adjectives have been adopted in an effort to add clarity to fidelity, such as physical, functional, psychological, behavioural, engineering, visual, auditory and more [5]. We return briefly to *fidelity* later in the chapter. The term *authenticity* includes a sense of genuineness, 'the quality of truthful correspondence between inner feelings and their outward expression; unaffectedness, sincerity' [6]. *Authenticity* is often used to refer to SP-based (simulated or standardized patient) and/or team-based simulations, both of which rely on interpersonal relationships. Other synonyms include *reproduction*, which is used to describe copies of a real object, sometimes mass-produced copies of an 'original'. Finally, *re-creation* refers to the intentional creation of some of the elements of something *real*, leaving an impression of realism although it clearly is not.

The broader landscape of realism

Realism has long been a subject of curiosity in the arts and literature. In the visual arts, *realism* is the precise, detailed, sometimes exacting presentation of objects, people and scenes. Other terms used to describe this movement are *naturalism, mimesis* or *illusionism*. The *magical realism* genre tells stories from the perspective of people who live in *our* world but experience a different reality.

In psychology and psychotherapy, reality and realism are important variables to consider from different angles. In clinical psychology, for example, the idea of *depressive realism* has attracted much attention; depressed individuals seem to be a little better able to make certain judgements than non-depressed individuals [7]. In social psychology, there is a fundamental axiom assuming that each person's view of reality is a construction shaped by cognitive and social processes [8]. Likewise, in systemic-constructivist psychotherapy, reality is considered to be in the eye of the beholder [9]. That is, there is no reality as such; reality is always cognitively and socially constructed [10]; individuals decide what they perceive as real [9].

While further description is beyond the scope of this chapter, it is stimulating to think about these varied examples.

Realism in healthcare simulations

Dieckmann has noted that debate in healthcare simulation focuses on 'real versus simulated' [11] and that this is problematic because it is not dichotomous. Kneebone [12] describes a *realism gradient* as a progressive shift in realism as one moves from the periphery to the centre of a simulation (see Example 4.3). Dieckmann [13] reminds us that simulation has its own reality and draws attention to the participants' improvisation: a participant in an immersive simulation holds up a biscuit tin *as if* it were an X-ray. This has been referred to as a *fiction contract*, where simulation educators and participants collaborate to suspend disbelief and act within the context of the simulation *as if* it were real. This can be very effective, allowing the participants to buy in, gaining an enhanced experience and opportunity to learn. Rudolph et al. [14] propose strategies for simulation educators to create and maintain the fiction contract with participants. However, the individualized nature of defining reality means that participants will inevitably determine realism for themselves.

This is reflected by the *aptitude treatment interaction*, a concept reflecting that *person* variables interact with *treatment* variables [15, 16]. Some participants might find it easier to act *as if*, while others might need more or different educational treatments to be able to engage in simulation. For example, investigating a participant's skill level as a *person variable* and the amount of contextual information as a *treatment variable*, McRobert et al. [17] found that skilled participants were better able to deal with the restricted context information of a simulation than less skilled participants. Another challenge is when the participants do not truly know how or what real is and the suspended disbelief on some scale is perceived as realistic or real, consciously or unconsciously. This may be an issue for participants when they do not have a frame of reference for the context that is being simulated.

Dieckmann [11, 13] draws on the work of Laucken, a contemporary social psychologist who has proposed three modes of thinking about the world: physical, semantic and phenomenal. Dieckmann [11] has applied

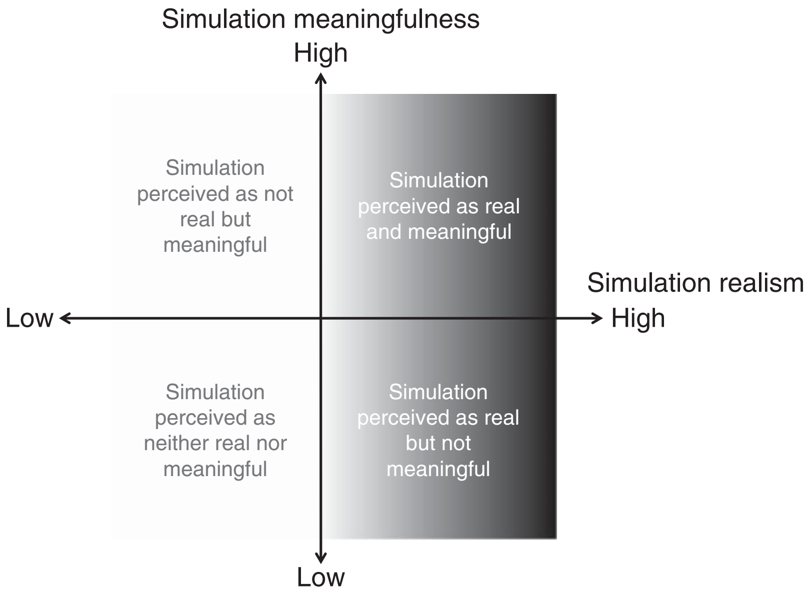

Figure 4.1 Simulation realism and meaningfulness applied to scenario-based learning.

these modes to simulation, describing the *physical* mode as representing measurements (e.g. the simulator appearance); the *semantic* mode as referring to the words used to indicate a clinical change (e.g. the reading on a monitor); while the *phenomenal* mode describes the participant's *experience of the simulator* as relevant to the learning goals of the activity. Rehmann et al. [18] offered a similar three-dimensional typology of simulation fidelity to aid simulation designers: *equipment*, *environmental* and *psychologic* fidelity. Recently, Kyaw Tun et al. [5] have proposed a framework for determining levels of fidelity in simulations along axes of patient, clinical scenario and healthcare facility, while Hamstra et al. [4] recommend abandoning the term *fidelity* altogether, shifting the focus away from physical appearance to functional task alignment.

Realism and meaningfulness

Now we shift our focus to a related concept – *meaningfulness*, the degree to which individuals experience a task as one which is valuable and worthwhile for their learning or professional practice, which they care about and which inspires them [19, 20]. Considering meaningfulness and realism as two distinct concepts, a two-by-two matrix results with high/low meaningfulness and realism, respectively (Figure 4.1). First, in an immersive mannequin-based simulation, a scenario can be perceived as realistic while it and the debriefing can be meaningless for participants. For example, the scenario can represent very well a severely injured, pregnant woman who is going into cardiac arrest, but during the debriefing the challenges of decision making and prioritizing within the team are not discussed. Second, a scenario can be perceived as unrealistic but still trigger a meaningful debriefing conversation. For example, the response of the mannequin to the treatment might be perceived as unrealistic, but the debriefing focuses on the challenges of speaking up to the colleague who seemed to suggest the wrong medication – a meaningful topic to healthcare personnel [21, 22]. Third, a simulation may be perceived as unrealistic and does not result in any meaningful debriefing. For example, the response of the mannequin to the treatment might be perceived as unrealistic and the debriefing does not address the confusion of the participants, but suggests that they were not putting enough effort into managing the *patient*. Fourth, the scenario would be perceived as real and would result in a meaningful debriefing. For example, the scenario represents very well a severely injured, pregnant woman who is going into cardiac arrest and the debriefing focuses on the challenges of decision making and prioritizing within the team – creating maximum learning possibilities.

Strategies for managing realism and meaningfulness to promote learning

We propose strategies for simulation educators before, during and after simulations to manage realism and meaningfulness to promote learning (Figure 4.2). *Before* the simulation, when inviting participants it can be made clear that learning will be in a simulated environment. Immediately before the simulation, educators can identify features and functions of a simulator that are similar and those that are different to reality and how this will be managed. Participants can be asked about their feelings towards the simulation and what they are hoping to achieve. Simulation educators can draw on real clinical events in designing scenarios that are aligned with participants' needs. *During* the simulation, educators can maintain the fiction contract and conduct scenarios in a realistic way. They can encourage discussion of safe and unsafe practices during debriefings. *After* the simulation, participants can be asked about realism and meaningfulness during the evaluation to inform faculty development and scenario design.

Examples of realism in healthcare simulation

Here we share four examples of different simulation modalities and associated considerations of realism from the perspective of simulation educators.

Example 4.1: simulated patients – realism in role portrayal

SPs are people well trained to portray patients. Many variables influence their level of realism during simulations. This includes casting – needs to be credible; the scenario – needs to be believable; the learner's task – needs to be appropriate for the SP role; and the SP portrayal – needs to be accurate, have internal consistency and be emotionally flexible. In an effort to achieve *standardization* for exams, SP realism can be compromised, as the desire to provide every candidate with the same experience takes precedence over authentic portrayal. However, designing SP roles that are based on real patients and offering rigorous training for portrayal can address some of these issues. Nestel et al. [23] describe a study in which they used a template to interview patients who had recently undergone procedural skills in the emergency department. Based on the interviews, SP roles were developed that mirrored the real patients' experiences and included their phrases and emotions. In another unpublished study funded by

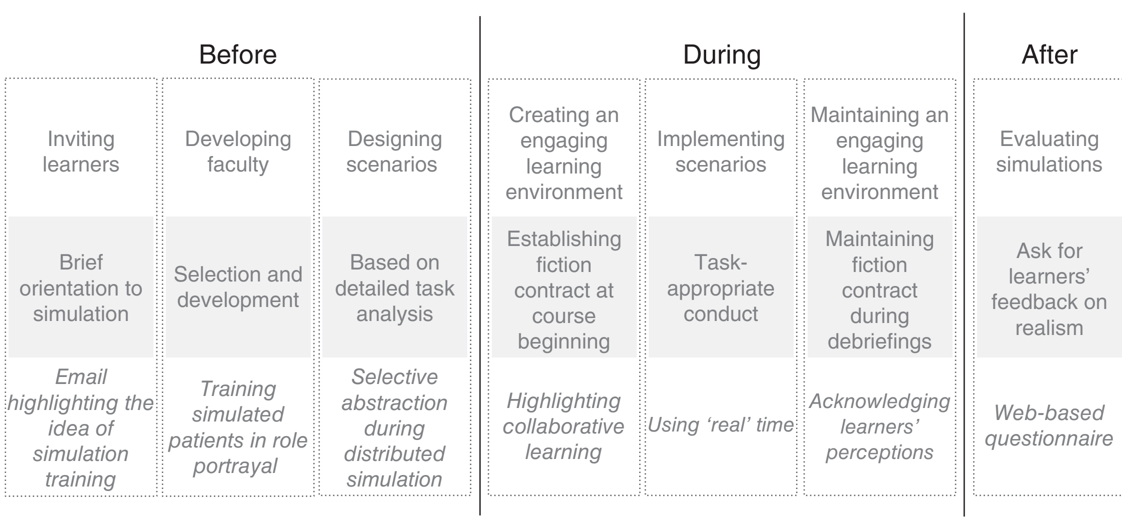

Figure 4.2 Considerations for realism in healthcare simulations. The text in italics offers examples of actions to address elements of realism before, during and after simulations.

Imperial College London as a Teaching Development Grant and led by Debra Nestel, patients from a general practice setting who had complex histories were interviewed and their stories and experiences documented as a *narrative*, which was then used as the basis for SP roles. In this study, SPs met with the real patients whose stories they were portraying. This was salutary for the SPs, as they connected directly with those whom they were *re-presenting*, a powerful reminder of the meaning of their work.

Example 4.2: real rather than compressed time – learning cardiopulmonary resuscitation

Krogh et al. [24] described how when attending *code blue* (cardiac arrest) emergency calls it was noticed that junior doctors were not keeping the recommended two minutes of cardiopulmonary resuscitation (CPR) between rhythm control/defibrillation. A study was undertaken of advanced life support (ALS) training to investigate whether shortened CPR cycles could be the source of lack of adherence to the ALS guidelines. Participants took part in a one-day ALS course where they were randomized to attend simulation scenarios using real-time CPR (120 seconds [s]) or shortened-time CPR cycles (30–45 s). Adherence to time was measured 1 and 12 weeks after the course using the European Resuscitation Council's Cardiac Arrest Simulation Test. The results showed that the real-time CPR group adhered significantly better to the recommended 120 s CPR cycles [24]. In this study, real rather than compressed time was a relevant and important part of overall realism (Figure 4.2). The risk of *negative learning* needs to be considered in the design of learning activities.

Example 4.3: distributed simulation – mobile immersive clinical environments

In this example we consider the setting of the simulation in which *good enough* realism is acceptable. Kneebone et al. [25] describe *Distributed Simulation* (DS), an immersive inflatable enclosure. The DS is the product of a team of industrial designers, prosthetic makers, special effects artists, information technologists, educationalists, simulated patients and clinicians. An active design process was used to identify the salient environmental features for re-creating in a simulated setting. Participants in the simulation use their own mental models to translate images of clinical environments to the simulated one. By including only minimal cues rather than everything in the environment, the functional flexibility of the DS can be increased. By the inclusion of different props and different photographic backdrops, it can be used for emergency department, intensive care, recovery room, operating theatre and more. The DS can be used in any room of sufficient size to take the enclosure. It inflates in a few minutes and equipment from the local site can be readily included in the DS. In some ways, the DS sits between the static simulation centre and simulations in clinical settings. It is currently used for teaching, learning and research activities.

Example 4.4: cross-training – rotating positions to enhance perspective taking

The final example describes a specific team training intervention, cross-training, in which realism is temporarily reduced for the sake of allowing team members to perceive and understand each other's perspectives and thus enhancing their overall understanding of the team's task. During cross-training, team members rotate roles [26, 27]. For example, a nurse takes on the role of an attending physician and an attending physician takes on the role of a nurse. The advantage of this training intervention is that it significantly facilitates the development of team interaction mental models; that is, the shared understanding among team members of how to work together [28]. A risk of cross-training is that participants may feel overwhelmed and experience too much stress, for example due to lack of knowledge or experience with the unfamiliar role. *Lighter* versions of cross-training, such as watching training videotapes modelling each others' positions rather than fully engaging in one another's roles, seem equally effective [28]. Alternatively, inviting a participant in an anaesthesia crisis resource management course (perhaps an anaesthetic trainee) to participate in the scenario as an additional, *embedded* simulated surgeon, being briefed just to observe the case from the surgeon's perspective, seems beneficial as well.

Conclusions

In this chapter we have shared several terms used to describe realism, offered insights into the contested nature of realism and introduced meaningfulness as an independent concept in healthcare simulations. It is important to note that low levels of realism can result in high meaningfulness for participants and associated learning, and vice versa. Thoughtful educational design is essential and includes simulation educators' awareness of participants' individual responses to realism in simulation, which are in turn shaped by their broader experiences. Our examples explored various facets of realism, illustrating the complexity of the concept. It is an exciting area for research and likely to benefit from viewing the concept from multiple perspectives.

References

1 Rowling, J.K. (2007) *Harry Potter and the deathly hallows*, Bloomsbury, London.

2 OED Online [cited 19 October 2015]. Available from: http://www.oed.com.ezproxy.lib.monash.edu.au/view/Entry/158931?redirectedFrom=realism - eid

3 Paige, J. and Morin, K. (2013) Simulation fidelity and cueing: a systematic review of the literature. *Clin Simul Nurs.*, **9**, e481–e489.

4 Hamstra, S.J., Brydges, R., Hatala, R. *et al*. (2014) Reconsidering fidelity in simulation-based training. *Acad Med*, **89** (3), 387–92.

5 Tun, J.K., Alinier, G., Tang, J. and Kneebone, R.L. (2015) Redefining simulation fidelity for healthcare education. *Simul Gaming*, **46** (2), 159–74.

6 Foronda, C., Liu, S. and Bauman, E.B. (2013) Evaluation of simulation in undergraduate nurse education: an integrative review. *Clin Simul Nurs*, **9** (10), e409–e416.

7 Moore, M.T. and Fresco, D.M. (2012) Depressive realism: a meta-analytic review. *Clin Psychol Rev*, **32** (6), 496–509.

8 Smith, E. and Mackie, D. (2007) *Social psychology*, Psychology Press, New York.

9 von Schlippe, A. and Schweitzer, J. (2007) *Lehrbuch der systemischen Therapie und Beratung [Textbook of systemic therapy and counselling]*, 10th edn, Vandenhoeck & Ruprecht, Göttingen.

10 von Foerster, H. and Pörksen, B. (2013) *Wahrheit ist die Erfindung eines Lügners. Gespräche für Skeptiker [Truth is the invention of a liar: talks for sceptics]*, Carl-Auer, Heidelberg.

11 Dieckmann, P., Gaba, D. and Rall, M. (2007) Deepening the theoretical foundations of patient simulation as social practice. *Simul Healthc*, **2** (3), 183–93.

12 Kneebone, R. (2010) Simulation, safety and surgery. *Qual Saf Health Care*, **19** (Suppl 3), i47–i52.

13 Dieckmann, P. (ed.) (2009) *Using simulations for education, training and research*, Pabst, Lengerich.

14 Rudolph, J.W., Raemer, D.B. and Simon, R. (2014) Establishing a safe container for learning in simulation: the role of the presimulation briefing. *Simul Healthc*, **9** (6), 339–49.

15 Cronbach, L.J. and Snow, R. (1977) *Aptitudes and instructional methods: a handbook for research on interactions*, Irvington, New York.

16 Johnson, T., Lyons, R., Kopper, R. *et al*. (2014) Virtual patient simulations and optimal social learning context: a replication of an aptitude-treatment interaction effect. *Med Teach*, **36** (6), 486–94.

17 McRobert, A., Causer, J., Vassiliadis, J. *et al*. (2013) Contextual information influences diagnosis accuracy and decision making in simulated emergency medicine emergencies. *BMJ Qual Saf*, **22** (6), 478–84.

18 Rehmann, A., Mitman, R. and Reynolds, M. (1995) *A handbook of flight simulation fidelity requirements for human factors research. Crew Systems Ergonomics Information Analysis Center*, Dayton, OH, Wright-Patterson Air Force Base.

19 Hackman, J. and Oldham, G.R. (1976) Motivation through the design of work: test of a theory. *Organ Behav Hum Perform.*, **16**, 250–79.

20 Iversen, A.-M., Pedersen, A.S., Krogh, L. and Jensen, A.A. (2015) Learning, leading, and letting go of control. *Learner-Led Approach Educ.*, **5** (4), 1–11.

21 Eppich, W. (2015) 'Speaking up' for patient safety in the pediatric emergency department. *Clin Pediatr Emerg Med.*, **16**, 83–9.

22 Raemer, D.B., Kolbe, M., Minehart, R.D. *et al*. (2016) Improving anesthesiologists' ability to speak up in the operating room: A randomized controlled experiment of a simulation-based intervention and a qualitative analysis of hurdles and enablers. *Acad Med*, **91** (4), 530–539.

23 Nestel, D., Cecchini, M., Calandrini, M. *et al*. (2008) Real patient involvement in role development evaluating patient focused resources for clinical procedural skills. *Med Teach*, **30**, 795–801.

24 Krogh, K.B., Høyer, C.B., Østergaard, D. and Eika, B. (2014) Time matters: realism in resuscitation training. *Resuscitation*, **85** (8), 1093–8.

25 Kneebone, R., Arora, S., King, D. *et al*. (2010) Distributed simulation: accessible immersive training. *Med Teach*, **32** (1), 65–70.

26 Blickensderfer, E., Cannon-Bowers, J. and Salas, E. (1998) Cross-training and team performance, in *Making decisions under stress: implications for individual and team training* (eds J. Cannon-Bowers and E. Salas), American Psychological Association, Washington, DC, pp. 299–311.

27 Salas, E., Nichols, D.R. and Driskell, J.E. (2007) Testing three team training strategies in intact teams. a meta-analysis. *Small Group Res*, **38**, 471–88.

28 Marks, M.A., Sabella, M.J., Burke, C.S. and Zaccard, S.J. (2002) The impact of cross-training on team effectiveness. *J Appl Psychol*, **87** (1), 3–13.

CHAPTER 5

Applying a framework to healthcare simulation: Micro, meso and macro levels

Marcus Watson

KEY MESSAGES

- Simulation can address fundamental safety and quality issues in healthcare when applied beyond individual training.
- Using a micro, meso and macro framework to classify simulations helps to integrate training and design solutions across healthcare.
- Simulation can be used for interventional, diagnostic and predictive purposes to address micro, meso and macro issues in healthcare.
- Simulation and debriefing methods used for individual and team training can be applied to systems design.
- Applying simulation to designing processes and technologies is likely to improve safety and quality more than using simulation for training.

Overview

Much simulation in healthcare currently focuses on simulation-based education (SBE); however, the application of simulation has greater potential to address safety and quality in healthcare. This chapter covers framing simulation into micro, meso and macro levels of analysis for healthcare systems and processes. Examples are used to illustrate the application of diagnostic, predictive and interventional simulations at the micro, meso and macro levels to improve healthcare outcomes. These include the design of tools and processes for improved patient care through to the method of simulation rapid prototyping to predict requirements and outcomes of the introduction of new technologies.

Introduction

A major focus of simulation in healthcare is centred on developing individual skills. To a lesser extent simulation is used for interprofessional learning and team development. Despite contemporary healthcare improving the quality of life, healthcare systems have shown little improvement in safety [1, 2] and there is public debate about inefficiency and a high proportion of inappropriate care delivered in healthcare systems [3, 4]. These problems will not be solved by improvements in clinical education; rather, they require approaches to addressing systems issues [5].

In other industries (transportation, finance, mining and manufacturing), modelling and simulation play a major role in systems design. The complex issues that lead to high error rates in healthcare, such as a system of systems (many systems that are inherently independent, large scale and distributed), are also found in other industries. For example, Khosravi and Nahavandi have demonstrated that numerous homogeneous and heterogeneous systems can be modelled with simulation to describe and improve airport baggage management [6]. Such techniques could be applied to the many systems in healthcare (e.g. patient records) to reduce errors. Simulation in healthcare needs to bridge the gap between training and system design if we are to address patient safety comprehensively. To do this we need to think about frameworks that help people understand what their simulations are addressing and in what parts of the healthcare system.

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

Micro, meso and macro framework

The terms micro, meso and macro are used in social sciences to point to the location, size or scale of a research target. Micro, the smallest unit of analysis, addresses individuals in their social settings. The meso level is used to analyse a community or an organization and the macro level is used to address the interactions over a large population. Arora and Sevdalis have applied the three levels of analysis to design comprehensive simulation approaches to training [7]. In their Defence Medical Services HOSPEX programme, micro simulation focuses on the basic technical skills of individual clinicians, while meso simulation addresses training clinicians to work as part of a clinical team. Finally, macro-level simulation is used to assess organizational *fitness for purpose* at a large scale.

The majority of clinicians deployed to support military operations have little experience with the trauma and operating conditions encountered in a field hospital. Using a warehouse to simulate the entire field hospital, every team member scheduled for deployment demonstrated their individual skills, ability to work as part of a team and ability to work across the field hospital teams through a series of simulations [7]. It is possible to see how the military could apply this framework, as it allocates dedicated time for pre-deployment work-up prior to departing to a combat zone. For most healthcare settings taking a department offline would be difficult, let alone an entire organization; so how can such a framework help?

Although it might not be possible to conduct all training in a systematic approach for all levels of an organization, there are many good examples of discrete event training. Addressing real patient events involve many skills; however, training often focuses on a subset of discrete critical skills. For example, at the micro level, cardiopulmonary resuscitation (CPR) training conducted in 'low doses at high frequencies' improved skill acquisition and retention [8]. At the meso level, regular training for mock paediatric arrest increased patients' hospital survival rate from 33% to 50% [9]. This book has many examples where simulation has been used effectively at the micro and meso levels for training. However, few training interventions address the macro-level requirements, such as that achieved in pre-deployment training conducted by the military.

The answer may not lie with the focus on training, but rather the design of systems with which clinicians deal every day. Arora and Sevdalis addressed known problems defined by feedback from prior deployments [7]. The simulations used were designed to identify individual skill deficits against the known problems and implement educational interventions to address individual and team needs. In hospitals, issues for individuals, within and across departments and wards, are likely to be highly variable. In many cases, what may be considered a training issue may have a fundamental cause in the design of the tools, processes or policy driving the behaviours. The micro, meso and macro framework can be extended beyond Arora and Sevdalis's use to cover prediction as well as diagnostics and intervention (Figure 5.1). Intervention simulation traditionally involves training; however, interventions can include the use of simulation to demonstrate activity. Diagnostic simulations are used to describe and measure activities and predictive simulations are used to discover possible future activities and barriers to activities.

Simulations can be employed to investigate discrete events such as a particular patient pathway or facility process. Using immersive simulation to investigate STEMI (ST segment elevation myocardial infarction), patient treatment across departments at the macro and meso levels demonstrated sustained improvements in patient care [10]. Employing a small number of simulations, the issues identified through the simulation were used to identify a solution, which was then tested in the next simulation. The mean time for a patient to arrive at the cardiovascular lab for treatment reduced from 60 to 27 minutes (55%) in a 6-month pre–post clinical trial. In this case, the simulation and debriefing were used to diagnose barriers to care and to test procedural changes as an intervention.

In more complex situations, such as the movement of a paediatric intensive care unit (PICU) from one hospital to another, simulation was used to diagnose and address team and organizational issues [11]. Macro- and meso-level simulation identified and addressed issues including the physical layout of the facilities, the set of new technologies, staff orientation requirements and emergency response procedures and policies. For example, equipment set-up time for emergency responses was reduced by 80% for the insertion of cardiac pacemaker cables. These diagnostic

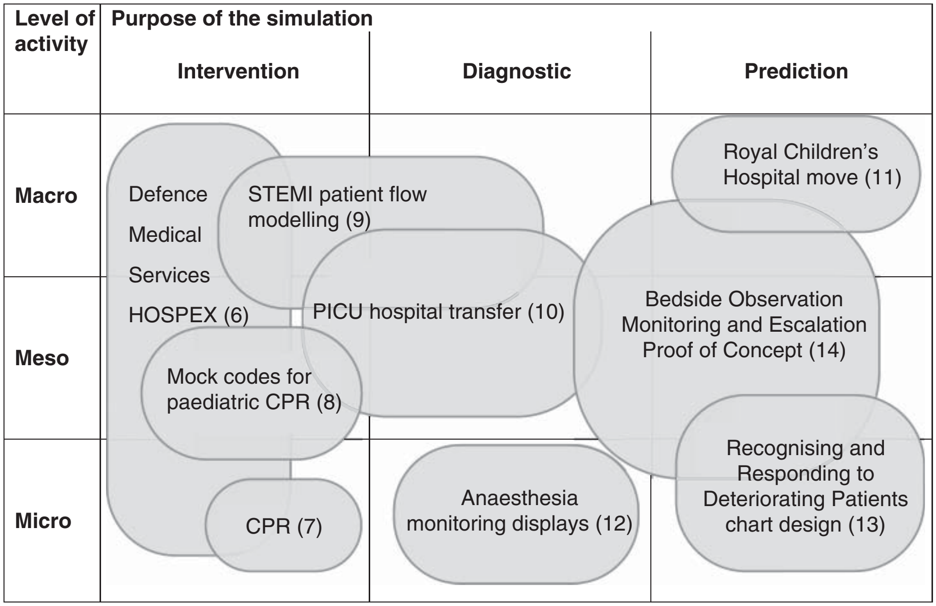

Figure 5.1 A framework for system approaches to applying simulation in healthcare illustrated with examples from the text.

and interventional simulations used multiple in situ simulations with staff at the original hospital and the new hospital. While this is possible when moving one department, it would be difficult to employ such methods for multiple departments or a whole hospital. However, macro-level simulation in the form of modelling was used to plan and conduct the transfer of all patients from the old Royal Children's Hospital in Melbourne, Australia to a new facility [12]. Modelling offers the advantage of scale; however, unlike the in situ simulation, it is dependent on measures from task analysis and clinical opinion. The combination of in situ simulation and modelling could provide the level of data required to improve safety and quality of care dramatically. Industries such as the military and aviation have been using blended simulation and modelling for some time; however, little is published on the methods. In healthcare, documented accounts of any attempt to combine methodologies appear elusive.

So far, the examples have focused on how simulation is used for training or integrating existing knowledge, technologies and processes to improve care. Simulation can, however, be an extremely powerful technique to inform the design of technology and evaluate the impact of new technologies on clinical practice. Currently most new technologies and procedures are introduced through clinical trials, or pilot studies in clinical areas for lower-risk changes. Additionally, simulation can be used to evaluate such technologies prior to their introduction into healthcare systems and in situ to ensure that these technologies are assessed for rare and complex situations.

The use of simulation to analyse local needs and test interventions has many advantages over the utilization of guidelines or even clinical trials to provide evidence around policies, processes and technologies. In simulation, it is possible to change individual, team and organizational practices and assess the outcomes of such changes without putting patients at risk. It is also possible to explore outcomes and find real boundaries of performance by exceeding them and establishing where systems actually fail. The value of such simulation is heavily dependent on the quality of the preparation and assumptions made in its design and delivery.

In anaesthesia, the use of head-mounted displays and new auditory displays for patient monitoring has been evaluated in immersive micro simulations [13]. Sanderson et al. used four 22-minute patient scenarios that covered common and rare issues faced in anaesthesia practice. Although the new auditory displays demonstrated significant improvement in detecting events over existing visual displays and pulse oximetry, surprisingly the head-mounted displays did not. In collaboration with traditional trials, such studies provide a more robust assessment of the strengths and weaknesses of new technologies and are likely to predict barriers to the introduction of new technologies and practices.

In well-designed simulations, the experience can be controlled and rare clinical events can be reliably integrated. As with training, the use of debriefing allows for a deeper understanding of individual and team experiences. Debriefing cannot be as easily conducted for clinical trials of new technologies and/or procedures due to ongoing patient and operational needs. In clinical trials of new technologies and/or procedures, patient safety concerns may prohibit novices from participating. The use of simulation does however allow for clinicians of all levels of expertise to participate. This is very important in understanding the different training requirements for novices to learn and experienced clinicians to adapt to new practices. Such simulation can also be used to identify cultural barriers to the adoption of new technologies and processes, which may differ across both professional groups and levels of skill.

As simulation can play a role in patient flow redesign [10], simulation can also play a role in the design of new technologies. For example, to ensure that patients who deteriorate receive appropriate and timely care, the right tools, systems of escalation and training are required. Historically healthcare failed to recognize that patient charts are actually clinical decision support tools that should be empirically evaluated for their effectiveness. In 2009 the Australian Commission on Safety and Quality in Healthcare commissioned work on the design and evaluation of charts to support recognition and response to deterioration. The use of simulation was combined with human factors methodologies to analyse, design and evaluate the effectiveness of charts for individual and team requirements (micro and meso). Empirical studies have since demonstrated that these processes have developed a more effective adult deterioration detection system than the charts already in clinical use [14]. A further study has shown that the design process trumped health professionals' prior chart experience and demonstrates that investment in the design of clinical support tools is more effective than good training [15]. In modified versions of the charts, clinical evaluation indicated a reduction in cardiac arrest events [16]. Investment in simulation to support the design and evaluation of healthcare tools and processes is likely to provide greater returns than simulation focused on training.

The process used in the micro simulations for the design of the adult deterioration detection system has evolved into simulation rapid prototyping (SRP). SRP is an extension of existing human factors design methodologies and healthcare debriefing techniques, and has now been used to address individual, team and organizational needs for a range of technologies. In a 2014 example, SRP was used in the bedside observation monitoring and escalation proof of concept that examined the potential of two existing electronic deterioration detection systems to be used in a major hospital and health services. The purpose of simulations was to identify quality improvement opportunities and staff acceptance of using the new technologies, rather than comparing the two systems.

The process simulated a close observation unit to examine what would need to change at the micro, meso and macro levels of the hospital and health services in order to move to electronic patient monitoring. The simulations were undertaken by small teams of nurses from the different hospitals across the service, while the debriefing included the simulated patient and observers from all aspects of the hospital service, including medicine and allied health executives and information systems teams. The debriefing addressed the difference in experience between the paper-based and electronic systems and also drew on the broader observer group. This enabled sharing of how this would affect their work and the hospital and health service's existing systems to support the uptake of electronic systems. Unique to this study were the systems developers, who were able to watch their systems in action in the simulations and debriefing via a remote video feed. This arrangement allowed wider participation in the final discussion about the flexibility of their systems to address micro, meso and macro issues identified in the scenarios and debriefing.

As the simulations were designed to analyse existing practices and predict the strengths and weaknesses of moving to electronic practices, the focus was on discovery, not control. The systems developers were able to provide a variety of hardware and evolving software during the three days over which their system was used. This allowed both participants in the simulation and observer groups to better envisage existing barriers and solutions required if the service were to move to electronic bedside observation monitoring and escalation systems. Issues identified included hardware selection, user interfaces, training requirements, processes of care and information technology (IT) infrastructure. Although many issues were identified at all levels (micro, meso and macro) of the healthcare service, participants' acceptance of the potential for electronic systems dramatically shifted as a result of the simulations. Such uses of simulations are not experiments, but rather opportunities to explore the potential for different ways of delivering care. Unlike an expert working group, SRP provides rich experiences, which allow a greater exploration of the possible solutions rather than relying on opinions based on clinicians' experiences.

If proof-of-concept simulations where the focus is on understanding the needs of patients, clinicians and the healthcare system and not on the procurement of a system are undertaken, the potential of new technologies and practices can be engaged at appropriate times and with a better understanding of what is likely to change throughout the system. The involvement of systems developers in SRP allowed them to better understand healthcare systems requirements and potential barriers that needed to be addressed in order for their systems to work effectively in patient care. Simulation has the potential to provide better developmental environments than even the eventual clinical setting, because of the ability to generate situations reliably and to explore where the boundaries of safe practice lie for existing and new practices.

SRP still has limits; such processes require significant work in the development of the scenarios. For example, the bedside observation monitoring and escalation systems took five weeks to develop and deliver with a large team. The skills required to undertake such proofs of concept are expertise in simulation, human factors, systems design and significant experience of the healthcare system. To capitalize on such investments, processes such as SRP would be more effective if they were used to inform computer models in order to aggregate knowledge capture and visualize potential future systems.

Conclusion

Healthcare simulation will play an expanding role in training and must go beyond the focus of developing competent clinicians to developing proficient teams who work in resilient systems. To do this we need to use simulation to understand human system integration at the cognitive and social levels of interaction in healthcare. Using a framework to scaffold different simulations may help to bridge the divide between training and design at all levels of healthcare. The use of discrete event simulation to improve macro processes of care should be achievable by most simulation providers. Nevertheless, as technology continues to grow exponentially, the healthcare simulation community needs to develop the capacity to conduct predictive simulation to understand how to adapt to new technologies and, even more importantly, to help design the right technologies, processes and training to ensure safe, high-quality care.

References

1 Vincent, C., Aylin, P., Franklin, B.D. *et al*. (2008) Is health care getting safer? *BMJ*, **337** (7680), 1205–7.

2 Wachter, R.M. (2010) Patient safety at ten: unmistakable progress, troubling gaps. *Health Aff*, **29** (1), 165–73.

3 Kohn, L.T., Corrigan, J.M. and Donaldson, M.S. (eds) (1999) *To err is human: building a safer health system*, National Academy Press, Washington, DC.

4 Swan N, Balendra J. Wasted. Four Corners. 28 Sept 2015. Available at: http://www.abc.net.au/4corners/stories/2015/09/28/4318883.htm

5 Carayon, P. and Wood, K.E. (2010) Patient safety: the role of human factors and systems engineering. *Stud Health Technol Inform.*, **153**, 23–46.

6 Khosravi, A., Nahavandi, S. and Creighton, D. (2009) Interpreting and modeling baggage handling system as a system of systems. *IEEE International Conference on Industrial Technology*, 1–6.

7 Arora, S. and Sevdalis, N. (2008) HOSPEX and concepts of simulation. *JR Army Medical Corps*, **154** (3), 202–5.

8 Sutton, R.M., Niles, D., Meaney, P.A. *et al*. (2011) Low-dose, high-frequency CPR training improves skill retention of in-hospital pediatric providers. *Pediatrics*, **128** (1), e145–e151. doi: 10.1542/peds.2010-2105

9 Andreatta, P., Saxton, E., Thompson, M. *et al*. (2011) Simulation-based mock codes significantly correlate with improved pediatric patient cardiopulmonary arrest survival rates. *Pediatr Crit Care Med*, **12** (1), 33–8.

10 Brazil V, Baldwin M, Dooris M, Muller H, Cullen L. 'Stemi-sim' – a 'process of care' simulation can help improve door to balloon times for patients with ST elevation myocardial infarction. *SimHealth Sydney*. 2012;10–13 Sept.

11 Hayden M, Watson MO. Simulation to manage a major relocation of paediatric cardiac services. *SimHealth* 2008;8–11 Sept.
12 Macleod K. Hospital simulation of patient migration. *RCH*. 2011;25 Nov. http://tmnsimulation.com.au/rch/
13 Sanderson, P.M., Watson, M.O., Russell, W.J. *et al*. (2008) Advanced auditory displays and head mounted displays: advantages and disadvantages for monitoring by the distracted anesthesiologist. *Anesth Analg*, **106** (6), 1787–97.
14 Preece, M.H.W., Hill, A., Horswill, M.S. and Watson, M.O. (2012) Supporting the detection of patient deterioration: observation chart design affects the recognition of abnormal vital signs. *Resuscitation*, **83** (9), 1111–18.
15 Christofidis, M.J., Hill, A., Horswill, M.S. and Watson, M.O. (2013) A human factors approach to observation chart design can trump health professionals' prior chart experience. *Resuscitation*, **84** (5), 657–65.
16 Drower, D., McKeany, R., Jogia, P. and Jull, A. (2013) Evaluating the impact of implementing an early warning score system on incidence of in-hospital cardiac arrest. *NZ Med J*, **126** (1385), 26–34.

CHAPTER 7

Simulated participant methodologies: Maintaining humanism in practice

Debra Nestel, Jill Sanko & Nancy McNaughton

KEY MESSAGES

- *Simulated participants* (SPs) are individuals who play the roles of others in scenarios – such as patients, clients, service users, healthcare professionals, students and so on [1].
- Specialized healthcare simulation practices have emerged such that those who work with SPs often do not work with confederates and so their methods have sometimes developed in isolation.
- There are points of intersection between simulated patients and confederate practices in simulation-based education, such as *emotional* work, which should be acknowledged in order to maintain humanism, a core underpinning of health professional education.
- Several strategies are offered that may strengthen SP role portrayal and feedback and mitigate any negative impact, and these require consideration before, during and after simulations.

Overview

This chapter explores the roles of simulated patients and confederates in simulation-based education. We use the collective term *simulated participant* (SP) for both and identify points of intersection in their work. A shared feature is the emotional component of their practice. This is an understudied area for SPs, especially for confederates. Educators have a responsibility to care for SPs; that is, to maintain humanism in simulation practices.

Introduction

In this chapter we explore the work of live 'simulators' in healthcare scenario-based simulations. There are two main types of live simulators. First, simulated (standardized) patients are individuals trained to portray a patient and also to provide feedback to trainees on their performance. Often, simulated patients are recruited from the community and may not necessarily have professional acting experience. Second, confederates are individuals who commonly portray the role of healthcare professionals in mannequin-based scenarios. They are usually recruited from local faculty, although there are many variations. What is notable is that simulated patients and confederates work with educators who often practise in isolation as a consequence of the locale of their primary simulation modality. That is, for simulated patient educators, their primary modality is simulated patients, while for educators who work with confederates, their primary modality is usually mannequins. In common is the critical addition of a human element to scenario-based simulations. With the recognition of the human element comes a responsibility for the humanity of those involved, simulated patients and confederates alike. Our focus in this chapter is to draw attention to these humanistic elements of simulation. Throughout the chapter we adopt the inclusive term *simulated participant* [1] when referring to simulated patients and confederates. Where we make reference to specific roles and experiences, we revert to simulated patient or confederate.

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

Simulated patients have a long history in healthcare simulations, with the first documented accounts based in the USA with the work of Howard Barrows in medical education [2]. Although now represented in the curricula of most health and social care professionals, the published literature is most commonly located in medical education. An important driver to development of the methodology has been the ubiquitous use of the objective structured clinical examination (OSCE). This summative assessment role has also influenced the focus on 'standardization'. That is, when simulated patients are required to produce the same performance consistently for participant learners, simulated patients effectively become the exam question, enabling each learner to be offered the *same* question [3]. However, simulated patients have also had a dominant role in formative assessment, where their individuality is valued. Nestel has also argued for valuing simulated patients as proxies for real patients, thereby foregrounding their re-presentation of patients rather than being agents for clinicians [4].

From a previous publication [5] comes the following description:

> Confederates usually play the role of a health or social care professional or a patient's relative and are often 'alone' in the scenario. That is, they are immersed in the scenario as an agent of the simulation educator or researcher as opposed to one of the participant group. They may also play the role of visitors, first responders (e.g. police, firemen) or witnesses (e.g. passerby at a motor vehicle accident). Confederates are most commonly colleagues (e.g. simulation educators, clinicians, research associates, etc.) or actors employed for this specific role. Sometimes participants other than the intended learner group are recruited as confederates, while in some simulations a fellow participant may be asked to take on this role.

Unlike simulated patient roles, confederate roles are often primarily developed as an agent for the educator. There are many commonalities in simulated patient and confederate work (Box 7.1). An important point of intersection is the emotional work in both roles. However, before shifting our focus to these emotional elements and offering considerations for educators in caring for SPs, we will explore the roles of simulated patients and confederates in more detail.

Box 7.1 Summary of the practices of simulated participants

Guide learners

- Orientate learners to the scenario
- Help learners work in an unfamiliar simulation environment
- Prompt learners at specified points – verbal and material/task
- Guide learners to meet learning objectives
- Offer feedback at pre-planned teachable moments, including the debriefing

Offer safety

- Provide physical safety for learners
- Protect simulators from damage/potential harm

Add realism

- Demonstrate appropriate emotions (e.g. sad, happy, cooperative, anxious and arrogant)
- Provide relevant cues to compensate in simulator fidelity (e.g. an infant's mother states 'he is so sleepy' or 'his hands are so cold!')
- Increase learners' engagement in the scenario by selectively increasing participants' cognitive load

Bridge between faculty and learners

- Respond to audio or other cues from faculty during scenarios
- Communicate with 'control room' during scenarios
- Offer insider experience during debriefing and/or evaluation

Provide assessments

- Use rating forms to make judgements on learners' performance

Facilitate research

- Observe actions and collect data not otherwise able to be collected unobtrusively (e.g. a nurse confederate would be able to observe a dose of medication prepared by a pharmacist prior to administration)
- Standardize the manner in which information is conveyed to study participants (e.g. laboratory data, physical signs and symptoms, whether the patient has a known allergy and so forth) to limit variability and minimize the risk of bias

Source: Adapted from Nestel et al, 2014.

Simulated patients work with health professional trainees and practitioners in a multiplicity of clinical formative and assessment activities. As proxies for patients they take on physical and emotional attributes, which they teach through their role portrayals and quite often also through their feedback following the simulation. Simulated patients use their bodies and minds to tell clinical stories – which are usually not their own. Engaging people in simulation requires educators to acknowledge the real possibility that the emotions (e.g. pain, grief, anxiety) in which we ask them to participate in the service of health professional trainees' and clinicians' learning may unintentionally be produced for real and therefore fully experienced and felt. Furthermore, simulated patients are often objectified by faculty, which may diminish their humanity and devalue their equality as co-teachers [6]. Anecdotes from simulated patients often describe simple acts by faculty that reduce their status, such as the location and quality of meeting rooms (e.g. far away from the examination area) and the food and refreshments offered to them compared with faculty examiners at OSCEs.

While confederates are also asked to engage in emotional work, the nature of this work may be different. Nestel et al. have documented that when confederates are faculty, especially junior colleagues or those asked to play caricatures (e.g. orthopaedic surgeons as autocratic, operating theatre nurses as clock watchers etc.), this can have a negative impact on them [5]. Aspiring surgical students invited to play roles as underperforming surgical trainees were concerned that the surgeons (learners in the simulations) may hold an enduring image of them as underperforming, unable to separate the confederates' identity from their real one. Additionally, experienced nurses have reported similar concerns when asked to play the role of unprofessional nurses, questioning the value of perpetuating unhelpful stereotypes. Like simulated patients, confederates asked to play the roles of simulated relatives may experience strong emotional reactions.

Caring for simulated participants

We have organized the remainder of the chapter into strategies to care for simulated participants across phases; that is, before, during and after simulations (Box 7.2). We acknowledge overlap with actions in later phases contingent on prior considerations. In each phase, we consider simulated patients prior to confederates. We also offer examples of scenarios with SPs to illustrate the strategies (Box 7.3).

Box 7.2 Strategies that educators can use to care for simulated participants

Before the simulation

Preparation

- Determine the considerations needed for appropriate recruitment and selection for roles (casting) of simulated participants
- Description of learning activity (and related logistics)
  - **a.** Formative, summative
  - **b.** Learning objectives/outcomes
  - **c.** Length, frequency, rotations, repetitions
  - **d.** Time outs
  - **e.** Feedback, video-assisted debriefing – written, spoken, facilitated, timing
  - **f.** Evaluation – written, spoken
  - **g.** De-roling
- Descriptions of role, character, task
- Descriptions of learners, including their discipline, level, task, expected performance, prior experience, potential challenges
- Description of scenario, including the setting, length (and scenario-related logistics)
- Ensure proper attire is available and worn and consistent with the role (e.g. simulated patient wears 'abuse' blouse, simulated participant playing a surgeon wears scrubs)

Briefing

- Considerations include when, where, who (with/without learners, with/without faculty), how long, checking in, opportunity for further questions, indication of start, finish and time-out cues

During the simulation

- Direct/indirect observation of what is happening in the simulation, who is permitted to be present and who can observe, enactment of cues as briefed
- Direct/indirect observation of observers of the simulation, including maintenance of privacy, minimal talking, constructive use of rating forms
- Observation for potential safety issues and being poised to intervene to maintain the safety of the learners and/or simulated participants

After the simulation

- Facilitate de-roling of simulated participants by introducing them to learners by their real name (and where relevant role), moving to a different space to that of the simulation, conscious shedding of emotion/behaviour from scenario
- Provide support to simulated participants to offer frank and honest feedback in rating forms and/or during debriefing
- Seek feedback from simulated participants on their experiences of the simulation to inform quality improvements
- Encourage simulated patients to move about between scenarios, to stretch limbs (e.g. if holding in a particular position during the scenario), neck rolls, shoulder rolls, concentrate on breathing
- If simulated patients are playing emotionally demanding roles, then encourage them to plan something uplifting afterwards
- Remind simulated participants that emotionally demanding roles may affect them later and offer a follow-up contact
- Propose additional strategies to simulated participants such as writing a journal, meditation or other de-stressing activities the individual enjoys

Box 7.3 Examples of Simulated Participant Roles

Simulated patient in an OSCE for summative assessment

Albert Jones is a retired engineer and has been recruited to a university simulated patient program. He is invited to a training session where he will learn about the ways in which the medical school works with simulated patients to test their medical students' inpatient assessment tasks and physical examinations. The first 3-hour session introduces medical terms, assessment skills and exercises to portray patients realistically. Following participation in this session, Mr Jones will return prior to playing a patient to receive training specific to his role(s). This includes scenario briefing, specific role information, student expectations, assessment criteria of learners and session evaluation. On the day of the encounter Mr Jones will play the patient ten times and evaluate ten learners individually. He will also participate in debriefing with learners, providing feedback on their performance from the perspective of the patient. Following completion of his day, he will be given feedback regarding his own performance, assisted in stepping out of the role and paid for his time.

Confederate in a mock code scenario for formative assessment

Betty Jones is a nurse educator and uses simulation-based education to provide training to the nurses at the hospital in which she works. Each week the intensive care unit (ICU) nurses and physicians who respond to codes within the hospital participate in a mock code scenario. Today's scenario is depicting a patient who has severe respiratory distress secondary to a pulmonary embolism. A high-technology mannequin will represent the patient. Betty will be playing the confederate, a floor nurse who called a code for the patient because of worsening respiratory distress. The confederate (nurse) is nervous when the team (learners) show up to assess the patient. She is worried that the patient's distress is from something she did. Part of the objectives of the simulation include the confederate providing help and information about the patient, but the learners need to recognize and respond to her nervousness in order to access valuable information. Just prior to the scenario starting, Betty reviews the scenario, her role and the goals and objectives of the scenario. Her role is loosely scripted, but she feels comfortable ad-libbing as needed. Following the scenario, she will co-debrief with a physician educator. To facilitate the role change, her physician colleague will encourage her to de-role immediately after the scenario.

Simulated patients and confederates in a formative assessment

A large academic medical centre trains a number of residents each year. Because these new residents may not see every type of patient during training, the hospital uses simulation-based education to present low-volume high-risk patients. Today several residents will be participating in a scenario that involves a woman arriving in the emergency department for a broken arm secondary to domestic abuse. A simulated patient will be playing the patient role and one of the nurse educators from the simulation centre will be the confederate, a triage nurse who first encounters the patient. The simulated patient is from the university's simulated patient programme. The simulated patient received her scenario preparation and briefing earlier and is ready to go. There will be no assessment of the learners for this scenario. The confederate has read over the scenario, the script and the objectives. Both the simulated patient and the confederate will participate in debriefing. The simulated patient will participate in debriefing, along with the confederate as an educator. Following the scenario and debriefing encounters, the team will debrief, discussing aspects of the scenario in need of improvement as well as aspects that went well.

Before the simulation

Recruitment, screening and role portrayal training practices are important in making sure that simulated patients can work effectively and be protected against unintended emotional effects. Sometimes even the most *neutral*-seeming scenario can cause a simulated patient emotional or psychological trouble if it triggers a memory or experience. All simulated participants need to understand the parameters and context of the activity in which they will be engaged, so it is important to impart information such as the purpose of a scenario, how many times they may have to repeat it or how long they will remain in role, and whether they are responsible for completing a checklist/rating form or providing verbal feedback. This information allows them to understand the scope of their responsibilities and expectations and to prepare more fully for their roles.

Two key factors to consider when recruiting and preparing simulated patients are the proximity of the role to the simulated patient's own life circumstances relating to *role adherence* and the *role fit* [7]. With respect to 'role adherence', it can be harder for a simulated patient to shed a role if the scenario is too close to their own life or written in such a way that they need to call on their own history and personal details for information. The particulars of the character's condition (physical, psychological, social and economic) or complaint may stick to the simulated patient like invisible threads that are difficult to remove. So it is important during recruitment and training activities to be transparent about role portrayal expectations. Simulated patients must be made aware that they should notify someone at any point in the training or work process if they feel uncomfortable. Additionally, if, during the training or another point in their work as a simulated patient, an individual feels uncomfortable or appears to be having trouble with the role, there should be a mechanism for a follow-up conversation, the option to withdraw and additional resources offered (e.g. psychological help).

The concept of 'role fit' refers to simulated patients who are too close to or too far from the temperament, personality or experience of the person they will be portraying. Uncomfortable feelings may be evoked in the simulated patient by the role play for reasons unrelated to the simulation. For example, many people are uncomfortable displaying anger. This is not due to any specific situation, but is difficult for their temperament or personality. The opposite can also be problematic. A key variable in the fit between the role and the simulated patient is their psychological sophistication or ability to understand their own personal make-up. Recruiting the right simulated patient for a nuanced psychological portrayal may require that they have the ability to differentiate between themselves and the role even though there may be similarities. From a study conducted by Woodward, a simulated patient stated: 'The thing is that through it all [role playing] it is touching things in me and bringing things out in me I wouldn't have been aware of before' [8]. The simulated patient needs to understand clearly the fit between them and the role that they are playing in order to avoid uncomfortable reactions both during and following role enactment. Woodward reported that some simulated patients chose to stop playing disturbing roles (incest survivor, alcoholic, schizophrenic or rape victim) that they had played previously because they found themselves feeling unsettled [8].

With a few exceptions, there is little empirically based published work on the recruitment and preparation of confederates for scenarios. Sanko et al. [9] and Nestel et al. [5] offer theory- and experience-based accounts of supporting confederates. Sanko et al. draw from the discipline of acting to provide guidance in refining the practice of simulation by embracing lessons and techniques commonly used in the theatre (performing arts) community, while Nestel et al. highlight the importance of drawing on practices from simulated patient methodology for character development and role portrayal.

During the simulation

Simulated patient work is not therapy, educators are not therapists and we are not suggesting that the details of simulated patients' personal stories even need to be known. However, it is important to support simulated patients in their experience with a role. In a study exploring the effects of emotionally complex roles, simulated patients reported that there were roles that they would never do again because of the similarity between the role and their own life [7]. Personal discomfort with an aspect of a role may inhibit simulated patients from responding in a way that is clinically accurate, appropriate or correctly portrayed. It is therefore important for the quality of the educational session that those portraying the roles can do so to the required level of realism and accuracy. For the same reason, if a simulated patient is struggling with an affect or physical aspect of a role, they need to be supported in their decision to discontinue involvement. It may be that at this time the simulated patient is experiencing something in their own life that prevents them from taking part. However, at a later time they may be fine. This kind of attention to the simulated patient's well-being also has implications for their employment retention. Acknowledging that simulated patient work is not meant to cause harm to those who are portraying roles for educational purposes recognizes the humanity of the SP. In the end, a fully developed character that is different enough in personal and clinical history from the simulated patient may in fact prove to be a mitigating factor in emotional fallout or role adherence. For, although a character and a simulated patient may share many of the same emotional, psychological and physical features, the boundary between the life stories makes it easier for the simulated patient to move back into their real life. For the confederate, simulating one's own role can raise questions of self-doubt in a way similar to the boundary blurring just discussed. It is therefore as important if not more so for people in a confederate role to acknowledge the differences between their performance in the role and in their everyday practice.

Training techniques can be used to help simulated participants take on a role while also clearly separating themselves from the role. However, there are instances in which there is no time or opportunity for a simulated participant to learn a role and practise it over time.

Information about what to do to keep SPs safe and fresh during or after a simulation should be sought, respected and acted on.

After the simulation

De-roling

With respect to shedding or stepping out of a role, sometimes called de-roling, actors are likely to be more familiar with techniques of transition than non-actors. They may be more likely to think of the simulation as an acting job and as a result be able to maintain a clear distinction between themselves and the role they are playing. They are also more likely to have techniques that they use to shed a role, such as the activity of taking off make-up or sometimes putting on make-up to return to the day-to-day world. Some simulated patients have particular clothes that they reserve for different, more emotionally challenging roles. An experienced simulated patient reported to one of the authors that she has an 'abuse' blouse that she never wears unless doing the role. When she takes it off, it is an important indicator of her return to her life. Another simulated patient always calls a family member on her way home from work as a way of checking back in or resuming *her* life. Other such techniques for returning to self are often shared between simulated patients who are doing the same role, such as simple mindful meditation before and after simulations and consciously acknowledging that this work may be difficult. For simulated patients it is important to recognize that psychological and emotional distress is not always felt during or immediately following a simulation, but may take time to filter through and be felt. It is not unusual for simulated patients to report lingering effects even days later. Writing a journal is a good way to decompress, process events and separate the simulation experience from one's own life. It is important for educators engaging simulated patients in difficult emotional simulations to hear about their experiences. Arranging a time to check in several days after a simulation session is helpful.

The physical effects of crying all day, sometimes every ten minutes during an OSCE, or having to revisit an angry or manipulative affect may require physical activity to break the role adherence. One author (NM) reports that following a day of portraying a person with antisocial personality disorder in an OSCE, a simulated patient felt so angry when driving home that he had to pull over and rest before continuing [10]. He reported that he went for a run as soon as he got home and felt much better afterwards. This response was only identified a week later despite the team having 'touched base' with him following the exam.

A simple technique includes having the simulated participant introduce themselves to learners by their real name, explicitly shedding the emotion and behaviours they were portraying in the scenario and adopting their usual persona following an interaction. This gives an immediate opportunity for all to recalibrate to one another's real-life roles and close the door on the prior encounter. Moving the debriefing session to a space different to that in which the simulation occurred is also helpful. Whether simulated participants are involved in the debriefing usually needs to be planned ahead of time. If they are not included, then learners may need to be reminded that simulated participants were playing roles. The amount of information shared with learners about the simulated participants would be negotiated with them, but usually does not involve much information. For example, 'the simulated patients you worked with today are part of the programme here at the university' or 'the confederate in the scenario is a simulation fellow in anaesthesia who has just joined our team. Her portrayal of the operating theatre nurse does not reflect her usual practice'.

Debriefing with learners

SPs are often required to share their experiences with learners during debriefings. SPs are usually asked to step out of role to offer feedback, as already outlined. There are few circumstances where it is helpful to stay in role. The debriefing may be facilitated by educators or SPs or may be learner led. During debriefing, learners' emotions are often aroused, sometimes with disappointment about their performance and with a sense of foreboding about what the debriefing may uncover. SPs may also be experiencing strong emotions about learners' helpful and unhelpful behaviours. An SP must feel psychologically safe to share their experiences with the learners. Offering constructive feedback on unhelpful behaviours is especially challenging. SPs usually require training to support development of the content and language of feedback and debriefing processes. Acknowledging to all those participating in the debriefing that being in the scenario often feels utterly different to being an observer can be a first step to validating statements about the interaction and its effects on the SP. It is also acceptable for SPs to hold different views to educators and to learners and these differences need to be respected. Facilitators have an important role here in making this explicit.

Evaluation of the simulation and debriefing the simulated participants

The term 'evaluation' here refers to the success of the simulation in meeting the needs of the learners. Quality improvement may include discussion with the simulated participants of the usefulness of written materials used in preparation, training for role portrayal, the rating form, debriefing with learners and commentary on the learners' performances. Evaluation may focus on what was easy and what was hard in the scenario, from the simulated participants' perspective. The overall goal is to improve the preparation and implementation of the learning session. Discussing the impact of learners' behaviours on role portrayal is important for potential modification of the role for future sessions. This is also an opportunity to provide simulated participants with feedback on role portrayal and their feedback to learners. Principles of effective feedback need to be modelled during this process to reinforce considerate educational methods.

The format for debriefing the SPs will vary depending on the related simulation activities. For example, in an OSCE, a simulated patient debriefing is likely to be in a large group. However, the quality improvement elements of a debriefing could also be collected in an evaluation form. Confederates are usually fewer in number and as such the format may be one to one or in a small group with other faculty. There is a danger that the emotional work of confederates in simulation activities may be forgotten, for a number of reasons. There may be a small number of confederates, the single person and the task are simply overlooked or perhaps incorrect assumptions are made about their identity and coping strategies. Of equal importance, the confederate may be a healthcare colleague. This is very important to acknowledge, especially if they have been asked to perform in the simulation scenario in a way and to a standard different to their usual professional role.

In the context of simulated patients, the value of debriefing is variable, although further research is required to better understand the consequences for simulated patients of this work. Some simulated patients have reported that they resent having to attend debriefing sessions, while other simulated patients report depending on them. Simulated patients who took part in focus groups following a psychiatry OSCE reported needing to retreat into themselves for a few days and to treat themselves almost as if they had been sick, taking long baths and not engaging too vigorously in social or physical activity. As one SP noted: 'If I don't sufficiently acknowledge that my psyche has visited a very vulnerable place, it will come back to haunt me three or four days later as deep fatigue' [7].

Conclusions

SPs provide a valuable contribution to healthcare professional education. They enable humanity to be foregrounded in healthcare scenarios. However, it is important that simulation educators prioritize the well-being of SPs. In summary, it is good practice to know your SPs and their abilities and for educators to create a working environment in which SPs can communicate their experiences and concerns. There is a need for research into these elements of SP methodology.

Key Term Definitions

Confederate: A well person, often a faculty member or healthcare educator, who portrays a role in a mannequin- or other scenario-based simulation with the intent of keeping the scenario on track and/or keeping learners safe.

Emotional fallout: The unintended consequences of playing an emotionally and psychologically difficult role that remains with the simulated participant beyond the portrayal.

Humanism: A philosophical and ethical stance that places value on an individual as a 'whole person'.

Objective structured clinical examination (OSCE): A form of summative simulation-based assessment that often involves simulated patients.

Simulated participant: A well person who is trained to portray the role of a patient, relative, healthcare professional, first responder, bystander, student or other.

Simulated (standardized) patient: A well person who is trained to portray a patient and who may also be asked to offer feedback on their experience as the patient.

Acknowledgements

We would like to acknowledge and thank the simulated patients and confederates with whom we have worked and who have informed our practices.

References

1 Bearman, M. and Nestel, D. (2015) The future of simulated patient methodology, in *Simulated patient methodology: theory, evidence and practice* (eds D. Nestel and M. Bearman), Wiley-Blackwell, Chichester, pp. 147–50.
2 Barrows, H.S. (1993) An overview of the uses of standardized patients for teaching and evaluating clinical skills. *Acad Med*, **68** (6), 443–53.
3 Smith, C., O'Byrne, C. and Nestel, D. (2015) Simulated patient methodology and assessment, in *Simulated patient methodology: theory, evidence and practice* (eds D. Nestel and M. Bearman), Wiley-Blackwell, Chichester, pp. 85–92.
4 Nestel, D. (2015) Expert's corner: standardized (simulated) patients in health professions education: a proxy for real patients? in *Defining excellence in simulation programs* (eds J. Palaganas, J.C. Maxworthy, C.A. Epps and M.E. Mancini), Wolters Kluwer, Philadelphia, PA, p. 394.
5 Nestel, D., Mobley, B.L., Hunt, E.A. and Eppich, W.J. (2014) Confederates in healthcare simulations: not as simple as it seems. *Clin Simul Nurs.*, **10**, 611–16.
6 Nestel, D., Burn, C.L., Pritchard, S.A. *et al*. (2011) The use of simulated patients in medical education: guide supplement 42.1 – viewpoint. *Med Teach*, **33** (12), 1027–9.
7 McNaughton, N., Tiberius, R. and Hodges, B. (1999) Effects of portraying psychologically and emotionally complex standardized patient roles. *Teach Learn Med*, **11** (3), 135–41.
8 Woodward, C. (1998) Standardized patients: a fixed role therapy experience in normal individuals. *J Constr Psychol.*, **11**, 133–48.
9 Sanko, J.S., Shekhter, I., Kyle, R.R. Jr., *et al*. (2013) Establishing a convention for acting in healthcare simulation: merging art and science. *Simul Healthc*, **8** (4), 215–20.
10 Naughton, N. (2003) *Standardized patients' experiences of long psychiatry exam stations: a case study. Ontario Institute for Studies in Education*, University of Toronto, Toronto.

Further Reading

1 Dudley, F. (2012) *The simulated patient handbook: a comprehensive guide for facilitators and simulated patients*, Radcliffe, London.
2 Nestel, D. and Bearman, M. (eds) (2015) *Simulated patient methodology: theory, evidence and practice*, Wiley-Blackwell, Chichester.
3 Nestel, D., Clark, S., Tabak, D. *et al*. (2010) Defining responsibilities of simulated patients in medical education. *Simul Healthc*, **5** (3), 161–8.
4 Sanko, J., Shekhter, I., Kyle, R.R. Jr., and Birnbach, D.J. (2015) Using embedded simulation persons (aka 'confederates'), in *Defining excellence in simulation programs*, vol. **2015** (eds J. Palaganas, J.C. Maxworthy, C.A. Epps and M.E. Mancini), Wolters Kluwer, Philadelphia, PA, pp. 213–26.
5 Wallace, P. (2006) *Coaching standardized patients for use in assessment of clinical competence*, Springer, New York.

Additional Resources

- www.aspeducators.org This is the website of the USA-based professional association the Association of Standardized Patient Educators.
- www.nhet-sim.edu.au/ The NHET-Sim programme is an online training programme for simulation educators.
- www.spp.utoronto.ca This website offers resources from the University of Toronto Standardized Patient Program.
- http://www.simulatedpatientnetwork.org/ The Simulated Patient Network is a repository of resources for simulated patients and educators.

CHAPTER 10

Virtual environments and virtual patients in healthcare

LeRoy Heinrichs, Parvati Dev & Dick Davies

KEY MESSAGES

- This chapter shows how virtual environments are being and could be developed and deployed in healthcare.
- A virtual environment (VE) is a real time, synchronous, persistent network of people, represented by avatars, facilitated by networked computers.
- VEs prepare students for clinical encounters so that time spent with patients is a safer and more valuable experience.
- When choosing a virtual world, the key criteria to consider are its accessibility, genre, adaptability and privacy.
- Interactive virtual patients are computer-based avatars exhibiting real-time normal or pathological signs and symptoms and often also treatable in real-time.
- Virtual patients offer the opportunity to create and deliver experiences that teach critical thinking, diagnostic reasoning and even communication.
- Barriers to the use of virtual environments in higher education include technology issues; student issues; institutional issues; and personal perceptions.

Overview

This chapter shows how 'virtualization technologies' are being developed and deployed in healthcare. First, it defines virtual environments and virtual patient technologies. Thereafter some examples of their uses in healthcare will be described. Interactive virtual patients are computer-based avatars exhibiting real-time normal or pathological signs and symptoms and often also treatable in real-time. The rationale for the deployment of these emerging technologies will then be addressed, before finally asking where virtual environments and virtual patients might be heading in tomorrow's healthcare environment.

Introduction

The junior doctor walks into the ward with a clinical colleague and asks to be directed to Mrs Fernandez, a recently admitted patient with sepsis. A ward nurse had called her to say that the patient had developed a red rash. The doctor introduces herself and her colleague to the patient and asks Mrs Fernandez how she is today. She checks the patient's medical record and then examines her with her colleague. Mrs Fernandez is uncomfortable, with a deep red rash. At this stage the doctor decides to involve a senior physician, who arrives and after discussion calls the pharmacist down to the ward to discuss the drug regime for the patient. The pharmacist reports that reactions can occur to some of the drugs administered. The senior physician diagnoses 'Red Man' syndrome on the basis of the pharmaceutical information. Treatment was prescribed and on follow-up the patient responded as expected, with the rash diminishing.

Real or virtual? In this case it was *both*, as this was a team interprofessional education (IPE) training exercise run at the Charles R. Drew/UCLA School of Medicine [1]. The student doctor entered the ward in a virtual hospital via her computer as an avatar. She then communicated in real time via her microphone and headset with her numerous clinical colleagues and the 'virtual patient', who were also in the virtual hospital as avatars. The dynamic 'virtual patient' responded as expected during her 'examination', demonstrating visually the signs of 'Red Man' syndrome, which in turn was linked

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

to the drugs administered as recorded in the electronic medical record and diagnosed following discussion with the pharmacist. The scenario reflects a medical error in that the rate of vancomycin administration was too rapid. (There is more on this case in Box 10.1.)

Unsurprisingly, these virtualization technologies are in day-to-day use in the recreational sector by many 'millennials' who are training to become tomorrow's healthcare professionals. This chapter shows how such technologies are being developed and deployed in healthcare. First, it defines virtual environments and virtual patient technologies. Thereafter some examples of their uses in healthcare are explored. The rationale for deployment will then be addressed, before finally asking where virtual environments and virtual patients might be heading in today's and tomorrow's healthcare.

Box 10.1 Team interprofessional education

> Charles Drew University School of Medicine, an affiliate of University of California Los Angeles (UCLA), implemented a virtual environment with interactive virtual patients, the CliniSpace Virtual Sim Center (Permission given by IIL and Drew/UCLA for figure 10.1), to teach team-based interprofessional education. In a study of 60 students, the large majority, 90% or greater, reported ease of use, and 70% reported effective learning among team members about antibiotic overdose, due to the virtual patient avatars in an infection scenario developing a skin rash unique to excessive drugs use. The virtual rash subsided and the skin colour of the avatar returned to normal after the excessive rate of administration was corrected [1].

Virtual environments and virtual patients

Virtual environments or virtual worlds are well-known technologies that were initially developed for recreational use by the computer gaming industry. They are now well-understood, stable technologies with many serious deployments in areas other than gaming, including retail, disaster response, procedure training in oil and gas, and marketing. On the other hand, virtual patients, while developed in the healthcare space, use a mixed range of media from patient actors, through paper exercises to computer-generated simulated patients.

What are virtual environments?

Also known as virtual worlds (VW), a virtual environment (VE) can be defined as a 'synchronous, persistent network of people, represented by avatars, facilitated by networked computers' [2]. Furthermore, 'a virtual

Figure 10.1 Learners in CliniSpace cooperating in treating a patient. Source: Copyright IIL & Drew/UCLA.

world operates in real time, exists whether the participants are in the world or not, is a social space in which people are digitally represented and so can interact, and is underpinned by networked computers that manage the world and its interactions' [3].

Many variations exist, but virtual worlds or environments are computer simulations offering some or all of the following [4]:

- Three-dimensional (3D) spaces
- People represented by avatars
- Objects in the world are persistent and may be interacted with, e.g. moveable chairs, vehicles
- Communication is usually in real time: voice, text and gesture

Immersive clinical environments (virtual clinical worlds)

Where virtual environments are used specifically for clinical purposes, they could be termed immersive clinical environments or virtual clinical worlds. Heinrichs [3, 5] proposed that in clinical practice virtual worlds are being deployed because they offer the following beneficial attributes:

- Presence
- Immersion, i.e. engagement
- Team-based activities
- Real workplace settings
- Safe 'play spaces'
- Relatively low cost (compared to custom healthcare game development)

We now explore virtual patients, before moving on to examine how virtual patients can work within virtual worlds.

Virtual patients

'Virtual patients' (VP) is a catch-all term for a range of distinct approaches: 'Such approaches include case presentations, interactive patient scenarios, virtual patient games, human standardised patients, high fidelity software simulations, high fidelity manikins and virtual conversational agents' [6].

Kononowicz et al. [7] have adapted and refined Talbot's earlier virtual patient framework [6] to provide a more complete picture of this confusing area. He classifies VPs by competency and by technology (Table 10.1).

The focus of this chapter is on the classes 'VP games' and 'High-fidelity software simulation'. These virtual patients are entirely computer based and should not be confused with simulated (standardized) patients; that is, humans playing the role of patients (see Chapter 7), nor with high-fidelity computer simulators connected to realistic robot mannequins [8].

Interactive virtual patients in immersive clinical environments

From Talbot [6] we recognize the components of interactive virtual patients (IVPs) as:

- A 3D clinical environment
- A human physiology engine
- 3D avatars
- Data displays
- Medical procedure capability
- Reporting or assessment capabilities

However, most of the few virtual patient models available for deployment in virtual environments are execute only; that is, they run from start to finish and cannot be interrupted or even in most cases parameterized simply at the start time. Two types of virtual patient designs can be distinguished: a *'narrative' or passive structure* and a *'problem-solving' or active structure*. In the narrative/passive cases, the simulation represents a single medical state, often in considerable detail, and with relevant graphics, audio and visual media displaying the patient's medical condition. Fewer simulations support the evolution of the 'problem-solving'/active patient state, both with and without medical intervention. In the problem-solving/active model, one specifies both gradual changes in physiological variables as well as a number of discrete important 'states', with the patient moving from state to state based on the virtual patient's condition and on the actions taken by the learner. 'Passive' patients, however, are often experienced as 'pale imitations of real world patients' [9].

The deployment of virtual environments and interactive virtual patients in healthcare is addressed in later sections.

Virtual environments and interactive virtual patients: some examples in healthcare

Healthcare is much wider than the core clinical professions. The allied healthcare professions make up 60% of the total health workforce of many millions [10] and, according to one source, 'one in every 11

Table 10.1 Virtual patient (VP) framework.

Class label	Predominant competency	Predominant technology	Short description
Case presentation	Knowledge	Multimedia systems	Interactive multimedia presentation of a patient case to teach primarily basic medical knowledge.
Interactive patient scenario	Clinical reasoning	Multimedia systems	Interactive multimedia presentation of a patient case to teach mainly clinical reasoning skills (e.g. VPs created for the eViP project).
VP game	Clinical reasoning or team training	Virtual worlds	Virtual world to simulate high-risk scenarios and team training situations (e.g. Second Life VPs).
High-fidelity software simulation	Procedural or basic clinical skills	Dynamic simulations or mixed reality	Real-time simulation of human physiology to teach mainly procedures or skills such as surgical simulations. Non-standard devices (e.g. haptic technology) can be included.
Human standardized patient	Patient communication skills	Multimedia systems	Video-recorded actors who role-play a patient to train in patient communication skills.
High-fidelity mannequin	Procedural and basic clinical skills, team training	Mannequins or part task trainers	Mannequins with realistic anatomy to train in complex procedures such as endoscopy.
Virtual standardized patient	Patient communication skills	Conversational characters	A virtual representation of a human being using artificial intelligence technologies and natural language processing to train in communication skills.

Source: Kononowicz 2015 [7].

US residents [is] employed in the health care business' [11]. An expanding group of examples of uses of virtual environments in healthcare covers medical librarianship to emergency care via pharmacy and clinical team interprofessional education [3] to obesity prevention [12]. Ghanbarzadeh et al. [13] classified the use of virtual environments in healthcare as follows: 'academic education, professional education, treatment, evaluation, lifestyle, and modeling' (see Figure 10.2).

The review by Ghanbarzadeh et al. [13] of some 62 papers showed that the most important uses of VEs were pedagogical and clinical (Figure 10.2). Given this, the discussion of virtual environments in this chapter will focus only on the use of virtual environments in clinical situations, as this area is relatively widely documented compared to the other healthcare areas.

On the other hand, virtual patients are usually deployed specifically for clinical purposes. As discussed earlier, a range of approaches are employed, but only computer-based interactive virtual patients will be covered here.

Virtual environments in healthcare

Stokowski [14] offers an accessible introduction to the use of virtual worlds in nursing education, providing examples of the use of a number of VEs to teach such topics as the treatment of a haemorrhaging pregnant woman after a motor accident, the assessment of patients for pressure ulcers, pre-operative skin preparation, chronic disease management, disaster response and the training of trauma teams. VEs 'prepare students for clinical encounters so that time spent with patients is a safer and more valuable experience … and can also provide arenas for the inter-professional education that is critically need to improve communication and teamwork in the health professions' [14].

Foronda et al. [15] offer an overview of the early uses of virtual simulation in medicine, noting that the US government initiated and funded the early work in VE simulations for medicine. As a result, the bulk of early funded experimentation was in military or disaster management situations. They further describe studies in the use of VEs in nursing in a child health course, safety issues with medication and interprofessional communication, and decision-making skills in clinical practice. Other examples include the 'virtual birth centre' [16], postgraduate distance learning in bioethics for health professionals [17], the intensive care unit (ICU) first-hour handover [18] and mass-casualty

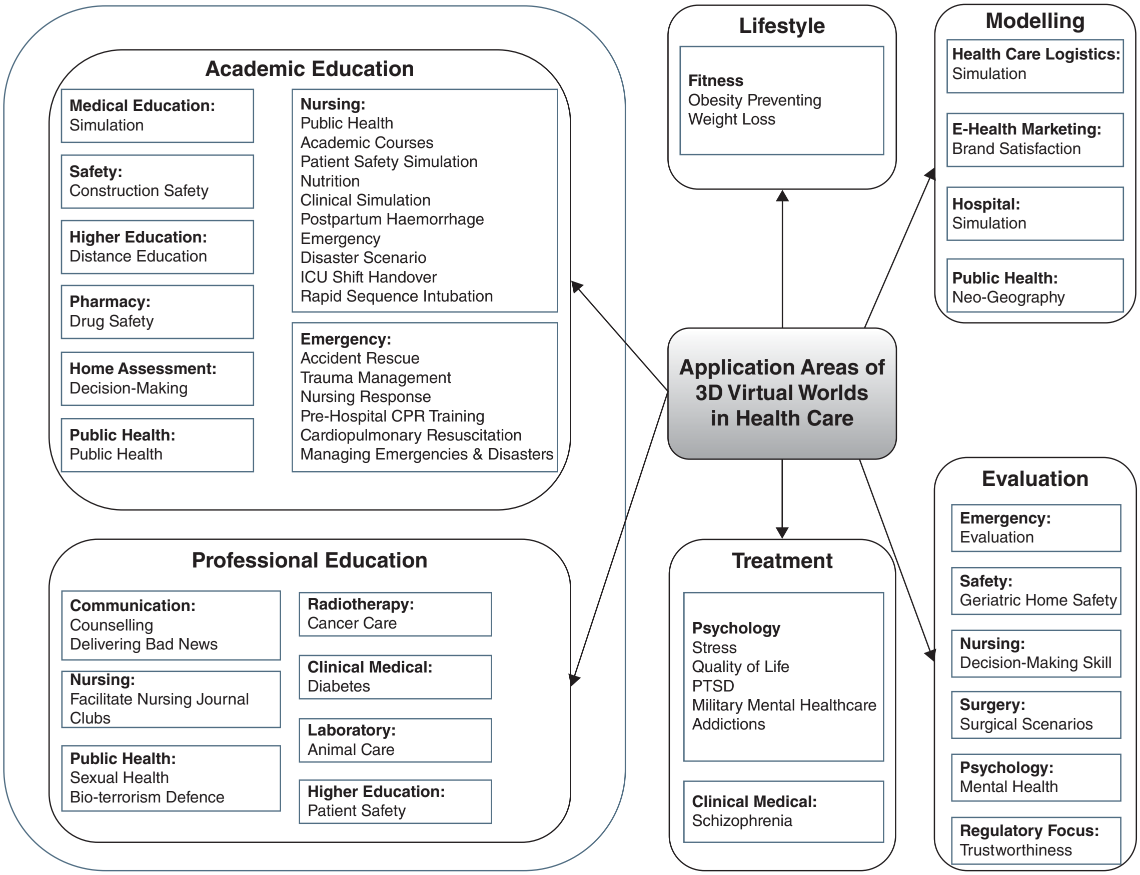

Figure 10.2 The use of virtual environments in healthcare. Source: Ghanbarzadeh 2014 [13].

incidents with CBRNE (chemical, biological, radioactive, nuclear or explosives) at Stanford University Hospital [5].

Virtual environments are designed to be virtual spaces for cooperation. In such real-time spaces, virtual experiences are often perceived as authentic, since the participants are visually and socially immersed. For healthcare it is therefore possible to posit that VEs are places for authentic and relevant experiences and are particularly suitable where the cooperative elements of healthcare need to be developed. To underpin this point, technical and cognitive medical skills are known to be only a part of the delivery of clinical practice. It has been shown that cooperative non-technical skills play an equally important role [19].

Kim et al. [20], while researching the use of virtual worlds in education, 'realized that in many of the studies, the authors did not explain why they used a certain virtual world platform for the specific contexts'. We assert that the early implementation of new technologies in organizations by enthusiastic 'intrepreneurs' is simply using whatever is accessible at zero or little cost – hence the widespread use of Second Life in education. A secondary incentive is to gain early coding experience among learners. Dickey, quoted in Robbins [21], comments: 'While it is theoretically possible for a VW platform to support all types of educational initiatives, designers typically make choices that lead technologies to be more or less suited for different teaching and learning purposes.'

Robbins [21] offers a calibrated approach, recognizing both that technologies evolve rapidly and that they are suited to certain niches. To address this, a taxonomy of virtual worlds has been developed based on generalized attributes, as well as a taxonomy of pedagogies based on the learner/instructor dichotomy. Robbins then proposes matching pedagogy types to virtual world types. Having done this, the approach is applied to the field of information systems, before a set of guidelines is offered for the implementation of virtual worlds in other domains. The approach has been further developed and refined for the clinical context [22].

Starting from the practical perspective of introducing different virtual worlds into different courses, Delwiche [23] points out that 'All virtual environments are not created equal'. He advocates that when choosing a virtual world, the key criteria to consider are accessibility, genre and extensibility:

- *Accessibility:* Is the world easy to use and understand? If not, is the additional time investment in learning to use the world appropriate to the intended use and outcomes?
- *Genre:* Is the world theme appropriate? Some virtual worlds are fantastical, game-like environments. These are therefore unlikely to be suitable for professional healthcare education. Other worlds are dull virtual office suites for corporate meetings. Again, these may be unsuitable for certain professional uses.
- *Extensibility:* Can the world be developed to design and add new scenarios? If yes, who could add those new scenarios? In other words, what level of skill and access are needed? Can the student or instructor modify the world or does it require a sophisticated C++ programmer?

In the context of professional environments in healthcare, a further factor should be added:

- *Security:* Can the virtual world be made private? Notice that this is an option, but the fact that non-public professional conversations and activities may be observed in a public virtual world is not acceptable to many healthcare organizations – and in fact to most organizations. Intruders (aka 'griefers') are never welcome!

Interactive virtual patients

Poulton [24] notes that 'Virtual Patients cannot replace real patients, but they can be of great assistance in areas where there are no other suitable learning tools, such as clinical problem solving … and arguably therefore should be an essential element of every undergraduate course'.

Virtual patients are sets of patient-linked medical data. This data can be organized into various forms:

- Linear, where the patient data is presented in a fixed, pre-determined sequence (e.g. CASUS) [25].
- Branching, where the data is structured into various paths with the student decisions on treatment affecting the patient's outcomes (e.g. Open Labyrinth) [26].
- Template-based systems, which allow the student to choose from ranges of possible data – interviews, lab data, physical examination – to reach a decision (e.g. CAMPUS) [27].
- Knowledge-based virtual patient applications, which are created dynamically from an algorithmic pathophysiological model (e.g. CliniSpace Dynapatients) [28].

Virtual patients now offer the opportunity to create and deliver experiences that teach critical thinking, diagnostic reasoning and even communication [29, 30] (see Figure 10.3).

Box 10.2 VPs in Nursing and Paramedicine

VPs were introduced as an assessment tool in three different nursing courses at two universities, comprising 77 students in total. Students' overall acceptance of this assessment tool, including its applicability to the practice of nursing and the potential of VP-based assessment as a learning experience, were investigated using questionnaires. Course directors used the Web-SP system to assess students' interactions with VPs and their answers regarding diagnoses, caring procedures and their justifications. Students found the VP cases to be realistic and engaging, and indicated a high level of acceptance for this assessment method. In addition, the students indicated that VPs were good for practising their clinical skills, although some would prefer the VP system to be less 'medical' and asked for more focus on nursing. Although most students supplied correct diagnoses and made adequate clinical decisions, there was a wide range in their ability to explain their clinical reasoning processes [32].

In a different context with paramedicine students and using the Second Life VE with the MedBiquitous VP international standard, Conradi et al. [33] reported that students believed that VEs provided a more realistic learning experience than problem-based classroom learning.

Figure 10.3 Example of a virtual patient in a virtual clinical environment. Source: SimTabs [31].

Box 10.3 Comparing Mannequin-Based Simulation with Virtual Patient Simulation

A randomized controlled study with 57 nursing students was carried out in Singapore to compare mannequin-based simulation with virtual patient simulation prior to the nursing students' encounters with deteriorating ward patients. While the study did not demonstrate the superiority of virtual patient over mannequin-based simulation, the former was shown to be equally effective. However, when the resource implications of mannequin-based simulation – volumes of students, faculty time, scheduling – were compared with virtual patient simulation, then 'the flexibility, practicality, and scalability of the virtual patient simulation … appears to provide a more promising learning strategy over time than the mannequin-based simulation for refreshing clinical performance' [34].

Cook et al. [29] posed an important set of questions regarding the use of virtual patients: what is their role; how should they be designed and presented; how should VPs be integrated with other educational activities; how can they be used in assessment; and who will develop and maintain VPs?

The integration of virtual patients into realistic healthcare virtual environments is novel and, while it is now being implemented in day-to-day clinical educational situations, it is still a pioneering development.

Virtual environments and interactive virtual patients: rationale and issues

The implementation of new approaches in healthcare is never easy. It can be argued that the cautious approach is, in principle, the correct approach, as the patient is the end point of any new implementation. The precautionary principle requires that the introduction of innovative approaches should be evidence based. This section looks at the range of issues surrounding the introduction and implementation of virtual environments and virtual patients. At first sight these may appear daunting but, as these technologies become more 'user friendly', so enabling their rapid deployment in organizations and at a falling cost, they are beginning to move into the mainstream.

So why should healthcare organizations implement VEs and IVPs? There are push and pull factors, some internal and some external.

Push factors

External push factors include the falling cost of technologies and the increasing sophistication and size of the virtual environment and virtual patient development community, leading to lower development costs [3]. The arrival of COTS (commercial off the shelf) platforms for VEs and IVPs means that custom development is less needed, which further strengthens the economic case for their deployment. It also argues that the substantial further development of existing physical simulation centres will be constrained by the cost of mannequins, professional staff and physical space [9]. Specifically:

> The greatest advantage of virtual world systems is that, since they are not physical, there is very little cost, beyond the software license, to scale up to a large number of learners. They do not require additional building space and, since they are not physical electro-mechanical objects as manikins are, they do not require maintenance by skilled technical personnel. A second advantage is that, since software can be updated with relative ease, changes in healthcare procedures or policy are easily introduced into the software. [30]

A further push factor is the increasing useability of VE and IVP technologies by medical professionals. An important driver is the arrival of platforms such as the CliniSpace Virtual Sim Center, which no longer require the constant services of IT professionals as they contain their own authoring tools for VE set-up and VP development.

Pull factors

From within medical educational institutions there are in turn a number of pull factors. A key internal pull factor is the face-time now lost due to the rise of academic medicine, where 'research has outstripped teaching in importance' [35]. Dev adds:

> At the same time, healthcare has become increasingly commercialized, with in-hospital teachers being forced to prioritize clinical productivity over clinical teaching. As a consequence, medical, nursing, and other healthcare students experience an ever-diminishing access to actual hands-on clinical practice, and they graduate without the confidence or practical knowledge that would allow them to be independent practicing professionals. [30]

Simulation is now offered as a key part of the solution.

For professional medical educators, the evidence base for the implementation of VEs and IVPs is now emerging. Cook et al. [29] 'found that virtual patients, in comparison with no intervention, are consistently associated with higher learning outcomes'; and Hayden et al. [36] presented the premise that 'with high-fidelity simulation, educators can replicate many patient situations, and students can develop and practice their nursing skills (cognitive, motor, and critical thinking) in an environment that does not endanger patients'. It has been shown that, in 'students who had 50% of their traditional clinical hours replaced by simulation', 'at the end of the nursing program, there were no statistically significant differences in clinical competency as assessed by clinical preceptors and instructors' [30]. Evidence such as this is an important factor in changing both professional and institutional attitudes. Finally, today's medical and nursing students are a part of the so-called millennial generation and, as digital natives, in general adapt readily to online environments.

Issues

The barriers to the use of virtual environments in higher education were found in a recent study [37] to be clustered into four groups: technology issues; student issues; institutional issues; and personal perceptions.

A more focused and healthcare-relevant study was recently carried out into the implementation of VEs with IVPs in team interprofessional education at the Charles R. Drew/UCLA School of Medicine [22]. The following relevant questions and associated short answers were offered:

- *Why choose virtual worlds over other technologies for learning?* Realistic clinical context; resourcing advantages; evidence base.
- *What expertise do you need to develop and deploy virtual worlds?* Design, development and deployment expertise at a number of levels: project management, technology – virtual patient and virtual world – development and deployment; authoring of IVPs; simulation management; team lesson development and delivery.
- *What issues are there in running a virtual world scenario?* Technology access; coordination logistics including

faculty availability, patient actor availability, assessor availability; assessment.

- *How do you assess and validate activity in virtual worlds?* Assessment systems have to be in place: debriefing; surveys; evaluation; action analysis; video analysis. However:

> Assessment methods used for manikin-based simulation training and virtual world training studies were developed initially to assess the individual's performance. They have now been extended to assess team performance. As multiple simultaneous teams interact in the virtual world, observer-based rating methods need to be augmented with other objective, automated measurement tools. Training in these more complex simulation environments requires new assessment tools to measure individual and team processes as well as patient outcome variables. [38]

Virtual environments and interactive virtual patientss: futures in healthcare

VEs and IVPs have a developing future in healthcare simulation. The rationale for implementation has been demonstrated and issues around implementation identified. This final section examines and summarizes some of the broader issues around implementation. They are classed as technological, professional and educational, economic and future developments.

Technology issues

It has been noted [39] that differentiation is a classic feature of the development of new technologies and that it is to be expected that specialized platforms will emerge in virtual environments to service the healthcare domain. This is developed in a discussion about the 'third wave' or generation of technologies that will 'be user driven and optimised to facilitate specific tasks' [40]. These platforms can be termed niched virtual environments or 'bespoke virtual worlds'. This does not imply that they will be expensive custom developments; rather, they could well be COTS platforms that can be extensively customized by the end user. A current example of this third-generation VE with authorable IVPs is the CliniSpace Virtual Sim Center [41].

A further technology driver is the widespread ownership by end users of powerful mobile devices such as smartphones and tablets, with the associated expectation that they should be able to use their devices to access both personal and professional services on demand. These BYOD (bring your own device) expectations are challenging for organizations and for the developers of online services.

In the meantime, emergent wearable technologies such as virtual reality (VR), with devices such as Facebook's Oculus Rift [42] providing deeply immersive experiences, and augmented reality (AR), with devices such as Microsoft's HoloLens [43] providing real-time overlays through eyeglasses over the real world, will offer opportunities and challenges for VE and IVP technologies in healthcare. These visualization technologies are tailor made for virtual environments.

Professional and educational issues

The positive evidence base for the educational efficacy of VEs and IVPs is slowly emerging. The barriers to deployment of VEs and IVPs, while weakening, do remain, however.

Economic issues

The resource context for the implementation of VEs and IVPs is strong. Linked to the decreasing 'face-time' provided for clinical training, the high costs and constraints of high-fidelity mannequin-based simulation will become evident. With falling costs, increasing accessibility and modifiability, the proposition for VEs and IVPs will strengthen further.

Future development issues

It has already been noted that virtual environments have other possibilities beyond clinical education. Some of these possibilities are clinical environment design, new procedure development and clinical action research [39]. The idea of the virtual hospital with a mix of cases available in real time will offer the chance to 'work with the range and complexity of the systems that support actual clinical care … information systems … safety policies' [30]. Finally, and presciently, 'as immersive spaces capable of exhibiting "real work place" characteristics, they will increasingly be developed as a "safe play space" for the modelling and testing of complex team-based health related activities' [39].

Key Term Definitions

Virtual environments: synchronous, persistent networks of people and environments, represented by avatars, facilitated by networked computers.

Virtual patients: case presentations, interactive patient scenarios, virtual patient games, human standardized patients, high-fidelity software simulations, high-fidelity mannequins and virtual conversational agents

References

1 Arciaga, P., Windokun, A., Calmes, D. *et al*. (2013) Board 501-Technology Innovations Abstract. Initial experience with the use of virtual simulation to teach students interprofessional education: the Charles R. Drew University (CDU) experience (submission# 863). *Simul Healthc*, **8** (6), 608.

2 Bell, M. (2008) Toward a definition of virtual worlds. *J Virtual Worlds Res*, **1** (1). doi: 10.4101/jvwr.v1i1.283

3 Heinrichs, L., Fellander-Tsai, L. and Davies, D. (2013) Clinical virtual worlds: the wider implications for professionals, in *Serious games and virtual worlds in education, professional development, and healthcare* (eds K. Bredl and W. Bösche), IGI Global, Hershey, PA.

4 Wikipedia. Virtual world [cited 1 September 2016]. Available at: https://en.wikipedia.org/wiki/Virtual_world

5 Heinrichs, W.L., Harter, P., Youngblood, P. *et al*. (2010) Training healthcare personnel for mass casualty incidents in a virtual emergency department. *VED II. Prehosp Disaster Med.*, **25** (5), 422–34.

6 Talbot, T.S. (2012) Sorting out the virtual patient: how to exploit artificial intelligence, game technology and sound educational practices to create engaging role-playing simulations. *IJGCMS*, **4** (3), 1–19.

7 Kononowicz, A.A., Zary, N., Edelbring, S. *et al*. (2015) Virtual patients – what are we talking about? A framework to classify the meanings of the term in healthcare education. *BMC Med Educ*, **15** (1), 11.

8 Kononowicz, A.A. and Hege, I. (2010) Virtual patients as a practical realisation of the e-learning idea in medicine, in *E-learning experiences and future* (ed. S. Soomro), InTech, Rijeka. doi: 10.5772/8803

9 Heinrichs, W.L., Dev, P. and Davies, D. (2014) The virtual sim centre: extending and augmenting in-house simulation centres. *BMJ Simul Technol Enhanced Learn*, **1** (Suppl 1), A12.

10 Wikipedia. Allied health professions [cited 1 September 2016]. Available at: https://en.wikipedia.org/wiki/Allied_health_professions

11 The Medica. Medical industry overview [cited 1 September 2016]. Available at: http://www.themedica.com/industry-overview.html

12 Siddiqi, S., Mama, S.K. and Lee, R.E. (2010) Developing an obesity prevention intervention in virtual worlds: the international health challenge in Second Life. *J Virtual Worlds Res*, **3** (3). doi: 10.4101/jvwr.v3i3.809

13 Ghanbarzadeh, R., Ghapanchi, A.H., Blumenstein, M. and Talaei-Khoei, A. (2014) A decade of research on the use of three-dimensional virtual worlds in health care: a systematic literature review. *J Med Internet Res*, **16** (2), e47. doi: 10.2196/jmir.3097

14 Stokowski LA. A digital revolution: games, simulations, and virtual worlds in nursing education. Medscape. 2013;15 March [cited January 2014]. Available at: http://www.medscape.com/viewarticle/780819.

15 Foronda, C., Godsall, L. and Trybulski, J. (2013) Virtual clinical simulation: the state of the science. *Clin Simul Nurs*, **9** (8), e279–e286.

16 Stewart, S. and Davis, D. (2012) On the MUVE or in decline: reflecting on the sustainability of the Virtual Birth Centre developed in Second Life. *Aust J Educ Technol*, **28** (3), 480–503.

17 Hack CJ. The benefits and barriers of using virtual worlds to engage healthcare professionals on distance learning programmes. *Interact Learn Environ*. Online before print. 2015;1–14. doi: 10.1080/10494820.2015.1057743

18 Brown, R., Rasmussen, R., Baldwin, I. and Wyeth, P. (2012) Design and implementation of a virtual world training simulation of ICU first hour handover processes. *Aust Crit Care*, **25** (3), 178–87. doi: 10.1016/j.aucc.2012.02.005

19 Flin, R. and Maran, N. (2004) Identifying and training non-technical skills for teams in acute medicine. *Qual Saf Health Care*, **13** (suppl 1), i80–i88.

20 Kim, S.H., Lee, J.L. and Thomas, M.K. (2012) Between purpose and method: a review of educational research on 3D virtual worlds. *J Virtual Worlds Res*, **5** (1).

21 Robbins, R.W. (2009) Selecting a virtual world platform for learning. *J Inform Syst Educ*, **20** (2), 199–210.

22 Davies, D., Arciaga, P., Dev, P. and Heinrichs, W.L. (2015) Interactive virtual patients in immersive clinical environments: the potential for learning, in *Simulations in medicine* (ed. I. Roterman-Konieczna), Walter De Gruyter, Berlin, pp. 138–78.

23 Delwiche, A. (2006) Massively multiplayer online games (MMOs) in the new media classroom. *J Educ Technol Soc*, **9** (3), 160–72.

24 Poulton, T. (2011) Virtual patients: a year of change. *Med Teach*, **33** (11), 933–7.

25 Fischer, M.R. (2000) CASUS: An authoring and learning tool supporting diagnostic reasoning, in *Use of computers in medical education (part II). Zeitschrift für Hochschuldidaktik*, vol. **1** (ed. C. Daetwyler), pp. 87–98.

26 SourceForge. Open Labyrinth [cited 30 July 2015]. Available at: http://sourceforge.net/projects/openlabyrinth

27 Garde, S., Heid, J., Haag, M. *et al*. (2007) Can design principles of traditional learning theories be fulfilled by computer-based training systems in medicine: the example of CAMPUS. *Int J Med Inform*, **76** (2–3), 124–9.

28 Heinrichs, L., Dev, P. and Davies, D. (2015) (2015) Authoring, deploying, and managing dynamic virtual patients in virtual clinical environments. *BAMS*, **11** (2), 79–88.

29 Cook, D.A., Erwin, P.J. and Triola, M.M. (2010) Computerized virtual patients in health professions education: a systematic review and meta-analysis. *Acad Med*, **85** (10), 1589–602.

30 Dev, P. (2015) Simulation: a view into the future of education, in *Healthcare information management systems: cases, strategies, and solutions*, 4th edn (eds M.J. Ball, C.A. Weaver, G.R. Kim and J.M. Kiel), Springer, Berlin, pp. 317–29.

31 Simtabs. [cited 1 September 2016]. Available at: http://simtabs.com/

32 Forsberg, E., Georg, C., Ziegert, K. and Fors, U. (2011) Virtual patients for assessment of clinical reasoning in nursing: a pilot study. *Nurs Educ Today*, **31** (8), 757–62.

33 Conradi, E., Kavia, S., Burden, D. *et al*. (2009) Virtual patients in a virtual world: training paramedic students for practice. *Med Teach*, **31** (8), 713–20.

34 Liaw, S.Y., Chan, S.W.C., Chen, F.G. *et al*. (2014) Comparison of virtual patient simulation with mannequin-based simulation for improving clinical performances in assessing and managing clinical deterioration: randomized controlled trial. *J Med Internet Res*, **16** (9).

35 Cooke, M., Irby, D.M., Sullivan, W. and Ludmerer, K.M. (2006) American medical education 100 years after the Flexner report. *N Engl J Med*, **355** (13), 1339–44.

36 Hayden, J.K., Smiley, R.A., Alexander, M. *et al*. (2014) The NCSBN National Simulation Study: a longitudinal, randomized, controlled study replacing clinical hours with simulation in prelicensure nursing education. *J Nurs Reg*, **5** (2 Suppl), S3–S64.

37 Gregory, S., Scutter, S., Jacka, L. *et al*. (2015) Barriers and enablers to the use of virtual worlds in higher education: an exploration of educator perceptions, attitudes and experiences. *J Educ Technol Soc*, **18** (1), 3–12.

38 Heinrichs, W.L. (2008) Simulation for team training and assessment: case studies of online training with virtual worlds. *World J Surg.*, **2**, 161–70.

39 Heinrichs, W.L., Davies, D. and Davies, J. (2012) Virtual worlds in healthcare: applications and implications, in *Serious games for healthcare: applications and implications* (eds S. Arnab, I. Dunwell and K. Debattista), IGI Global, Hershey, PA, pp. 1–22.

40 McDonald, M., Gregory, S., Farley, H. *et al*. (2014) Coming of the third wave: a move toward best practice, user defined tools and mainstream integration for virtual worlds in education, in *Proceedings of the 31st Australasian Society for Computers in Learning in Tertiary Education Conference (ASCILITE 2014). (pp. 161-170)*, Macquarie University, Sydney, pp. 161–70.

41 CliniSpace. Virtual Sim Center [cited 1 September 2016]. Available at: http://virtualsimcenter.clinispace.com/

42 Wikipedia. Oculus Rift [cited 1 September 2016]. Available at: https://en.wikipedia.org/wiki/Oculus_Rift

43 Wikipedia. Windows Holographic [cited 1 September 2016]. Available at: https://en.wikipedia.org/wiki/Windows_Holographic#Microsoft_HoloLens

CHAPTER 12

Taking simulation beyond education in healthcare

Marcus Watson

KEY MESSAGES

- Healthcare simulation has applications in other industries.
- Healthcare simulation can be applied in healthcare outside of the clinical context.
- Simulation healthcare system can be used in healthcare to design and evaluate the system.
- Simulation has therapeutic uses for patients.

Overview

This chapter explores the broader roles of healthcare simulation. It discusses the use of simulation in other industries that require first aid and emergency response skills. It expands on the application of simulation in healthcare to include recruitment, career development and patient advocacy. The chapter also looks into the emerging use of simulation as a therapeutic intervention.

Healthcare education using simulation for non-healthcare industries

As the capacity for healthcare simulation grows with the increasing number of facilities, advances in evidence and technologies, so too do those areas in which simulation can be applied. This chapter aims to be thought provoking as to the future uses for simulation in those settings.

The most elementary extension of healthcare simulation is its application to education and training outside of traditional healthcare contexts. Many industries require some level of first aid training; however, some industries require more advanced medical emergency response skills. Industries including defence, mining, manufacturing, aviation and maritime often outsource training and this provides opportunities for simulation facilities. In many cases the industries have accredited training where simulation could be integrated to meet some or all of the requirements of a programme. In other cases specialized training is sought to meet an emerging need. For example, the outbreak of Ebola had a range of industries scrambling for training on the use of personal protective equipment. Another opportunity for various industries is to use medical emergency response training as a team-building exercise. Equally there are opportunities to work with and inform other industries in skills such as simulation facilitation and scenario design.

Many healthcare simulation facilities experience fluctuations in demand for their services from hospitals and tertiary education institutes. With appropriate scheduling, the training of non-healthcare industries has the potential to bring in significant funding that can then be applied to the healthcare simulation facilities' core business. Such training also provides opportunities to get external assessment of a simulation process, including training, assessment and management. It is also possible for the training of people from other industries to increase the opportunity to conduct research on the efficacy of simulation, since many people may be

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

novices with no prior experience that could influence learning outcomes.

Knowledge and skills development beyond the clinical context: life skills

Simulation in healthcare has a focus on clinical skills for individuals and teams. In some cases simulation facilities have been used to expand beyond clinical skills to help people choose careers and develop non-clinical skills required in the effective running of hospitals and health services. Gaba describes simulation being used from 'cradle to grave', including with school children and members of the lay public, to explain healthcare issues and practices, educate people in basic sciences and engage the interest of students in clinical careers [1].

Using simulation to recruit future healthcare professionals

It is predicted, with the world's population ageing, that healthcare and social assistance are going to be the largest areas of employment growth [2]. Choosing a career in the modern world is difficult for young people, given that many jobs of the future have not yet been created. Furthermore, subject choice in mid-secondary schooling may have an impact on tertiary entry opportunities, especially in healthcare. In many industries, work experience can provide school students with some insight into what a career might offer. Traditional work experience in healthcare is exceptionally limited, as it would be inappropriate for children to undertake the activities conducted by doctors, nurses or other healthcare professionals. Well-designed simulations can act as an alternative to work experience, where young students can get hands-on experience that would normally only occur some time into a professional career. They also provide the ability for students to experience several professions in a short amount of time.

Using simulation to advocate healthcare

Simulation can provide powerful narratives (Chapter 8) and compelling experiences (Chapter 4) that can be used to motivate people to change their behaviour. Simulation has been used in many campaigns to address the causes of trauma, such as drink driving; however, more recently simulation has been used to address behaviours with long-term consequences, such as the APRIL® Face Aging Software, which simulates the effect of smoking on ageing [3]. Alternatively, using make-up 'moulage' showing the impact of smoking on age has also been employed [4]. Simulation also has the ability to help carers and clinicians experience illness from the patient's perspective. The Virtual Dementia Experience™ has won awards for the use of game technology to deliver experiential learning [5]. As virtual and augmented reality technologies advance over the next five to ten years, the breadth of applications for health advocacy is likely to expand rapidly.

Using simulation for leadership development

In team-based clinical training, the leadership role is often a core component of scenarios and debriefing. Programs such as Crisis Resource Management focus on leadership, role clarity and good teamwork; however, broader leadership skills are likely to be required to undertake other roles in healthcare successfully. For example, the skills required to lead a sustainable department over years will go beyond those faced in most traditional clinical scenarios. Again, the use of persuasive experiences (Chapter 4) and strong narratives (Chapter 8) can create financial, human resources and ethical scenarios to develop future healthcare leaders.

Applying simulation to design and evaluation in healthcare

Healthcare is getting more complex, with the average lag in translational research estimated at 17 years [6]. The general consensus is that we need to get new technologies and therapies into healthcare quicker than we have historically. Simulation has the potential to play a role between bench top and bedside, in analysing both what works and also how best to implement changes in practice. Further simulations can be used to understand and improve the way we deliver care and even how we design facilities and processes of care.

Using simulation as a diagnostic tool (immersive and modelling)

Simulation can be used to examine existing processes and technologies to identify better ways to deliver care. Simulation has already been used to evaluate new technologies prior to clinical trials. These vary from new ways of representing information for graphical cardiovascular display [6, 7] through to new devices for displaying information [8]. Equally, simulation has been used to understand and improve the delivery of clinical processes. Employing discrete event simulation as a prototype, the simulation showed that a minor rotation among the nurses could reduce the mean number of visitors that had to be referred to alternative flows within the hospital from 87 to 37 on a daily basis, well within the work capacity of the staff [9]. Another study that placed simulated patients in a real clinical setting reduced the mean time for chest pain (STEMI) patients to arrive at the cardiovascular lab for treatment by 55% [10]. Both modelling simulation and immersive simulation have proven effective for improving existing processes of care. More examples are discussed in Chapter 5.

Using simulation as a predictive tool

Both computer-based models and immersive simulations also have a role to play as predictive tools for healthcare. One area that is expanding is the use of computer simulations to model pharmacology for decision support systems in order to guide clinical decision making [11]. Such decision support systems are likely to change the way clinicians practise and therefore to have an impact on the technologies and processes used in simulation. Chapter 5 provides a more detailed discussion of where predictive simulation can be used to understand how new technologies might change the way clinicians need to practise.

Simulation as therapy

The ability to design simulations that engage through narrative, meaning and entertainment means that simulation may work where traditional approaches fail. Simulations using virtual environments are now demonstrating effectiveness for cognitive and motor skill rehabilitation. Areas such as fear reduction [12], therapy for combat-related post-traumatic stress disorder [13], pain reduction during wound care and physical therapy with burn patients [14] have demonstrated the value of virtual reality simulation for patient care. It has also been argued that video games can be used to improve adherence to physiotherapy programmes [15]. Simulation as a therapy may not work for all patients, however; for example, some patients might find the technology threatening and therefore fail to engage with the simulation.

As the virtual environments improve, so do the interfaces, including motion sensing input devices (e.g. Kinect) and voice recognition, which will expand the types of solutions that can be created. With the bourgeoning accessibility to virtual reality and the introduction of augmented reality, it is likely that simulation will become one of many tools clinicians have at their disposal to meet patient needs. It is tempting to think (as it is with all forms of simulation) that higher levels of realism will provide better outcomes. Potentially well-designed, simple simulations (both virtual and physical) will achieve as much or more than expensive virtual environments. The development of therapeutic simulations will require significant research to ensure that they go beyond engagement and produce improved patient outcomes. As much of that research will need to be developed, how do we use simulation to train clinicians to apply therapeutic simulations effectively?

Conclusion

This chapter has aired some alternative uses of simulation beyond traditional clinical education and training. As technology and evidence build in healthcare, the use of simulation will diversify, which will broaden both opportunities and challenges for simulation providers. As many of the reports of using simulation beyond education in healthcare exist in the grey literature, there is a need to formalize research and share learning across healthcare.

References

1 Gaba, D.M. (2004) The future vision of simulation in health care. *Qual Saf Health Care.*, **13**, i2–i10. doi: 10.1136/qshc.2004.009878

2 Australian Workforce and Productivity Agency. *Future focus: 2013 National Workforce Development Strategy*. Canberra: Commonwealth of Australia; 2013. Available at: https://docs.education.gov.au/system/files/doc/other/futurefocus2013nwds-2013.pdf

3 Burford, O., Moyez Jiwa, B., Carter, O. *et al.* (2013) Internet-based photoaging within Australian pharmacies to promote smoking cessation: randomized controlled trial. *J Med Internet Res*, **15** (3), e64.

4 Queensland Government. See the ugly side of smoking [cited 1 September 2016]. Available at: http://ifyousmoke.initiatives.qld.gov.au/

5 Alzheimer's Australia. Virtual Dementia Experience [cited 1 September 2016]. Available at: https://vic.fightdementia.org.au/vic/about-us/virtual-dementia-experience

6 Albert, R.W., Agutter, J.A., Syroid, N.D. *et al*. (2007) A simulation-based evaluation of a graphic cardiovascular display. *Anesth Analg*, **105** (5), 1303–11.

7 Sanderson, P.M., Watson, M.O., Russell, W.J. *et al*. (2008) Advanced auditory displays and head mounted displays: advantages and disadvantages for monitoring by the distracted anesthesiologist. *Anesthes Analges*, **106** (6), 1787–97.

8 David, L., Jenkins, S.A., Sanderson, P.M. *et al*. (2010) Monitoring with head-mounted displays in general anesthesia: a clinical evaluation in the operating room. *Anaesthes Analges*, **110** (4), 1032–8.

9 Nielsen, A.L., Hilwig, H., Kissoon, N. and Teelucksingh, S. (2008) Discrete event simulation as a tool in optimization of a professional complex adaptive system. *Stud Health Technol Inform.*, **136**, 247–52.

10 Cullen, L., Brazil, V., Dooris, M., Baldwin, M. and Muller, H. (2012). 'Stemi-sim'—A 'Process of Care' simulation can help improve door to balloon times for patients with ST elevation myocardial infarction. *Heart, Lung and Circulation*, **21**, p.S50.

11 Barrett, J.S., Mondick, J.T., Narayan, M. *et al*. (2008) Integration of modeling and simulation into hospital-based decision support systems guiding pediatric pharmacotherapy. *BMC Med Inform Decis Mak.*, **8**, 6. doi: 10.1186/1472-6947-8-6

12 Parsons, T.D. and Rizzo, A.A. (2008) Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: a meta-analysis. *J Behav Ther Exper Psychiatry.*, **39**, 250–61.

13 Rothbaum, B.O., Rizzo, A.S. and Difede, J. (2010) Virtual reality exposure therapy for combat-related posttraumatic stress disorder. *Ann N Y Acad Sci.*, **1208**, 126–32. doi: 10.1111/j.1749-6632.2010.05691.x

14 Hoffman, H.G., Chambers, G.T., Meyer, W.J. *et al*. (2011) Virtual reality as an adjunctive non-pharmacologic analgesic for acute burn pain during medical procedures. *Ann Behav Med*, **41** (2), 183–91.

15 Lohse, K., Shirzad, N., Verster, A. *et al*. (2013) Video games and rehabilitation: using design principles to enhance engagement in physical therapy. *J Neurol Phys Ther*, **37** (4), 166–75. doi: 10.1097/NPT.0000000000000017

SECTION IV
Elements of simulation practice

CHAPTER 16

Ethics of healthcare simulation

Nathan Emmerich, Gerard Gormley & Melissa McCullough

KEY MESSAGES

- Although simulation is often considered to provide a *safe* environment for experiential learning without risking harm to 'patients', we are aware that learners, and those directly involved in the learning process, are at potential risk too.
- Facilitators of simulation-based education need to continue to advance ethical frameworks around such learning.
- Such ethical frameworks should guide best practice in how risks are minimized for those who learn and benefit from such teaching practices.
- In terms of *virtue ethics*, simulation-based education can contribute to the development of a student into a professional.
- If the process of debriefing and reflection becomes merely a performative technique, simulation-based education may fail to be as beneficial for students in generating self-knowledge, and consciously realizing the process of their professional development.

Overview

Simulation-based education can provide valuable opportunities to provide learners with an insight to the many complex dimensions of real clinical practice. Although it is often considered to provide a *safe* environment for experiential learning without risking harm to 'patients', we are aware that learners, and those directly involved in the learning process, are at potential risk too. Facilitators of simulation-based education need to continue to advance ethical frameworks around such learning. Such ethical frameworks will guide best practice in how risks are minimized for those who learn and benefit from such teaching practices.

For the purposes of this chapter, ethics can be defined as the moral principles that govern a person's behaviour or the conduct of an activity. Given that the principles of biomedical ethics – autonomy, beneficence, non-maleficence and justice – continue to provide a common ethical vocabulary in the healthcare professions, these principles can lend themselves to our discussion of the ethics of simulation. We will also introduce an analysis of the ethics of reflective education and a virtue ethics, informed by a Foucauldian perspective, to examine the ethical responsibilities of healthcare educators to provide a safe learning environment that best prepares learners.

Introduction

Health and social care professional education aims to provide learners with a transformative experience so that they can offer competent, compassionate and safe healthcare as professionals. Simulation-based methods are increasingly being used to provide learning experiences for students and practitioners to advance their clinical skills and behaviours [1]. Simulation-based education is being used alongside, and as a complement to, more traditional educational methods [2–4] and, indeed, some consider its introduction to be an ethical imperative [5]. Unquestionably, simulation will continue to offer new types of learning experiences in the future as this pedagogical paradigm matures and develops.

Fundamentally, simulation-based education offers two key learning opportunities. First, it provides learners with an invaluable opportunity to 'rehearse' and incrementally advance their skills before transferring them to the clinical setting. This reduces the possibility

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

of learners harming patients unnecessarily (for example, first practising peripheral vein cannulation on a mannequin arm and then progressing to a real patient). Second, simulation can create learning opportunities that may not be readily available, or frequently occurring, in clinical practice (for example, managing a patient with a tension pneumothorax). Thus, learners can accumulate a greater level of experience than is the case were simulations not made available. Of course, such experience cannot, in the final analysis, perfectly replicate or replace encounters with real patients in clinical practice. Nevertheless, the experiences that simulation provides remain valuable and cannot be dismissed as 'mere simulation'. A key tenet of simulation is that it provides a *safe* environment for experiential learning without risking harm to *patients*.

Simulation can provide valuable opportunities to challenge learners and allow them to gain insight into not only the clinical but also the complex emotional and psychological landscapes of healthcare environments. For simulation to achieve its full pedagogical potential, it is important that such learning experiences are not overly simplistic and therefore predictable. Simulations must, to whatever degree appropriate and possible, provide sufficient challenge for individuals to learn from by replicating the complexities of clinical practice and not simply provide an opportunity for exercising technical skills. Thus, simulations should provide *desirable challenges*, such as adverse events, and opportunities to manage uncertainty and respond to the possibility of error. Simulation has the potential to allow learners to encounter and explore the boundaries of their clinical and professional competence in order that they might draw on these experiences in the interest of their future clinical and professional development. As such, simulation pedagogy offers an opportunity for students to better 'know thyself', an essential component of contemporary understanding of reflective education and practice.

However, if we consider the use of such learning experiences in more detail, the potential risks to learners can be brought into focus. Regardless of the degree of simulation complexity, learners are at risk of potential harm, both psychological and emotional, in their pursuit of best preparing themselves for providing excellence in patient care. The process of transforming students of the healthcare professions into professional practitioners is not a simple one. It is less a case of moving from A to B than it is of moving from A to B via a number of intermediate – and not necessarily linear or incremental – steps. While simulation must stretch students, it should be carefully designed so as not to be insurmountable or overwhelming. While psychological and emotional harm can and should be anticipated in simulation-based education, strategies must be set in advance to minimize the harm but maximize the learning. Such concerns provide the primary basis of ethical concerns in simulation.

For the purposes of discussion, ethics can be defined as the moral principles that govern a person's behaviour or the conduct of an activity. Conducting simulation in the context of healthcare education should endeavour to be guided and informed by moral principles and an analysis of the risks and benefits of simulation. Beauchamp and Childress's principlism is an often-taught framework for ethical reasoning and thought in healthcare professional education [6]. Given that the principles of biomedical ethics – autonomy, beneficence, non-maleficence and justice – continue to provide a common ethical vocabulary for the healthcare professions, these principles can lend themselves to our discussion of the ethics of simulation. Nevertheless, given that the nature and practice of education differ from those of healthcare, it would be unwise to limit our discussion of the ethics of simulation to these four principles alone. Thus we also introduce an analysis of the ethics of reflective education and a virtue ethics informed by a Foucauldian perspective to our examination of the ethical responsibilities of healthcare educators to provide a safe learning environment that best prepares learners for good clinical practice [7, 8].

Benefits and risks of simulation

Simulation-based education is increasingly being used in the training of future and current health professions. Underpinning this teaching practice is a mounting evidence base that is attributing many benefits to this form of learning education: enhanced patient care, patient safety, error management and patient autonomy are many of the purported benefits of simulation [1–3, 9–11]. It should be noted that while there is a growing evidence base, some studies have shown that the effects of simulation-based training may not always transfer to the real clinical arena [12]. However, on balance and with such growing evidence of the benefits of simulation-based education, it could be argued that it would be unethical to wait for unequivocal proof to emerge in order to embrace innovative simulated-based learning initiatives where possible and practicable in clinical education [2, 5].

Although considered to be a *safe* learning environment, there are inherent risks in simulation-based education. While no *actual patients* may be harmed during a simulation-based learning activity, all individuals involved in the learning experience are at a degree of potential risk; simulation-based education is not risk free for either the learners or the role players. We might also consider the potential impact of simulation learning on future patient care.

The four principles applied to simulation

The four principles of biomedical ethics [6, 13] are in common parlance across healthcare and healthcare education – including attempts to integrate the teaching of medical ethics into simulations [14]. While they do not exhaust the ethics of healthcare education, and may not even provide the best approach to its evaluation, they do offer a collectively comprehensible starting point and one that is suitable to an introductory chapter such as this.

The principle of autonomy can be considered as the counterpart of respect for people. When designing and implementing simulations, it is important to bear in mind that one should maintain respect for all those involved. Medical education has an unfortunate history of using humiliation as a pedagogical tool. While this activity has not been entirely eliminated from medical culture, that should not be an excuse for it to appear in simulation exercises. Of course, maintaining respect for learners does not mean designing ineffectual tests or exercises in which failure is not possible. Rather, it means recognizing the range of outcomes that a simulation might produce and having appropriate responses in place to support students as their education and training progress. One might connect this to broader notions of reflective education. Prior to undertaking a simulation, students need to be briefed in what they might expect and what is expected of them. Subsequently, they need to be debriefed about their performance and about any opportunities for further development. At this point, healthcare educators can offer students an external perspective on their performance and encourage them to reflect on this, their performance in the simulation and their learning more generally. Thus, healthcare educators can (and should) express their respect for learners through competent and comprehensive pedagogical design. Furthermore, this perspective indicates that, when expressed in the context of reflective education, the 'ethic' of respect for persons is tied to its pedagogical ethos.

Students of the healthcare professions are adults who undertake their studies autonomously. While the *transformative* nature of such education calls into question simplistic notions of informed consent – no students can fully realize the implications of their decision to undertake a professional programme of study over a number of years – it is nevertheless the case that educators should respect reflective learners as autonomous people. This means providing them with instructions, examinations and feedback that are clear and engage them as individual learners. Again, this should be taken to mean that instructions for particular simulations cannot be 'incomplete' or in some way ambiguous. Nor does it mean that feedback must be honest to the point of brutality.

The ethical imperative of respect for people is also operative in the context of simulations that include actors in the role of patients or 'expert patients'. It is important for educators to be aware that the contribution these individuals have to offer may extend beyond what educators presume or expect. Part of the purpose of involving simulated patients and actors in healthcare education is to introduce the kind of lay or patient perspective that is present in clinical practice to the professional education of healthcare students. Thus there are good pedagogical reasons to respect the contribution that external contributors make to healthcare education and simulation. This is not, of course, to suggest that such individuals need not be offered guidance on what is expected of them, or with regard to what they might expect. Rather, it is to suggest that they be allowed a certain degree of freedom to 'speak for themselves', from their own experience, and for their potential to contribute not to be restricted or constrained from the outset. Achieving a mutually consistent understanding of the responsibilities of patient actors is, one might say, a two-way street [15].

As this discussion regarding autonomy or respect for people suggests, educators should attend to their pedagogical motivations and ensure that they act beneficently and not maleficently. The education of healthcare professionals takes a number of years and, rather like medical practice, what might seem like harm in the short term is, in fact, done in the interests of the patient/student over the long term. This is true of simulation as a formative and summative approach to teaching.

Simulations can legitimately challenge and even stretch students. It is not unethical for students to experience failure, and simulations can be designed to include the unavoidable death of the patient [16]. Such experiences do not necessarily lead to emotional or psychological harm. What is of ethical importance is the way in which educators and students respond to such experiences. In practice, all medical professionals will undoubtedly experience failure at some point – they will have patients who die and patients they could have better served – thus medical education must equip students with the ability to respond to such experiences, to build on them and to do better in future. The relevant morality is akin to what Bosk called 'forgive and remember' [17]. Challenging simulations provide an opportunity to inculcate in students, both individual and collectively, the ability to respond to the inevitable experience of failure.

As simulation becomes ever more present in health and social care curricula across many institutions, there are a number of limitations to its provision: expense in terms of resourcing such activities and the expertise of facilitators [18]. In consideration of the ethics of simulation, it is important to remember equality of learner opportunity. Furthermore, institutions should pay particular attention to the level of resources allocated to simulation in clinical education [19]. It should be noted here that often variation in simulation provision across programmes of study is not easily attributable to the financial status of institutions, schools or departments. Rather, individuals leading programmes of clinical study may simply lack experience and interest. It is in terms of 'justice' not only to the students but to the patients and populations served that institutions should continue, within their finite budgets, to prioritize simulation-based activities in keeping with best practice and evidence in whatever way they can. At a minimum, however, effective and sound simulation in clinical education requires appropriate funding for training of staff – including appropriate time made available to them – and facilitators, simulated patients (recruitment and usage), equipment and other overheads to help minimize risks to learners, professional colleagues, future patients and their families. The limiting factors to successful simulation have much to do with the facilitator(s) of the simulation and include effective design, environment, pre-briefing and debriefing and facilitator adaptability during the simulation. All of these require that the facilitator has had specialized training to avoid lack of engagement and buy-in from learners and reinforcement of errors and/or inappropriate practice. Hence, the importance of prioritized funding and support from management within the organization.

Virtue ethics: building character through simulation

The arena of healthcare education involves the development – or, more accurately, the transformation or metamorphosis [20] – of students into professionals. Given the characterological dimensions of such educational programmes, we should recognize that there is an (implicit and explicit) normative purpose to their pedagogical content. In this context, we can appreciate the degree to which professional education is an apprenticeship; the degree to which it involves induction into a particular culture and way of being. In such accounts it is clear that students become professionals through a set of complex developmental processes that have impacts on them as moral individuals [21, 22].

Such views exhibit an affinity with virtue ethics, a perspective that presumes an expanded conception of 'the ethical' and, unlike mainstream approaches to applied ethics, one that facilitates a consideration of the moral psychology underpinning our actions. Thus, while virtue ethics runs counter to the prevailing norm of focusing moral judgement on 'actions' rather than 'individuals', it connects with common practice in healthcare education. For example, it is normal for applicants to medical schools to be selected on the basis of their (perceived) character, and it is common for this to be seen as the basis for future development. Furthermore, such development is not the responsibility of educators alone, but something that students are required to pursue for themselves. This is particularly true in the contemporary era, where ongoing professional development is seen as a basic requirement of practice.

The education of healthcare professionals therefore aims to instil in students a particular relation to their own, and especially professional, self; one in which they are capable of reflective monitoring and evaluating themselves in order that they might pursue and self-direct their own further development. Not only is this consistent with the medical imperative for physicians to know themselves, but there is also a particular resonance with the Foucauldian account of ethics, something that is usually understood as a contemporary, if unorthodox, form of virtue ethics [23]. Here ethics involves the care or, perhaps better, *government* of the self by the self. The particular forms this might take are essentially political, which is to say that they are inescapably shaped by social, cultural and historical forces. The conception of the 'reflective professional' and, more importantly, their education [24, 25] is suffused with what Foucault would call technologies of the self, cultural processes through which the self continually 'makes' and 'remakes' itself according to aesthetical – which is to say ethical – norms [26]. This positions healthcare education as an activity that is essentially ethical; it requires students to develop a specific relation to their own self, something that, for Foucault, is the very essence of ethics.

Simulation exists within the ecology, or normative ethos, of reflective pedagogy. Indeed, it has a particular role to play within the reflective approach to healthcare education. In the first instance, simulations provide students with the opportunity to practise – or 'dress rehearse' – their knowledge and skills at a specific point in time. This means that they can be used to structure particular courses and, correctly positioned, they can fundamentally contribute to the reflective development of healthcare students. In this view, simulations are not simply 'tests' of knowledge or abilities, but opportunities for educators and students to examine their demonstrable strengths and weaknesses, and to do so on the basis of performance that seeks to approximate to clinical practice.

As with reflective portfolios, there is a danger that simulations are reduced to the *merely* performative [27]. While there must be an element of performance in the design and completion of any simulation, part of what simulations offer students is the opportunity to practise being in the clinic through a kind of rehearsal performance. Such experiences can contribute to the formation of the relevant professional dispositions and/or habits in a manner similar to the actual accumulation of observational and practical clinical experience [28]. Thus, concern regarding performative acts that are unethical primarily pertains to the authenticity of subsequent processes of self-reflection and the accuracy with which they are reported to and discussed with both oneself, peers and others. Students are predisposed to present themselves as meeting the imagined or actual expectations of educators. The project of reflective pedagogy can be undermined by attempts to fulfil these expectations. First, students' reflective accounts might be misleading or even false; and second, the lessons that students learn by providing accounts that misrepresent their experience will run counter to the ideals that reflective education seeks to impart.

In terms of Foucault's perspective on ethics, if the process of reflection becomes subordinated or instrumentalized as a merely performative technique, it does not cease to be a technique of the self – it can still contribute to the pedagogical construction (or assembly) of the individual as a professional – but it does cease to be a way of generating self-knowledge, of students knowing themselves and consciously realizing the process of development. An authentic process of reflection can be one way to 'care for the self', but this is no longer the case if such processes become little more than expectation-meeting performances.

Conclusion

The health and social care needs of our societies are changing and will continue to change. With a rapidly expanding evidence base, ageing population and increasing number of patients living with multiple co-morbidities, healthcare provision is becoming more complex and challenging. Simulation can provide valuable opportunities to challenge learners and allow them to gain an insight into not only the clinical, but also the complex emotional, social and psychological dimensions of the real working environment. With the greater use of simulation and increasing evidence base, simulation-based educational methods will continue to open up new approaches to learning. Although often considered to provide a *safe* environment for experiential learning without risking harm to *patients*, we are aware that learners, and those directly involved in the learning process, are at potential risk. Given the emphasis on the sociomaterial aspects of simulation, material modifications are often made to greatly reduce, but not totally mitigate, physical risks. However, simulation has the potential also to cause significant psychological and emotional harm. Facilitators of simulation-based education will need to continue to advance ethical frameworks around such learning. Such ethical frameworks will guide best practice in how risks are minimized to those who learn and benefit from such teaching practices. While simulation-based learning aims to reduce harm to actual patients, harming learners is also of benefit to no one.

References

1 Cook, D.A., Hatala, R., Brydges, R. *et al*. (2011) Technology-enhanced simulation for health professions education: a systematic review and meta-analysis. *JAMA*, **306** (9), 978–88.

2 Gaba, D.M. (2004) The future vision of simulation in health care. *Qual Saf Health Care*, **13** (suppl 1), i2–i10.

3 Issenberg, S.B., McGaghie, W.C., Petrusa, E.R. *et al*. (2005) Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Med Teach.*, **27**, 10–28.

4 Murphy, J.G., Cremonini, F., Kane, G.C. and Dunn, W. (2007) Is simulation based medicine training the future of clinical medicine? *Eur Rev Med Pharmacol Sci*, **11** (1), 1–8.

5 Ziv, A., Wolpe, P.R., Small, S.D. and Glick, S. (2003) Simulation-based medical education: an ethical imperative. *Acad Med*, **78** (8), 783–8.

6 Beauchamp, T.L. and Childress, J.F. (2009) *Principles of biomedical ethics*, 6th edn, Oxford University Press, New York.

7 Gutting G. Michel Foucault. In: Zalta EN, editor. *The Stanford encyclopedia of philosophy*. 2014. Available at: http://plato.stanford.edu/cgi-bin/encyclopedia/archinfo.cgi?entry=foucault.

8 Hodges, B.D., Martimianakis, M.A., McNaughton, N. and Whitehead, C. (2014) Medical education… meet Michel Foucault. *Med Educ*, **48** (6), 563–71.

9 Evans, L.V., Dodge, K.L., Shah, T.D. *et al*. (2010) Simulation training in central venous catheter insertion: improved performance in clinical practice. *Acad Med*, **85** (9), 1462–9.

10 McGaghie, W.C., Issenberg, S.B., Cohen, E.R. *et al*. (2011) Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence. *Acad Med*, **86** (6), 706–11.

11 Zendejas, B., Brydges, R., Wang, A.T. and Cook, D.A. (2013) Patient outcomes in simulation-based medical education: a systematic review. *J Gen Intern Med*, **28** (8), 1078–89.

12 Finan, E., Bismilla, Z., Campbell, C. *et al*. (2012) Improved procedural performance following a simulation training session may not be transferable to the clinical environment. *J Perinatol*, **32** (7), 539–44.

13 Gillon, R. (1994) Medical ethics: four principles plus attention to scope. *BMJ*, **309** (6948), 184.

14 Tritrakarn, P., Berg, B.W., Kasuya, R.T. and Sakai, D.H. (2014) Medical school hotline: can we use simulation to teach medical ethics? *Hawaii J Med Public Health*, **73** (8), 262.

15 Nestel, D., Clark, S., Tabak, D. *et al*. (2010) Defining responsibilities of simulated patients in medical education. *Simul Healthc*, **5** (3), 161–8.

16 Bruppacher, H.R., Chen, R.P. and Lachapelle, K. (2011) First, do no harm: using simulated patient death to enhance learning. *Med Educ*, **45** (3), 317–18.

17 Bosk, C.L. (1981) *Forgive and remember: managing medical failure*, 2nd edn, University of Chicago Press, Chicago, IL.

18 Okuda, Y., Bryson, E.O., DeMaria, S. Jr., *et al*. (2009) The utility of simulation in medical education: what is the evidence? *Mt Sinai J Med.*, **76**, 330–43.

19 Zendejas, B., Wang, A.T., Brydges, R. *et al*. (2012) Cost: the missing outcome in simulation-based medical education research: a systematic review. *Surgery*, **153** (2), 160–76.

20 Martin, J. (2007) *Educational metamorphoses: philosophical reflections on identity and culture*, Rowman & Littlefield, New York.

21 Emmerich, N. (2013) *Medical ethics education: an interdisciplinary and social theoretical perspective*, Springer, London.

22 Emmerich, N. (2015) Bourdieu's collective enterprise of inculcation: the moral socialisation and ethical enculturation of medical students. *Brit J Sociol Educ*, **36** (7), 1054–72.

23 Levy, N. (2006) Foucault as virtue ethicist. *Foucault Stud.*, **1**, 20–31.

24 Schön, D.A. (1984) *The reflective practitioner: how professionals think in action*, Basic Books, New York.

25 Schön, A. (1990) *Educating the reflective practitioner: toward a new design for teaching and learning*, Jossey-Bass, San Francisco, CA.

26 Robinson R. Foucault, Michel : *ethics*. Internet encyclopedia of philosophy. 2011. Available at: http://www.iep.utm.edu/fouc-eth/

27 Ghaye, T. (2010) In what ways can reflective practices enhance human flourishing? *Reflect Pract*, **11** (1), 1–7.

28 Underman, K. (2015) Playing doctor: simulation in medical school as affective practice. *Soc Sci Med.*, **136–7**, 180–88.

CHAPTER 17

Teamwork and healthcare simulation

Jenny Weller & Ian Civil

KEY MESSAGES

- Failures in teamwork and communication between healthcare providers account for a major burden of avoidable patient harm and treatment injuries.
- The curriculum for team training is well defined and based in theory and evidence, and simulation is an effective approach to delivering this curriculum.
- Teamwork training needs to involve teams who work together in order to overcome professional boundaries and needs to engage all members of the team in meaningful activities relevant to their professional roles.
- Development and delivery of multidisciplinary simulation-based team training requires a multidisciplinary faculty and organizational commitment to overcome the many barriers to implementation.
- Simulation-based team training should be embedded in healthcare institutions and become part of business as usual for quality improvement and patient safety.

Overview

Failures in teamwork and communication lead to tension, unhappy workplaces and error. There is good evidence that simulation training improves teamwork and communication and reduces the risk of peri-operative harm. Multidisciplinary simulation-based team training presents many challenges in terms of effective scenario design and the logistics of multidisciplinary attendance and 'buy-in'. Changes in the culture and expectations of both professional groups and employers are necessary for effective simulation in teamwork and communication, but it is only with such change that the benefits can be realized.

Introduction

Modern healthcare is complex, multifaceted and often fragmented. Patients see many different health professionals over the course of a single illness. The extent to which their care is coordinated, and these health professionals communicate effectively and work as team, will to a very large extent influence the outcome for the patient [1]. Teamwork and communication between health professionals both have an important effect on patient outcomes through reducing errors, delays and disorganized patient care. Improving teamwork and communication could potentially bring about the most significant reductions in morbidity and mortality in modern healthcare.

However, health professionals have paid little attention to teamwork and communication between different health professional groups in traditional training programmes. Furthermore, it is common for training to occur in professional silos, from undergraduate programmes through to continuing professional development [2, 3]. The results are communication failures and sub-optimal teamwork in healthcare teams, particularly across professional boundaries. These failures have been documented by observations of healthcare teams in the clinical environment [4]. Adverse events are common, millions of hospitalized patients suffer

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

avoidable treatment injuries every year, and many of these are attributed to failures in communication [5–8]. Simulation-based training for multidisciplinary healthcare teams could be part of the solution to this problem.

Does Simulation-Based Team Training Work?

There are numerous reports of simulation-based team training across many disciplines [9–22]. These have demonstrated effectiveness in many different forms, including participant self-report, evidence of learning or improved performance in simulated cases, improved teamwork processes in the clinical environment, changes in attitudes towards safety, improved perceptions of clinical decision making and, in some cases, improved patient outcomes. While it is difficult in a single study to provide incontrovertible evidence of improved outcomes for patients, the combined evidence of the many published studies is overwhelming. In some regions, simulation has become embedded in institutional practice [23], but this is generally not the case, and the failure of institutions to act on this evidence is a cause for concern.

Key Considerations in Simulation-Based Team Training

Theoretical Framework for Effective Team Functioning

A theoretical framework for effective teamwork is a good starting point in developing simulation-based team training. Salas et al. [24] undertook an extensive review of the teamwork literature and developed a framework comprising five key dimensions and three underpinning mechanisms for effective teams. The key dimensions are team leadership, mutual performance monitoring, back-up behaviour, adaptability and team orientation. The underpinning mechanisms are mutual trust, closed-loop communication and shared mental models (Figure 17.1).

Each component can be considered in the context of healthcare team training. Members of the team must respect and trust each other in order to monitor each other's performance, speak up and give and receive advice or assistance on mistakes, lapses or task overload. Good communication is critical for sharing information and developing a shared mental model. Shared mental models of the situation, the plan for treatment, the

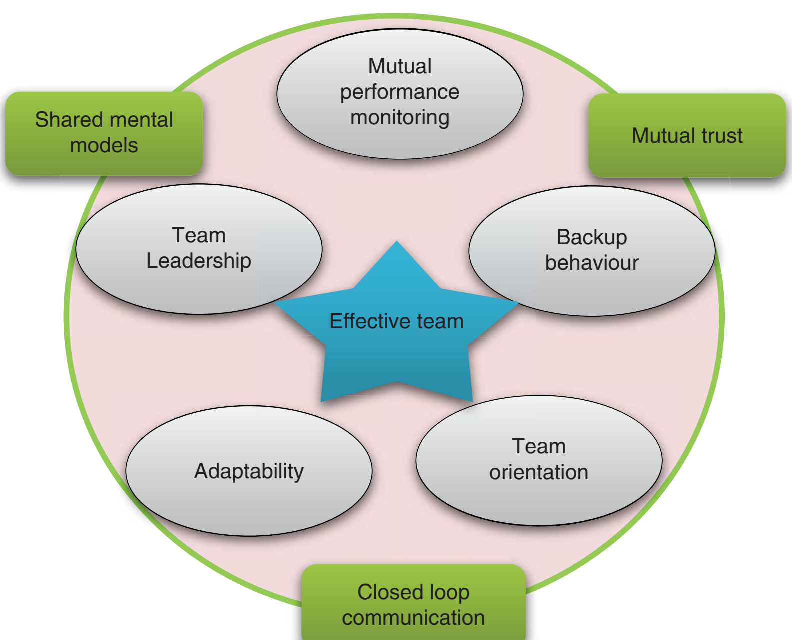

Figure 17.1 A framework for effective teams. Source: Adapted from Salas 2005 [24]

roles and tasks of other individuals in the team and future events enable team members to anticipate each other's needs, identify changes in the clinical situation and adapt accordingly. An effective leader coordinates tasks and treatment plans and is pivotal to the development of the team, and in establishing a positive team atmosphere. This framework provides a basis for a curriculum in simulation-based team training, and specific strategies and skills to enhance team performance. Alternative frameworks such as TeamSTEPPS have very similar sets of goals and frameworks supported via well-developed curricula [25].

A Curriculum for Training Healthcare Teams

A curriculum can be described in terms of knowledge, skills and attitudes, all relevant to the simulation-based training of healthcare teams.

Knowledge

The relevance of teamwork can be emphasized through the literature on error causation and the consequences of failures in teamwork. A theoretical framework for effective teamwork behaviors such as that proposed by Salas et al. [24] is essential to underpin behaviour change. An understanding of the issues of interprofessional collaboration and collective competence [2], the influence of hierarchies in healthcare teams and the construction of professional boundaries [26] underpins culture change.

Skills/behaviours

The skills and behaviours required for effective teamwork include managing the team (e.g. coordination, monitoring and supporting others); managing the task (e.g. role allocation, planning, prioritizing, identifying and utilizing resources); and developing a shared team mental model (information sharing on task and role). The communication skills underpinning effective teamwork include closed-loop communication, structured handover [27], call-out [28] and speaking up [29] (Table 17.1).

Measurement scales for teamwork behaviours often provide explicit descriptors of expected behaviours, which help both participants and instructors to recognize and develop these behaviours (Table 17.2).

Attitudes

Mutual trust and respect and a team orientation are key dimensions of effective teams. Clinicians need to be convinced of the relevance of learning about teamwork and communication in order to change, but important barriers exist. Bringing the different health professional groups together in simulation-based team training provides opportunities to learn about the roles

Table 17.1 Some useful communication behaviours.

Closed-loop communication	ISBAR (structured handover)	Call-out (SNAPPI) (call-out in a crisis)	Speaking up
Sender: clear, concise, directed instruction **Receiver**: read-back of instruction to ensure correct understanding **Sender**: confirmation of instruction **Receiver**: acceptance of the task	**I**dentify – who you are **S**ituation – the main issue **B**ackground – the background history **A**ssessment – what you think is going on **R**ecommendation – what you think needs to be done next	**S**top – leader steps back and gets the attention of the team **N**otify – inform the team of patient status **A**ssessment – your interpretation of the situation **P**lan – what you think needs to be done **P**riorities – state the order for the plan **I**nvite ideas – seek input from the team	**3-step CUS model** I am **C**oncerned I am **U**ncomfortable This is a **S**afety issue **4-step PACE model** Probe Alert Challenge Emergency **Modified PACE model** Observation Suggestion Challenge Emergency

Table 17.2 Teamwork measurement tools.

OTAS – observational teamwork assessment for surgery [30]	Operating room teams: covers five behavior categories of three sub-teams (surgical, nursing, anaesthesia) over three phases of surgery
Teamwork Behavioral Rater [31]	Intensive care teams: covers 23 individual behavioural items that group into three main categories, rated over the entire encounter
Non-technical skills – ANTS [32]	Anaesthesia: covers four behaviour categories of performance, rated over the entire encounter

and capabilities of others and how they contribute to decision making and patient management. Hierarchical attitudes, where power differentials exist between team members, discourage open communication. The less powerful fear negative consequences, and the powerful fail to value the input of all team members [33]. Simulation-based team training brings different members of the team together on an equal footing. It can engage them in challenges designed to expose assumptions and behaviours that limit effective team function and result in sub-optimal care.

Simulation can be a powerful way of demonstrating what happens when teamwork and communication fail. Unlike other methods, such as a video demonstration, the experiential perspective provided through active participation in a simulated event can promote a deeper reflection on strategies to improve team effectiveness and patient care. Where participants display effective teamwork and communication in the simulation, the experience can be used to reflect on and promote behaviours that support good outcomes. Simulation provides many advantages over other training modalities, including the option of repeating an event to try out or practise new strategies. The opportunity for participants to meet and get to know each other during the training sessions should not be overlooked.

Practical Considerations

Effective multidisciplinary team training requires each member of the team to undertake activities similar to their normal tasks. In the operating theatre (OT) context, for example, this means that anaesthesiologists, anaesthetic technicians, nurses and the surgical team must all have relevant clinical activities in which to engage during the simulation. An appropriate level of fidelity for each group is a prerequisite for this engagement. In this context, fidelity relates not only to the physical environment in which the simulation occurs, but also to the nature of the scenario that the simulation seeks to replicate. Mismatch in fidelity results in an 'observational' process where those with less to do simply watch the performance of those with more. It is apparent therefore that a multidisciplinary team is needed to provide input into scenario design to ensure appropriate balance.

Where suitable fidelity exists for the different professional groups, all participants can engage in realistic activities. Team members can then interact with each other in a similar way to their interactions in the clinical environment. Thus the realism is more about interactions between participants rather than interactions with the simulator.

For example, tasks that might form part of an OT scenario for which there should be similar levels of fidelity might include monitoring for the anaesthesiologist, control of surgical bleeding for the surgeon and maintaining sterility for the scrub nurse.

Multidisciplinary scenarios must be reasonably specific for the professional groups involved. For example, in the OT context, involving surgeons is probably more difficult than the other professional groups due to sub-specialism differences in surgical procedures. For example, a scenario about abdominal bleeding cannot be used for a neurosurgical team and, similarly, an extremity vascular scenario is of limited relevance to urologists. The temptation to go for a 'common denominator', such as skin incision, runs the risk of relative disengagement by the surgical participants unless some particular action is required of them. The less any individual group engages, the less teamwork can be simulated and thus the objective of the simulation may be defeated. Therefore, the challenge of creating realistic physical simulation models and believable scenarios is a particular challenge for simulations involving surgeons and necessitates a high level of surgical engagement in the simulation design team. Similar issues will apply in other healthcare contexts, particularly those involving invasive procedures or imaging techniques.

Briefing and Debriefing Multidisciplinary Teams

Much of the learning and application to practise from the simulation will occur in the debriefing. Factors to consider are seizing the opportunity to debrief interprofessional issues, and identifying and debriefing of issues of importance to all the different professional groups. Debriefing multidisciplinary teams exposes the particular challenges of communication and teamwork across professional boundaries, for example assumptions of shared understanding of the issues and plan for treatment; understanding others' roles and capabilities, and what they need to know to work most efficiently, as well as the difficulties in speaking up across hierarchies or professional boundaries. Opportunities for such discussions are so rarely otherwise available. Highlighting the opportunities for interprofessional learning when preparing participants for the simulation, and facilitating discussion around interprofessional issues as they arise in the debriefing, may help to address power gradients and interprofessional barriers in the clinical environment.

Again in the context of OT simulations, an anaesthesiologist debriefer may not be in the best position to notice and make explicit the issues that arose during the scenario for nursing staff. Ideally, a multidisciplinary instructor team should be involved in the debriefing. This requires planning and an agreed approach to the structure of the debriefing and the different roles that the debriefers will take. An option could be a non-clinical debriefer, not aligned with any particular professional group and trained in team-based debriefing.

Logistically this could mean that more faculty are required, and perhaps a rapid upskilling of some faculty to take on the role of debriefer. A structured format to debriefing can be of benefit to less experienced debriefers [34]. A useful structure is to begin with exploration of feelings or emotional reactions to the scenario, then clarification of the events during the scenario, followed by exploration of why certain things happened and how things could have been managed differently, and finally application of these simulated experiences and lessons learnt to clinical practice. Questioning techniques include questions of clarification, questions prompting self-reflection of what was done well and areas for improvement, and advocacy/inquiry [35], where the debriefer states their observation and potential concern and explores the reasoning or rationale of the participants. With a multidisciplinary team of instructors, it is important that they share the same mental model – their plan for the debriefing, their various roles and who will do what (see Chapter 21).

Challenges in Teamwork Simulation

Appropriate Level of Fidelity of Simulation and Team Interactions

For teamwork simulation to be effective, every member of the team needs to be engaged and the interaction between them needs to have fidelity as well as their individual relationship with the simulation. Needless to say, the whole team needs to be represented in the scenario and the roles they are assigned should be as close as possible to the normal roles they fill in the clinical environment. In teamwork simulations as much effort needs to be put into the scenario as into the simulator.

Appropriate fidelity can be defined as that degree of realism that allows team members to suspend disbelief and engage in the scenario in a meaningful way. Chapter 4 provides a more detailed discussion on generating meaningful outcomes. Thus there is no precise degree of anatomical, physiological or facility fidelity that is required, but rather sufficient physical realism and scenario narrative that allow all participants to engage. Attention to all elements is critical during the briefing, conduct and debriefing to achieve effective teamwork simulation.

Logistical Challenges to Implementation

The need to engage all members of the multidisciplinary team presents both cost and logistic challenges. Many of these are similar to the barriers widely reported for undergraduate interprofessional education initiatives, for example timetabling; different weight for the assessment of the activity; and ensuring that learning objectives are equally relevant for all students [36].

In multidisciplinary healthcare teams, availability of the various team members as well as the culture of the health professional group to which they belong can be problematic. Issues including difference in funding, rosters and competing individual training needs will vary across professional groups. Some professional groups may struggle with the relevance of multidisciplinary team training to their own professional practice and require special efforts or incentives. This may affect the appropriate numbers of participants from each profession able to attend interprofessional education at external sites. While participation may be facilitated by using in situ simulation training, participants may be called away, and the simulation activity needs careful management so as not to detract from patient care [37].

Multidisciplinary simulation team training requires strategies that actively involve all groups. Again, this comes back to involving a multidisciplinary team at the outset, but also identifying champions in each clinical group and gaining organizational support.

Transfer from Simulation to Real World

One of the challenges of any simulation-based intervention is the degree to which learning and new insights transfer to the clinical workplace. In this regard, multidisciplinary teamwork simulation is no different from any other form of simulation. Whereas task-based simulation requires an individual's experience with the task to be recalled when in the real-life environment, team-based simulation aims for changes in the behaviour of whole teams. One factor affecting transfer may be the location in which the simulation is held. The mere fact that an individual may need to travel to a simulation environment other than their workplace, and potentially train with participants with whom they do not normally work, may affect learning transfer. The extent to which the learning and insights about teamwork and communication flourish and lead to changes in behaviour in the clinical workplace is likely to depend on the percentage of staff who attended the training and who can reinforce the lessons learnt.

Current Trends and Future Directions

In situ simulation has the advantage of providing immediate relevance to the workplace, but does place demands on the instructors to ensure that management of the scenario is safe and that fidelity is not compromised. Simulation centres have the benefit of a tightly managed environment and the opportunity to practise repeatedly in the same place, leading to a well-managed process, but this will inevitably result in geographical dissonance for the participants.

Perhaps the ideal compromise is a formal simulation environment close to or within the workplace (for example, one cubicle in the emergency department, or one patient room in the intensive care unit, permanently used for simulation) [38]. In an environment where educators generally struggle to get employers (other than airlines and the military) to regard simulation as 'business as usual', this is a distant goal for many at the present time.

A single workshop is unlikely to have a prolonged effect. To promote permanent change in culture and retention of knowledge, skills and behaviours, the intervention needs to be recurrent and embedded, to become part of normal business. The 'stickiness' of the intervention will depend on the ability to engage the majority of members of departments, the clear relevance and evidence of the benefits of the training, and regular reinforcement through repeated training and organizational support.

Some areas of clinical practice have embraced multidisciplinary simulation-based team training to a far greater extent than others, in particular OT teams, obstetrics, emergency medicine and intensive care. These are typically the areas of acute care practice, where outcomes are closely linked to immediate management and where senior clinicians are involved. Extending teamwork training to ward staff, including junior doctors involved in acute response to the deteriorating patient, and further to more routine or chronic care, are areas for future exploration.

A key dimension of teamwork is team orientation – an attitude that recognizes the value of teamwork, information sharing and team decision making in optimizing patient care and safety. Optimal multidisciplinary teamwork simulation could potentially produce such a change in the culture of the participants through carefully crafted scenarios and debriefings designed to expose the inefficiencies and potential hazards of entrenched hierarchies and individualistic attitudes. Simulation can also be used to demonstrate the advantages of flattened hierarchies, environments that encourage speaking up, and the implementation of safety interventions designed to enhance information sharing between health practitioners, such as the WHO Surgical Safety Checklist [38].

Conclusion

Bringing health professionals together in multidisciplinary simulation-based team training enables teams that work together to learn how to communicate more effectively with each other and work collaboratively in patient-centred healthcare teams. While challenges exist in incorporating simulation-based team training into healthcare organizations as part of 'business as usual', the potential for improvements in patient safety and reductions in avoidable harm could be significant.

References

1 Mazzocco, K., Petitti, D.B., Fong, K.T. *et al.* (2009) Surgical team behaviors and patient outcomes. *Am J Surg.*, **197**, 678–85.

2 Hodges, B. and Lingard, L. (2012) *The question of competence: reconsidering medical education in the twenty first century*, Cornell University Press, Ithaca, NY.

3 Baker, D.P., Salas, E., King, H. *et al.* (2005) The role of teamwork in the professional education of physicians: current status and assessment recommendations. *Jt Comm J Qual Patient Saf.*, **31**, 185–202.

4 Lingard, L., Espin, S., Whyte, S. *et al.* (2004) Communication failures in the operating room: an observational classification of recurrent types and effects. *Qual Saf Health Care.*, **13**, 330–34.

5 Jha, A.K., Larizgoitia, I., Audera-Lopez, C. *et al.* (2013) The global burden of unsafe medical care: analytic modelling of observational studies. *BMJ Qual Saf.*, **22**, 809–15.

6 Davis, P., Lay-Yee, R., Briant, R. *et al.* (2002) Adverse events in New Zealand public hospitals I: occurrence and impact. *N Z Med J.*, **115**, 271–7.

7 Leape, L., Brennan, T., Laird, N. *et al.* (1991) The nature of adverse events in hospitalized patients: the results of the Harvard Medical Practice Study II. *N Engl J Med.*, **324**, 377–84.

8 Vincent, C., Neale, G. and Woloshynowych, M. (2001) Adverse events in British hospitals: preliminary retrospective record review. *BMJ.*, **322**, 517–19.

9 Tan, S.B., Pena, G., Altree, M. and Maddern, G.J. (2014) Multidisciplinary team simulation for the operating theatre: a review of the literature. *ANZ J Surg.*, **84**, 515–22.

10 Merién, A.E.R., van de Ven, J., Mol, B.W. *et al.* (2010) Multidisciplinary team training in a simulation setting for acute obstetric emergencies: a systematic review. *Obstet Gynecol.*, **115**, 1021–31.

11 Undre, S., Koutantji, M., Sevdalis, N. *et al.* (2007) Multidisciplinary crisis simulations: the way forward for training surgical teams. *World J Surg.*, **31**, 1843–53.

12 Falcone, R.A. Jr., Daugherty, M., Schweer, L. *et al.* (2008) Multidisciplinary pediatric trauma team training using high-fidelity trauma simulation. *J Pediatr Surg.*, **43**, 1065–71.

13 Steinemann, S., Berg, B., Skinner, A. *et al.* (2011) In situ, multidisciplinary, simulation-based teamwork training improves early trauma care. *J Surg Educ.*, **68**, 472–7.

14 Allan, C.K., Thiagarajan, R.R., Beke, D. *et al.* (2010) Simulation-based training delivered directly to the pediatric cardiac intensive care unit engenders preparedness, comfort, and decreased anxiety among multidisciplinary resuscitation teams. *J Thorac Cardiovasc Surg.*, **140**, 646–52.

15 Nishisaki, A., Nguyen, J., Colborn, S. *et al.* (2011) Evaluation of multidisciplinary simulation training on clinical performance and team behavior during tracheal intubation procedures in a pediatric intensive care unit. *Pediatr Crit Care Med.*, **12**, 406–14.

16 Robertson, B., Kaplan, B., Atallah, H. *et al.* (2010) The use of simulation and a modified teamstepps curriculum for medical and nursing student team training. *Simul Healthc.*, **5**, 332–7.

17 Weaver, S.J., Dy, S.M. and Rosen, M.A. (2014) Team-training in healthcare: a narrative synthesis of the literature. *BMJ Qual Saf.*, **23**, 359–72.

18 Riley, W., Davis, S., Miller, K. *et al.* (2011) Didactic and simulation nontechnical skills team training to improve perinatal patient outcomes in a community hospital. *Jt Comm J Qual Patient Saf.*, **37**, 357–64.

19 Maxson, P.M., Dozois, E.J., Holubar, S.D. *et al.* (2011) Enhancing nurse and physician collaboration in clinical decision making through high-fidelity interdisciplinary simulation training. *Mayo Clin Proc.*, **86**, 31–6.

20 Cumin, D., Boyd, M.J., Webster, C.S. and Weller, J.M. (2013) A systematic review of simulation for multidisciplinary team training in operating rooms. *Simul Healthc.*, **8**, 171–9.

21 Frengley, R.W., Weller, J., Torrie, J. *et al.* (2011) The effect of a simulation-based training intervention on the performance of established critical care unit teams. *Crit Care Med.*, **39**, 2605–11.

22 Weller, J., Cumin, D., Torrie, J. *et al.* (2015) Multidisciplinary operating room simulation-based team training to reduce treatment errors: a feasibility study in New Zealand hospitals. *N Z Med J.*, **128**, 1418.

23 Arriaga, A.F., Gawande, A.A., Raemer, D.B. *et al.* (2014) Pilot testing of a model for insurer-driven, large-scale multicenter simulation training for operating room teams. *Ann Surg.*, **259**, 403–10.

24 Salas, E., Sims, D.E. and Burke, C.S. (2005) Is there a 'Big Five' in teamwork? *Small Group Res.*, **36**, 555–99.

25 AHRQ. TeamSTEPPS: strategies and tools to enhance performance and patient safety [cited 1 September 2016]. Available at: http://www.ahrq.gov/professionals/education/curriculum-tools/teamstepps/index.html

26 Weller, J. (2012) Shedding new light on tribalism in health care. *Med Educ.*, **46**, 134–6.

27 Marshall, S., Harrison, J. and Flanagan, B. (2009) The teaching of a structured tool improves the clarity and content

of interprofessional clinical communication. *Qual Saf Health Care.*, **18**, 137–40.
28 Weller, J.M., Torrie, J., Boyd, M. *et al.* (2014) Improving team information sharing with a structured call-out in anaesthetic emergencies: a randomized controlled trial. *Br J Anaesth.*, **112**, 1042–9.
29 Rutherford, J.S., Flin, R. and Mitchell, L. (2012) Teamwork, communication, and anaesthetic assistance in Scotland. *Br J Anaesth.*, **109**, 21–6.
30 Passauer-Baierl, S., Hull, L., Miskovic, D. *et al.* (2014) Re-validating the Observational Teamwork Assessment for Surgery tool (OTAS-D): cultural adaptation, refinement, and psychometric evaluation. *World J Surg.*, **38**, 305–13.
31 Weller, J., Frengley, R., Torrie, J. *et al.* (2011) Evaluation of an instrument to measure teamwork in multidisciplinary critical care teams. *BMJ Qual Saf.*, **20**, 216–22.
32 Fletcher, G., Flin, R., McGeorge, P. *et al.* (2003) Anaesthetists' non-technical skills (ANTS): evaluation of a behavioural marker system. *Brit J Anaesthes.*, **90**, 580–8.
33 Lichtenstein, R., Alexander, J.A., McCarthy, J.F. and Wells, R. (2004) Status differences in cross-functional teams: effects on individual member participation, job satisfaction, and intent to quit. *J Health Soc Behav.*, **45**, 322–35.
34 Eppich, W. and Cheng, A. (2015) Promoting excellence and reflective learning in simulation (PEARLS): development and rationale for a blended approach to health care simulation debriefing. *Simul Healthc.*, **10**, 106–15.
35 Rudolph, J.W., Simon, R., Dufresne, R.L. and Raemer, D.B. (2006) There's no such thing as 'nonjudgmental' debriefing: a theory and method for debriefing with good judgment. *Simul Healthc.*, **1**, 49–55.
36 Gilbert, J.H.V. (2005) Interprofessional learning and higher education structural barriers. *J Interprof Care*, **19** (suppl 1), 87–106.
37 Gaba, D.M. (2004) The future vision of simulation in health care. *Qual Saf Health Care.*, **13**, i2–i10. doi: 10.1136/qshc.2004.009878
38 Haynes, A., Weiser, T., Berry, W. *et al.* (2009) A surgical safety checklist to reduce morbidity and mortality in a global population. *N Engl J Med.*, **360**, 491–9.

CHAPTER 21

Debriefing: The state of the art and science in healthcare simulation

Adam Cheng, Walter Eppich, Taylor Sawyer & Vincent Grant

KEY MESSAGES

- Debriefing conversations remain a cornerstone of effective simulation-based education.
- Debriefing frameworks provide structure to the conversation by outlining phases to the debriefing process that serve specific functions.
- Debriefing approaches are characterized by particular methods of questioning, flow of discussion and overarching goals.
- Debriefing adjuncts, such as the use of video, a co-facilitator or a debriefing script, can help promote discussion and optimize learning outcomes.
- The healthcare simulation community and patients will benefit from determining optimal debriefing methods, defining ideal means of assessing debriefing performance and structuring peer feedback in order to improve learner performance.

Overview

The expansion of simulation-based education (SBE) parallels the equally exciting growth of debriefing in healthcare. Studies provide a growing evidence base that highlights the value of debriefing in SBE and compares variations of debriefing method, structure and content. Skillful and artful debriefing involves thoughtful application of debriefing frameworks, approaches and adjuncts, carefully executed in a manner most likely to promote conversation aligned with learners' needs. We outline various debriefing frameworks, approaches and adjuncts, while providing a toolbox of resources for simulation educators to use during debriefing. We also describe opportunities for debriefing faculty development and highlight key areas for future research to advance the field.

Introduction

Healthcare simulation continues to expand in a wide variety of venues, including undergraduate and postgraduate education as well as continuing professional development. Combined with scenarios designed with clear learning objectives in mind [1], debriefing remains a cornerstone of simulation-based education (SBE). Debriefing refers to the conversation about the simulation experience that traditionally occurs post event (i.e. after the simulation ends) [1]. With debriefing conversations, facilitators strive to promote reflective processes essential for learning [2], but also to provide learners with information about their performance to help them improve [3]. In contrast to debriefing, which is widely viewed as the conversation, feedback refers to the specific information provided to the learner about their performance compared with a defined standard [4]. Recent work has added to our understanding of the alignment between the type of learning objectives and the timing of performance feedback and debriefing conversation [3]. In addition to post-event debriefing strategies, within-event debriefing approaches are gaining traction. Such within-event debriefings, also termed micro-debriefings given their highly focused nature, have shown promise for resuscitation training [5].

Healthcare Simulation Education: Evidence, Theory and Practice, First Edition.
Edited by Debra Nestel, Michelle Kelly, Brian Jolly and Marcus Watson.

Conceptually, debriefing provides learners with an important opportunity to reflect on various aspects of the simulation, from concrete events related to what happened to, even more importantly, the rationale for their actions or inactions. Indeed, this reflection represents an essential element of the experiential learning cycle [6]. Once learners have reflected on concrete experiences from the simulation, they work to generalize what they have learnt to generate lessons for future clinical practice [3]. Active experimentation with potential solutions then leads to future experiences, when the experiential learning cycle begins anew. This process of reflection-on-action is the hallmark of SBE and represents an advantage over learning from clinical practice, for which time devoted to deliberate reflection is often a luxury. Thus, debriefing is a conversation in which the reflective process is facilitated by educators [7] or a structured reflection for peer-led debriefings [8]. Meaningful discussion and honest reflection about mistakes and sub-optimal performance are greatly enhanced by a supportive yet challenging learning environment that starts with an effective pre-briefing [9, 10]. While we focus on debriefing in this chapter, educators should recognize that effective SBE also includes a pre-briefing where the learners are orientated to the simulated clinical environment, expectations and roles are clarified, and rules of engagement are explicitly described for the purposes of creating a safe container for learning [9, 10].

The science of debriefing

Is debriefing effective? An extensive meta-analysis conducted across a broad body of research (including non-healthcare fields) reported that organizations can significantly improve the performance of individuals and teams by implementing properly conducted debriefings [11]. A recent systematic review of debriefing in SBE identified 177 studies in which debriefing accompanied an intervention [1]. Debriefing as a component of SBE was associated with improved knowledge, skills and clinical behaviours when compared with no intervention or other forms of instruction. Specific aspects of the debriefing process have been studied as well [1, 12]. A meta-analysis of four studies demonstrated no significant benefit for video-assisted debriefing, while three separate studies of short debriefing combined with expert modelling demonstrated some benefit when compared with a longer debriefing with no expert modelling of performance [1].

Several additional studies provide further detail regarding some instructional design features of debriefing that may help to enhance learning outcomes. Post-event debriefing has been found to be effective for resuscitation education [13], while within-event debriefing has been effective for endoscopy skills [14]. Student-led debriefing (or self-debriefing) has been effective for certain learner groups [8], and learners prefer debriefing that emphasizes reflection over performance critique [15]. Other researchers have described best practices for debriefing that were developed from an assimilation of existing literature and personal experience [16]. While studies increasingly assess various design elements of debriefing, research comparing one method of debriefing with another is lacking. As a consequence, educators are left to manage the art of debriefing with little guidance on which methods should be used to optimize learning.

The art of debriefing

Healthcare educators can learn the technical skills of debriefing, but *the art of skillful debriefing* involves thoughtful application of a debriefing framework, approaches and adjuncts carefully executed in a manner that is most likely to lead to conversation that addresses the learners' needs.

Debriefing frameworks

A debriefing framework structures the conversation by outlining several phases to the debriefing process that serve specific functions. Various debriefing frameworks have been described in the SBE literature. A commonly applied framework consists of three main phases: the reactions phase (where learner share their visceral emotions and initial reactions to the simulated experience); the analysis phase (where learners engage in reflective discussion and close performance gaps); and the summary phase (where key learning points are highlighted) [17]. Others have advocated for a description phase immediately following the reactions phase, the purpose of which is to have the learners briefly describe their perspective of what the simulation event was about (i.e. clarifying the working diagnosis) [3]. This ensures that the educator(s) and all learners have a shared mental model regarding the events of the simulation prior to detailed discussion about specific aspects of performance in the analysis phase.

The Gather, Analyze, and Summarize (GAS) framework of debriefing adopted by the American Heart Association [18] also incorporates three phases. In the *Gather* phase the educator invites learners to describe event of the case; the *Analyze* phase has learners reflecting on and analysing their performance, generating ideas for improvement and generalizing discussion points to other contexts; and the *Summarize* phase provides an overview of key take-home messages. Other multiphase frameworks have been described and utilized in SBE. The US Army's after-action review framework includes several distinct phases [19]: define the rules; explain learning objectives; benchmark performance; review expected actions; identify what happened; examine why things happened the way they did; and formalize learning. Lastly, the TeamGAINS approach encourages educators to apply six phases to the debriefing [20]: reactions; discuss the clinical component; transfer from simulation to reality; discussion of behavioural skills; summarization of the learning experience; and supervised practice of clinical skills (if necessary). See Table 21.1.

While many debriefing frameworks exist, little evidence guides their effective use for a given learning context or specific learner groups. However, consistent use of a particular debriefing framework helps educators structure their debriefings and, in turn, may help learners anticipate the flow and nature of conversation once they buy into a particular framework. For novice educators, adopting a debriefing framework can help predictably organize the debriefing process and promotes confidence. More seasoned educators may find that using a debriefing framework helps them to recognize exactly where they are in a debriefing, which can assist with managing time and prioritizing discussion points. The adoption of a particular debriefing framework by a simulation programme can standardize the debriefing process, thus making it easier to provide peer and/or expert feedback on debriefing skills.

Debriefing approaches

Debriefing approaches are characterized by particular methods of questioning, flow of discussion and overarching goals. These include providing information in the form of directive feedback or teaching to knowledge gaps, learner self-assessment, focused facilitation and blending approaches in a single debriefing (Table 21.1) [3, 20]. With directive feedback, the educator aims to identify a performance issue and then provide specific information in order to correct the performance gap [21]. It can be helpful to pair this information with the supportive rationale for corrective behaviours [3]. Directive feedback, while typically unidirectional with information flowing from educator to learner, plays an important role within a debriefing conversation to address specific issues efficiently [4]. Directive feedback and/or teaching is best suited to situations in which knowledge deficits are evident, or if learners are struggling with a particular procedural skill [3].

With learner self-assessment, educators engage learners in a self-reflective process to identify areas of individual or team strengths and weaknesses. The plus-delta method is one form of learner self-assessment where educators ask learners to identify things that went well, and some things that need improvement [3, 7]. This approach to debriefing is educator prompted, but subsequent discussion can be guided by issues or topics generated through learner self-assessment. After learners generate a list of issues, educators can gauge learners' insight based on how they assess their own performance. Aspects of performance that are miscategorized as strengths when they are actually areas of improvement are high-priority items for discussion during the analysis phase of the debriefing.

Educators choose focused facilitation strategies to catalyse discussion that promotes self-reflection, exploration of the underlying reasons for specific behaviours or decisions, identification of solutions to problems and generalization of these solutions to various different contexts. In 'debriefing with good judgement', educators use advocacy inquiry as one form of focused facilitation by pairing a concrete observation from the simulation with their point of view about it, followed by an open-ended question to solicit the learners' perspectives [17, 22]. For example, an educator may notice that during a simulated resuscitation of a child in septic shock, the medication nurse hesitates when the physician orders an incorrect dose of a sedative. Using advocacy inquiry, the educator can probe for the underlying rationale by asking: 'As the team was preparing for intubation, I saw you hesitate when the midazolam was ordered. I was thinking that the midazolam dose

Table 21.1 The art of skilful debriefing: Critical components.

Component of debriefing	Example	Description
Debriefing framework	Debriefing with good judgement	Phases: (1) Reactions; (2) Analysis; (3) Summary
	Promoting Excellence and Reflective Learning in Simulation (PEARLS)	Phases: (1) Reactions; (2) Description; (3) Analysis; (4) Summary
	Gather, Analyze, Summarize	Phases: (1) Gather; (2) Analyze; (3) Summarize
	US Military After-Action Review	Phases: (1) Define the rules; (2) Explain learning objectives; (3) Benchmark performance; (4) Review expected actions; (5) Identify what happened; (6) Examine why things happened the way they did; (7) Formalize learning
	TeamGAINS	Phases: (1) Reactions; (2) Discuss the clinical component; (3) Transfer from simulation to reality; (4) Discussion of behavioural skills; (5) Summarization of the learning experience; (6) Supervised practice of clinical skills (if necessary)
Debriefing Approaches	Providing information	Educators provide specific information to learners in the form of directive feedback or teaching in order to improve future performance
	Learner self-assessment	Educators engage learners in a self-assessment exercise whereby they explore aspects that went well during the simulation, and things that could be improved
	Focused facilitation	The educator facilitates discussion among the learners that encourages self-reflection, exploration of the underlying rationale for specific behaviours/action, identification of solutions to problems and generalization of solutions to various clinical contexts
	Blended approach	The educator thoughtfully and skilfully blends various approaches during a single debriefing. Approaches are carefully selected and adapted based on learner type, learning objectives, learning contexts and time available
Debriefing adjunct	Video debriefing	Video clips are selectively used to highlight aspects of performance during the simulation event
	Co-debriefing	Co-debriefing involves more than one educator contributing to the facilitation process
	Scripted debriefing	Use of a debriefing script or tool helps to standardize the framework and/or approach to debriefing and can serve as a faculty development tool

was high for the child's age, and that perhaps you had noticed that as well. What were your thoughts at that time?' This method uncovers the underlying rationale for a certain behaviour; modifying a learner's rationale for action through discussion and/or teaching is a powerful way to improve future performance. To use advocacy inquiry effectively, educators must be genuinely curious, hold their assumptions loosely and be willing to take the time needed to explore learners' thought processes openly [3].

Guided team self-correction helps learners address their own performance with facilitator support [23]. The educator prompts learners to compare their performance against defined standards of teamwork. Following this, learners are encouraged to analyse and self-correct their behaviours for each component of teamwork. In this sense, guided team self-correction is highly learner centred, but learners must have sufficient prior knowledge and experience to address their own performance deficits adequately. Thus, it is well suited for experienced teams.

Circular questions are a relatively new addition to the healthcare debriefing repertoire [20]. When using circular questions, educators invite someone to reflect on an interaction during the simulation between two other people, thus encouraging a third-person perspective [20]. Sharing insights from this third-person vantage point often triggers discussion that helps uncovers the underlying rationale driving behaviours of interest. This method of questioning also allows individuals and teams to generate solutions to problems uncovered through conversation. Circular questions, in addition to advocacy inquiry and guided team self-correction, play an important role in the TeamGAINS approach to debriefing healthcare teams [20].

Blending approaches to debriefing allows educators to adapt debriefing methods to learner types, learning objectives and learning contexts. No one approach to debriefing is optimal for all intended learning outcomes (e.g. improved clinical reasoning, team working or psychomotor skills). The Promoting Excellence and Augmented Reflective Learning in Simulation (PEARLS) debriefing approach encourages selective blended use of learner self-assessment, focused facilitation strategies and providing information such as directive feedback or targeted teaching during the analysis phase [3]. The PEARLS approach maximizes the strengths of various approaches while striving to minimize weakness, and guides educators as to when each method could be used. Blending debriefing approaches, such as TeamGains [20] or PEARLS [3], require proficiency with each approach to integrate them skilfully and dynamically during a single debriefing.

Debriefing adjuncts

Educators can utilize a number of debriefing adjuncts to maximize the impact of the debriefing experience. Three adjuncts that could be utilized with the debriefing experience include video review, using a co-debriefer and employing a debriefing script. Video-assisted debriefing allows learners and educators to review a relevant clip of the simulation event to prompt further discussion. While a meta-analysis of four video debriefing studies showed equivocal results when compared to non-video-assisted debriefing [1], the use of video may still demonstrate promise if used in specific situations. Video review can clarify actions and behaviours, illustrate excellent individual or team performance and review unclear communication patterns lost in busy clinical activity [24]. When educators selectively use short video clips and preview for learners what aspects are relevant, this strategy can trigger learner reflection and facilitate meaningful discussion [24].

Co-debriefing involves more than one educator from the same or a different profession facilitating the debriefing conversation together [25]. Effective co-debriefing requires shared understanding of educator roles, debriefing methods and frameworks, learning objectives and a co-debriefing method to leverage the collective experience of all educators. Adding extra educators creates a dynamic between them that should be managed tactfully in a proactive fashion. A co-debriefing checklist encourages open discussion among educators before the simulation session [25]. Educators should meet briefly after each simulation session (e.g. a post-simulation huddle) to discuss positives and negatives from the prior debriefing. If performed consistently and paired with some structure, these huddles represent an important faculty development opportunity that may lead to improved debriefing performance over time.

A debriefing script is a cognitive aid with suggested wording and phrases to guide less experienced educators through the debriefing process. When novice educators use debriefing scripts, learning outcomes for simulation-based paediatric advanced life support training improve [26]. The American Heart Association incorporated debriefing scripts into instructor materials for its advanced life support courses in 2010 to standardize debriefing methods across training programmes [18]. Debriefing scripts also serve as faculty development tools for training new simulation educators [3].

Future directions

The art and science of debriefing have evolved significantly in the past 15 years, primarily devoted to the description of various methods of post-event debriefing. Less attention has been paid to debriefing quality and how to design faculty development opportunities to ensure safe and effective debriefing practice [1, 12].

These aspects represent critical elements for simulation education programme planning related to debriefing and SBE [27].

Debriefing assessment tools

Effective faculty development for debriefing relies on tools that yield valid and reliable information about debriefing quality. Several tools exist that provide both qualitative and quantitative assessments of debriefing practice [28, 29]. Two tools that focus on simulation educator debriefing performance have undergone psychometric testing: the Objective Structured Assessment of Debriefing (OSAD) [28] and the Debriefing Assessment for Simulation in Healthcare (DASH) [29]. The OSAD was developed for debriefing following surgical simulations and for pediatric simulations [30], and demonstrates good inter-rater reliability and internal consistency [28]. It assesses eight core elements using a behaviourally anchored rating scale: approach, learning environment, learner engagement, reaction, reflection, analysis, diagnosis and application [28]. Also a behaviourally anchored rating scale, DASH assesses debriefing across six elements: establishes an engaging learning environment; maintains an engaging learning environment; structures the debriefing in an organized way; provokes engaging discussion; identifies and explores performance gaps; and helps trainees achieve or sustain good future performance [29]. DASH was developed for a variety of specialties and disciplines, and has versions for raters, instructor self-assessment and learner assessment of instructors. The DASH rater (i.e. expert) version demonstrates good evidence of validity and reliability in one limited context. Further generalization of these tools to other learner groups and contexts will aid in the development and ongoing assessment of debriefing skills in simulation educators.

Assessment of debriefing skills for faculty development

Debriefing assessment tools can be used in a formative (or summative) manner to provide objective feedback to educators as part of a debriefing quality assurance programme, where debriefing practice can be measured and tracked over time. Longitudinal data may offer insights into retention and decay of debriefing skills, and may highlight specific faculty development needs for individual educators [27]. How best to provide feedback on debriefing performance for both novice and experienced debriefers is poorly understood.

Peer feedback is a potential means to enhance the feedback culture surrounding debriefing within simulation programmes. Peer observation and feedback have already been shown to be an effective means of improving clinical teaching [31]. Application of peer observation and feedback for debriefing skills would likely yield similar results. However, simulation educators need guidance on how to provide honest and constructive peer feedback through faculty development that allows for deliberate practice in facilitating feedback conversations on debriefing performance [27].

Debriefing research

Finally, progress in debriefing assessment and faculty development lies in well-designed research that augments our understanding of how these advances can affect learners' educational outcomes. Important areas for future research include the various factors that influence debriefing (e.g. timing, length, structure); how adjuncts can further enhance debriefing (e.g. video, scripting, multiple facilitators); comparative effectiveness research on debriefing methods and their impact on educational and clinical outcomes; and characteristics of faculty development in debriefing (e.g. frequency, timing, content and structure) that benefit both educators and ultimately learners [32]. Researchers should carefully isolate the independent variable and ensure that all simulation-specific confounders are carefully controlled for in the study design [32, 33].

Conclusion

Debriefing is a critical and rapidly evolving part of SBE. The application of frameworks, structured approaches and debriefing adjuncts provides educators with a toolbox of resources that promotes learning from SBE. Future debriefing research should define optimal methods and identify strategies to enhance debriefing skills through faculty development.

References

1 Cheng, A., Eppich, W., Grant, V. *et al*. (2014) Debriefing for technology-enhanced simulation: a systematic review and meta-analysis. *Med Educ*, **48** (7), 657–66.

2 Kihlgren, P., Spanager, L. and Dieckmann, P. (2014) Investigating novice doctors' reflections in debriefings after simulation scenarios. *Med Teach.*, **5**, 1–7.

3 Eppich, W. and Cheng, A. (2015) Promoting Excellence and Reflective Learning in Simulation (PEARLS): development and rationale for a blended approach to health care simulation debriefing. *Simul Healthc*, **10** (2), 106–15.

4 van de Ridder, J.M., Stokking, K.M., McGaghie, W.C. and ten Cate, O.T. (2008) What is feedback in clinical education? *Med Educ*, **42** (2), 189–97.

5 Eppich, W., Hunt, E.A., Duval-Arnauld, J. *et al*. (2015) Structuring feedback and debriefing to achieve mastery learning goals. *Acad Med*, **90** (11), 1501–8.

6 Kolb, D. (1984) *Experiential learning: experience as a source of learning and development*, Upper Saddle River, NJ, Prentice Hall.

7 Fanning, R.M. and Gaba, D.M. (2007) The role of debriefing in simulation-based learning. *Simul Healthc*, **2** (2), 115–25.

8 Boet, S., Bould, M.D., Sharma, B. *et al*. (2013) Within-team debriefing versus instructor-led debriefing for simulation-based education: a randomized controlled trial. *Ann Surg*, **258** (1), 53–8.

9 Kolbe, M., Grande, B. and Spahn, D.R. (2015) Briefing and debriefing during simulation-based training and beyond: content, structure, attitude and setting. *Best Pract Res Clin Anaesthesiol*, **29** (1), 87–96.

10 Rudolph, J.W., Raemer, D.B. and Simon, R. (2014) Establishing a safe container for learning in simulation: the role of presimulation briefing. *Simul Healthc*, **9** (6), 339–49.

11 Tannenbaum, S.I. and Cerasoli, C.P. (2013) Do team and individual debriefs enhance performance? *A meta-analysis. Hum Factors.*, **55**, 231–45.

12 Garden, A.L., Le Fevre, D.M., Waddington, H.L. and Weller, J.M. (2015) Debriefing after simulation-based non-technical skill training in healthcare: a systematic review. *Anaesth Intensive Care.*, **43**, 300–8.

13 Van Heukelom, J.N., Begaz, T. and Treat, R. (2010) Comparison of post-simulation debriefing versus in-simulation debriefing in medical simulation. *Simul Healthc.*, **5**, 91–7.

14 Walsh, C.M., Ling, S.C., Wang, C.S. and Carnahan, H. (2009) Concurrent versus terminal feedback: it may be better to wait. *Acad Med*, **84** (Suppl), 54–7.

15 Dreifuerst, K.T. (2012) Using debriefing for meaningful learning to foster development of clinical reasoning in simulation. *J Nurs Educ.*, **51**, 326–33.

16 Lyons, R., Lazzara, E.H., Benishek, L.E. *et al*. (2015) Enhancing the effectiveness of team debriefings in medical simulation: more best practices. *Jt Comm J Qual Patient Saf*, **41** (3), 115–25.

17 Rudolph, J., Simon, R., Dufresne, R. and Raemer, D. (2006) There's no such thing as "nonjudgmental" debriefing: a theory and method for debriefing with good judgment. *Sim Healthc*, **1** (1), 49–55.

18 Cheng, A., Rodgers, D., Van Der Jagt, E. *et al*. (2012) Evolution of the pediatric advanced life support course: enhanced learning with a new debriefing tool and web-based module for pediatric advanced life support instructors. *Ped Crit Care Med*, **13** (5), 589–95.

19 Sawyer, T. and Deering, S. (2013) Adaptation of the U.S. Army's After-Action Review (AAR) to simulation debriefing in healthcare. *Sim Healthc*, **8** (6), 388–97.

20 Kolbe, M., Weiss, M., Grote, G. *et al*. (2013) TeamGAINS: a tool for structured debriefings for simulation-based team trainings. *BMJ Qual Saf*, **22** (7), 541–53.

21 Archer, J.C. (2010) State of the science in health professional education: effective feedback. *Med Educ*, **44** (1), 101–8.

22 Rudolph, J.W., Simon, R., Raemer, D.B. and Eppich, W.J. (2008) Debriefing as formative assessment: closing performance gaps in medical education. *Acad Emerg Med*, **15** (11), 1010–16.

23 Smith-Jentsch, K.A., Cannon-Bowers, J.A., Tannenbaum, S.I. and Salas, E. (2008) Guided team self-correction: impacts on team mental models, processes, and effectiveness. *Small Gr Res*, **39** (3), 303–27.

24 Krogh, K., Bearman, M. and Nestel, D. (2015) Expert practice of video-assisted debriefing: an Australian qualitative study. *Clin Simul Nurs.*, **11**, 180–87.

25 Cheng, A., Palaganas, J., Rudolph, J. *et al*. (2015) Co-debriefing for simulation-based education: a primer for facilitators. *Simul Healthc.*, **10**, 69–75.

26 Cheng, A., Hunt, E., Donoghue, A. *et al*. (2013) Examining pediatric resuscitation education using simulation and scripted debriefing: a multicenter randomized trial. *JAMA Pediatr*, **167** (6), 528–36.

27 Cheng, A., Grant, V., Dieckmann, P. *et al*. (2015) Faculty development for simulation programs: five issues for the future of debriefing training. *Simul Healthc*, **10** (4), 217–22.

28 Arora, S., Ahmed, M., Paige, J. *et al*. (2012) Objective structured assessment of debriefing (OSAD): bringing science to the art of debriefing in surgery. *Ann Surg*, **256** (6), 982–8.

29 Brett-Fleegler, M., Rudolph, J., Eppich, W. *et al*. (2012) Debriefing assessment for simulation in healthcare: development and psychometric properties. *Simul Healthc*, **7** (5), 288–94.

30 Runnacles, J., Thomas, L., Sevdalis, N. *et al*. (2014) Development of a tool to improve performance debriefing and learning: the paediatric objective structured assessment of debriefing (OSAD) tool. *Postgrad Med J*, **90** (1069), 613–21.

31 Steinert, Y., Mann, K., Centeno, A. *et al*. (2006) A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education: BEME Guide No. 8. *Med Teach*, **28**, 497–526.

32 Raemer, D., Anderson, M., Cheng, A. *et al*. (2011) Research regarding debriefing as part of the learning process. *Simul Healthc.*, **6**, s52–s57.

33 Cheng, A., Kessler, D., MacKinnon, R., *et al*. (2016) Reporting Guidelines for Health Care Simulation Research: Extensions for the CONSORT and STROBE Statements. *Simulation in Healthcare*. **11** (4):238–248.