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Chapter 1

Setting the Scene for Simulation-Based Education

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I still can't believe that we did that difficult epidural scenario right before it happened for real. We knew exactly what to do. So very proud of our teamwork. [Delivery suite team participant in simulation]

Practising speculum insertion on the pelvic model built my confidence before doing my first Pap smear. Although it was different on my patient, I'd rehearsed the manoeuvres and knew how to handle the speculum. [Medical student]

We tried out the functionality of our new delivery suite before it was fully fitted out by simulating a whole day of clinical practice. Probably saved a lot of money but even more importantly uncovered some flaws in our processes from patient and staff perspectives. [Hospital manager]

Introduction

Whether healthcare simulation is providing an opportunity to develop teamwork skills, build individuals' confidence and psychomotor skills, or testing processes in a new facility, its impact can be profound. Simulation practice and research has matured sufficiently such that we need no longer focus on proving that it works, but on how to use it optimally and efficiently. The question is: how can we use simulation to support students and clinicians in developing safer practices and to design safer healthcare systems? The first chapter of an edited book is written with the intent of setting the scene. It is both a privilege and a responsibility to offer the foundations for the contributions from other authors. This book focuses on the use of simulation as an educational method and contributes to the broader conversation on safer healthcare systems. We start by defining simulation and describing the current healthcare landscape with reference to drivers for simulation uptake. We then offer an overview of simulation modalities and considerations for designing and implementing simulation-based education (SBE).

Scoping the Healthcare Simulation Landscape

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. (Gaba, 2007)

Healthcare simulation is not a new concept. Quite conversely, it has historical origins. Take, for example, Madam du Coudray's fully simulation-based curriculum for midwives which was implemented in rural France in the eighteenth century (Owen, 2016). The drivers for that programme related in part to *macro-level* factors of the day. These agricultural populations were vulnerable to numerous socioeconomic stressors, among which high infant mortality made significant negative contribution. An important point here is that significant change occurred not because of *evidence* for the effectiveness of simulation but in response to large-scale social, economic and political demands. Today we are in a similar position, where our own modern macro-level factors are influencing simulation uptake. However, we are also equipped with knowledge about how simulation works, when and for whom. Empowered by this understanding, we can move towards addressing macro-level considerations, with simulation as an evidence-based and useful tool in our educational armamentarium.

What are some of these contemporary macro factors? Newspaper reports in 2017 document the apparently high numbers of infant deaths in one National Health Service (NHS) Trust in the United Kingdom (UK). Just as in eighteenth-century France, simulation could play a key role in addressing this issue. Despite recommendations from earlier investigations to improve professional practices and systems, the standards of care remain insufficient to meet societal expectations (Buchanan, 2017; Donnelly, 2017). The negative financial and reputational implications of

these events to the NHS are significant. Perhaps even more so are the immeasurable emotional, psychological and social costs to the families and healthcare providers involved in adverse events. Although there can be no doubt that such expenses far outweigh the cost of targeted simulation training and systems testing, high-level political commitment is still required to effect change. In 2009, the UK's Chief Medical Officer (Sir Liam Donaldson) wrote that simulation was one of the top priorities of the health services for the next decade (Donaldson, 2009). He emphasised the utility of simulation in rehearsal for emergency situations, for the fostering of teamwork and for the development of psychomotor skills in safe settings that do not place patients at risk. He also questioned the logic of charging clinicians to undertake training to make their practice safer.

In Australia, a macro driver for significant government investment in healthcare simulation infrastructure and faculty development was the estimated shortfall of clinical placement opportunities for healthcare students. Of course, patient safety is an important consideration, but the pressing need for training the future healthcare workforce remains. So far, investment has largely been at entry-level health professions (Australian Government Department of Health, 2015), although several initiatives were funded in 2010 for specialty medical and surgical training. However, only the Training in Professional Skills (TIPS) programme at the Royal Australasian College of Surgeons (RACS) has been sustained (Bearman et al., 2011, 2012).

Other drivers for SBE are well reported (Box 1.1). We have already identified patient safety and the expanding numbers of health professional students, while other key drivers may be values-based, education-focused, or initiatives at *meso-* or *micro*-level. The shift to competency-based education, combined with growing evidence supporting SBE as an effective instructional approach, is also important (Nestel et al., 2013). Herein, we are seeing *accountability* arising from published standards for simulation practice, certification of practitioners and accreditation of programmes. Higher-educational systems in healthcare now offer short and award courses which feature prominent roles for simulation, thus facilitating quality control and improvement, as well as mitigation of the *human factors*. There is a vibrant research community with

Box 1.1 Drivers for Uptake of Simulation-Based Education, Adapted from Nestel et al. (2011).

Values-based drivers
- Ethical imperative of causing no harm to patients
- Recognition of importance of patients' perspectives
- Responsibility of preparing healthcare practitioners to work in a changing clinical landscape

Education-oriented drivers
- Facilitating a systematic approach to curriculum activities
- Shifting to competency-based curricula
- Assuring students/clinicians have direct/indirect exposure to certain clinical events
- Allowing for adjustment in the level of challenge offered to participants
- Identifying boundaries of competence of participants
- Providing rehearsal and assessment of technical, communication and other professional skills essential for safe clinical practice
- Enabling rehearsal of infrequently occurring events

Meso-level drivers
- Growing prominence of the patient safety movement
- Reducing length of hospital stays for patients and therefore reducing access to patients for learning
- Growing evidence of simulation as an effective educational method
- Increasing number of professional networks/societies/associations with a simulation orientation
- Establishing standards for optimal simulation practice including certification of simulation practitioners, accreditation of simulation centres or programmes

Macro-level drivers
- Working time directives/safer working hours initiatives
- Maturing national quality improvement strategies
- Growing prominence of the patient safety movement
- Increasing numbers of medical and health professional students
- Expanding national assessments for professional practice
- Billion-dollar worldwide healthcare simulation industry

new healthcare simulation-focused journals and several new textbooks such as this one. We provide a list of additional resources at the end of the chapter. It is also important to acknowledge that healthcare simulation is a billion-dollar global industry.

Healthcare simulation also has limitations and these are shared across the book. A major limitation remains the operational cost of simulation. An important area of research will be economic evaluations of SBE and other simulation applications (Maloney and Haines, 2016; Nestel et al., 2017). Further, assumptions are also 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 it is incumbent on simulation practitioners to design *safe learning environments* in which all participants can develop their practice without harm.

Simulation Modalities

Simulation modalities are diverse. Most introductory books on healthcare simulation document these according to type and create a hierarchy of realism or fidelity – a highly contested notion (see later). We offer examples of core modalities and their combined use, especially in simulation scenarios. These modalities may be available in simulation centres and skills labs in higher education units and health services or may be offered *onsite* or *in situ* (Posner et al., 2017). See Chapter 5 for more information.

Simulated, or *standardised*, *participants* (SPs) refer to individuals who are paid or volunteers (patients, actors, health professionals or students) who are trained to portray specific roles within a simulation and to offer feedback to participants. As proxies for patients, SPs must be empowered to accurately represent (or simulate) them. Given that clinicians (with their own view of healthcare experiences) often train SPs, there can be challenges to the delivery of authentic *patient* perspectives (Nestel, 2015). (See example in Table 1.1.)

Task trainers enable participants to learn psychomotor skills applicable to procedures or operations. They vary in sophistication and technology from simple benchtop models (e.g. suturing, intubation) to sophisticated virtual reality models (e.g. laparoscopy; Aggarwal et al., 2007; Larsen et al., 2009) and virtual reality environments (Huber et al., 2018) (see example in Table 1.1).

Manikins are commonly used for developing team-based interprofessional care. They vary in technological sophistication and can be programmed to demonstrate physiological indicators of a patient's condition. Depending on the manikin, participants can also undertake a diverse range of clinical procedures. Examples include *SimMom* (Laerdal; enabling SBE through all phases of labour) and *Desperate Debra* (Adam Rouilly; enabling SBE in the management of impacted fetal head at caesarean section).

Screen-based simulators use different technologies to provide learners with opportunities to develop knowledge of diverse clinical skills including diagnostic decision-making, steps in operative procedures, patient-centred communication and more. They often have a tremendous advantage of being highly accessible, including at the point of care.

Hybrid simulations are those in which simulation modalities are combined. They usually involve an SP with a task trainer (e.g. urinary catheter model, rectal examination model) and enable a staged approach to the development of psychomotor and communication skills (Higham et al., 2007).

Simulation-based training packages are widely available in obstetrics. Developed in the UK, PRactical Obstetric Multi-Professional Training (PROMPT) is designed to support the development of interprofessional collaborative practice for obstetric emergencies. The package is used internationally and has demonstrated direct improvements in perinatal outcome and improvements in practitioners' knowledge, clinical skills and team-working (*PROMPT – Making Childbirth Safer, Together*, 2017). *Advanced Life Support in Obstetrics* (ALSO) and *Become a Breech Expert* (BABE) are Australian-based examples (Advanced Maternal and Reproductive Education).

Robotic surgery is emerging as a minimally invasive operative modality in gynaecology. Benefits over existing modalities include improved surgeon ergonomics, *wristed* nature of robotic instruments, and elimination of requirement for counterintuitive motion in the operative field. While we are watching this space, steady emergence of robotics must be recognised as limited by cost, access (currently available within the private health system only) and lack of robust data demonstrating global superior efficacy over techniques such as laparoscopy (Manolitsas, 2012). With increasing availability and utility of robotic surgery, simulation

Table 1.1 Considerations of tasks for simulation practitioners using the simulation phases in three examples. For each example, we have assumed that the session is either mandated, addresses a curriculum gap, meets a clinical need or is experimental. It is not possible to include all tasks but we have attempted to identify some critical ones and those that characterise simulation as an educational method.

	SP-based formative assessment for medical students explaining vaginal examination and Pap smear to a patient	**Laparoscopic simulator for trainees to learn basic skills**	***In situ* delivery suite simulation with hybrid simulator for interprofessional collaborative practice**
Preparing	• Align assessment with curriculum requirement and set learning objectives • Write simulation plan for all phases noting Calgary–Cambridge[1] guide for debriefing phase • Choose simulators – simulated patient • Set up the environment – consultation room • Recruit SP and provide training for role portrayal and feedback • Identify rating forms • Rehearse the consultation including timings; note differences to a real encounter • Recruit and train faculty	• Set learning objectives for distributed training package that is trainee-led • Check simulator is available and working • Write simulation plan for all phases • Write guidance notes for trainees to optimise use considering different levels of experience • Ensure trainees will have access to simulators	• Set learning objectives • Develop scenario in a consultative process (with other stakeholders) • Write simulation plan for all phases noting pause and discuss feedback during the simulation and SHARP[2] after the scenario with video-assisted debriefing (VAD)[3] • Choose simulators – simulated patient and birthing suit • Recruit SP and provide training for role portrayal, using a birthing suit and debriefing process • Obtain permissions/notify all staff of the *in situ* simulation • Rehearse the whole scenario including timings; note differences to a real encounter • Recruit and train faculty
Briefing	• Inform faculty and students about the simulation • Orient students to the task, learning objectives and process for feedback • Orient students to the environment and SP including differences to a real encounter • Give observer students specific tasks • Ask for questions	• Trainees new to the simulator will need orientation to its set up, tasks, data capture for feedback • Ensure reporting process if simulator is not working	• Inform faculty and participants about the simulation • Orient participants to the task, learning objectives, pause and discuss and debriefing approaches • Discuss current strengths and areas for development of collaborative team practice • Discuss respect issues relevant to participants' performances and ideas shared in the debriefing • Orient participants to *in situ* simulation, the SP and the limitations of the birthing suit • Ask for questions
Simulating	• Implement the simulation activity as planned	• Trainees to use the simulator as requested over 6-week training package and in response to meeting end goals	• Start video-recording • Use pause and discuss approach to feedback if necessary • Ensure *in situ* simulation does not compromise safety in ongoing clinical activity
Debriefing/ offering feedback	• Give time for completion of rating forms • Use Calgary–Cambridge approach to feedback • Invite observer students to participate • Check SP has come out of role for feedback	• Trainees use feedback generated from simulator to improve their performance	• Use SHARP for debriefing • Illustrate key points with VAD • Check SP has come out of role for feedback
Reflecting	• Ask students to complete a 500-word written reflection to be placed in portfolios • Ask students to commit to a peer discussion about the task once they have had practice in real settings	• Trainees encouraged to note progress in portfolio; to identify their improvements and areas for development to help set new goals for the next training session	• Ask participants to plan how they will use the learning from the simulation in their future practice • Faculty can use OSAD[2] to reflect on their debriefing practice
Evaluating	• Ask faculty, SP and students to complete a rating form about the effectiveness of the session • Use evaluation data to inform planning for next session	• Ask trainees to complete an evaluation form after the completion of the whole training package • Use evaluation data to inform planning for next training package	• Ask faculty, SP and participants to complete a rating form about the effectiveness of the session • Use evaluation data to inform planning for next session

[1]Kurtz, S. and Silverman, J. (1996). The Calgary–Cambridge Referenced Observation Guides: an aid to defining the curriculum and organizing the teaching in communication training programmes. *Medical Education*, 30, 83–89.
[2]Imperial College London. (2012). *The London Handbook for Debriefing: Enhancing Performance Debriefing in Clinical and Simulated Settings*. Retrieved from: https://workspace.imperial.ac.uk/ref/Public/UoA%20 01%20-%20Clinical%20Medicine/lw2222ic_debrief_book_a5.pdf
[3]Krogh, K., Bearman, M. and Nestel, D. (2015). Expert practice of video-assisted debriefing. *Clinical Simulation in Nursing*, 11, 180–187.

Chapter 2

The Where of Simulation Training

Al May

Simulation is by no means a new phenomenon in medical education; it is an ever-developing learning modality. When agreeing the learning objectives and goals of the simulation, consideration of the locality of your session is essential to maximise the focus of the learning.

In Situ Simulation Versus the Simulation Centre

In situ simulation can be generally taken to mean simulation that is integrated into the real environment. In its broadest sense within healthcare, this could include actual clinical areas where patients are managed, and areas set aside solely for simulation but within a wider clinical area (e.g. a side room of a labour ward permanently set up for simulation). To take this further, it is clear that the *in situ* environment must be the actual clinical environment for the specific people participating in the simulation. They may be participating in the simulation as part of their normal working day while simultaneously engaged with the clinical care of real patients, or participating solely in simulation with no other responsibilities. The importance of this difference is highlighted under the heading of safety for patients. This is contrasted with simulation centre simulation, which will be isolated either physically or functionally from real clinical areas. Although an isolated simulation set up may not be referred to locally as a 'Centre', it clearly should be considered as such. In either case, the simulation modality could of course be anything from a paper-based drill walk-through in the real clinical environment to fully immersive, real-time, psychologically high-fidelity simulation.

What are the Similarities Between *In Situ* Simulation and Simulation in a Dedicated Centre?

Similarities: Aims of Simulation

With the potential exception of systems assessment (discussed below in What Are the Differences?), the simulation centre and the *in situ* environment can be used for all the same aims. You will almost certainly soon get tired of people asking you to 'come and do some simulation'. The first question you should be asking is, 'What do we need to achieve?' This needs to be followed up with a serious consideration of whether simulation (in all its many forms) is the most efficient and effective way to achieve that aim for your learner/organisation.

In terms of volume of learning for time spent, constructively aligned, planned learning through debriefing of actively driven simulation is probably the most efficient. This may make use of anything from simple table-top exercises to fully immersive real-time, real-team events. The planned learning content could be equally diverse from practising an uncommon drill in a step-by-step way, to learning how to hand over information in real time. Simulation for formative assessment is commonly used, but in reality, is only efficient for a minority of high-performing, well-trained stable teams: there is usually some planned learning that could be delivered first. Summative assessment of individuals, teams, equipment or work processes can clearly be done in both environments, but the simulation centre is usually better placed in terms of resource and research expertise to create a validated assessment tool which would stand up to scrutiny.

Once the aims are clarified and the specific objectives defined, you will select the cheapest and most efficient simulation modality to deliver what you plan, both *in situ* and in a simulation centre. You will consider everything from table-top exercise simulation, through individual task trainers, to full-body manikin immersive simulation.

Similarities: Structured Developmental Conversations and Debriefing

A developmental conversation of some form is equally important in both *in situ* and simulation centre environments. This is both to ensure the objective of the

simulation is achieved, but also to maintain the psychological safety of the participants. Of prime relevance here is Ericsson's assertion that practice merely makes permanent. Development is unlikely without deliberate practice; the sandwiching of active efforts to improve through reflection, facilitated reflection or feedback, between episodes of performance (Ericsson et al., 1993).

When participants are engaging with simulation in their real clinical environment, where there may be resource pressure in terms of time or space, they still require the same amount and quality of debriefing as they would for the same objectives in the centre. If time is tight and you think you may have to cut some debriefing, you're trying to pack too much in and the simulation activity or scenario needs to be shorter.

What are the Differences Between *In Situ* Simulation and Simulation in a Dedicated Centre?

Differences: Aims of Simulation

The main potential difference in what objectives can be achieved using *in situ* simulation pertains to 'the system', or the interaction of staff, patients and system with the healthcare process. If a real-time immersive simulation can allow participants, the system and the simulation itself to act and react exactly as they do in real life, then there is a relevance to using this technique. If any of these aspects depart from reality, the data that are discovered are at best less likely to be representative and at worst dangerously misrepresentative of the system being analysed. By extension, this means that using real-time immersive simulation to test a system must have the sole objective of testing the system. Any interference in the running of the 'scenario' activity in order to create learning for participants within debriefing is highly likely to pollute and therefore invalidate the systems testing information.

So where does this leave *in situ* real-time immersive simulation for systems testing? There are various publications associating *in situ* simulation with the detection of latent safety threats (Patterson et al., 2013; Wetzel et al., 2013; Auerbach et al., 2015). This includes assessment of new facilities and systems before patients are treated, as practised by the UK army for several years (Ingram, M. Col., Clinical Director Army Medical Services Training Centre, personal communication; Kobayashi et al., 2006). However, consider how latent safety threats could be discovered in a more efficient way, or put another way, consider how many of these latent threats are truly 'hidden' if we actually look for them in the right way. Gathering key relevant staff together from the top of the organisation all the way to the clinical floor will allow you to identify a process map for the specific 'system' that requires testing. Overlaying a failure mode and effects analysis will identify the majority of 'system problems', which could be eliminated or mitigated before the manikin even gets out of the box. More importantly, this approach provides you with a structure for data collection if and when you decide to run a real-time immersive *in situ* simulation system test. In a way, you can sit around the table and conceptually drive a patient through a system within your department. Because our systems within healthcare are complex, as for any other complex system, we would expect errors or latent threats not to be independent. Therefore, running a manikin through the system in real time will only pick up one error chain; one snapshot of things that happened once and not a rich overview of how the system works and what it needs for resilience. Having considered this, you may get to the end of the table-top exercises and then decide that an *in situ* simulation is in fact warranted, but it certainly should not be your first port of call. Other methodologies for understanding your systems are available and specifically the functional resonance analysis method (FRAM, available at: http://functionalresonance.com/index.html; Hollnagel, 2012) is gaining utility within healthcare, and the reader with aspirations of improving healthcare systems is directed to further reading on this.

Taking a step back to look at the whole picture, perhaps one of the broader aims of *in situ* simulation is to promote learning in the workplace and a culture of continual support for improvement. Using simulation to make debriefing and learning an everyday occurrence can create a learning opportunity from every clinical encounter, fostering a culture that is continually striving to improve through recognising and understanding success and learning from mistakes. Linking your simulation activity to the clinical governance systems within your organisation will help stakeholders see relevance and value in what you are doing. Perhaps this is the true added value of *in situ* simulation versus the simulation centre.

Differences: Resources

The first consideration is whether the equipment you want to use is portable enough. Along with this goes a consideration of what you actually need to use to

achieve the intended outcomes. As a general rule, the responsible approach is to use the cheapest, simplest and most portable equipment that will deliver the intended outcome with the optimal degree of engagement and psychological fidelity for that outcome. Most modern equipment can be moved around, but employing a trained simulation technician within your organisation will almost certainly be cheaper than the cost of ongoing repairs of badly maintained equipment.

If video capture is part of your process then ensure you have a robust organisational policy governing its use. Increasingly, video capture of real patients being treated is used for staff development through video-assisted debriefing, and modifications to policy already written for this purpose will often suffice. Retention of video must have specific consent that would usually include the purpose and likely uses of this video in the future. The big question to ask first is 'Why do I need this piece of video?' and the answer is usually that you don't. Retaining pieces of debriefing video for a limited time (e.g. 2 weeks) to allow in-house faculty development is probably the only purpose you should consider.

Differences: Time

Having tightly planned simulation activity ensures that the 'on the ground' time is minimal. This should include as much information as possible including requirements in terms of simulation, ancillary and audiovisual equipment, environmental set-up, running instructions, faculty roles, debrief notes, intended outcomes, evaluation of event and clean up procedure. In fact, if you have a library of simulation-based packages (not simply full-body manikin immersive simulations) then you will find that education can fit in to the occasional ten minutes of downtime – even over a cup of tea!

Differences: Space

When performing *in situ* simulation, you should automatically have a higher degree of environmental fidelity; the environment is actually real! This will be useful, depending on what your aims are. Having the real environment means the location and time to retrieve equipment and staff are close to reality so helping people to learn about this will be easier than in the simulation centre. A simple example could be an equipment race; simulating gathering equipment for a task without needing to run an immersive, real-time simulation. Being in the real environment will almost certainly make achieving high psychological fidelity (the perception of reality in the participant mind) easier, which will be useful when achieving the objectives that require real behaviours, in real time, from the participants. Having said this, you would be striving for the same level of psychological fidelity to achieve these objectives in the simulation centre also.

With the *in situ* environment, you may not have the luxury of a remote area set up with audiovisual for a wider group of participants to watch the simulation and then take part in the debriefing. You may not have a separate area to debrief in while the next simulation is being set up. You may not have a separate control room from which to drive the simulation. Thankfully, you will find that these logistical differences are easy to overcome, primarily by focusing everyone on the process of learning through simulation. People soon forget about these logistical potential problems. There are also some physical things you can do if you feel it necessary. Using a fishbowl set-up whereby participant observers are placed around the edges of the simulation can be useful. The observers are briefed that they are there to watch and not interfere in any way with the simulation but to get involved in the debriefing conversation afterwards. You will find that the participants within the simulation soon forget there are people at the periphery. This is certainly preferable to involving everyone in the simulation itself because you think you should, but it in fact detracts from the reality of the situation. A laptop, webcam and long cable can simply and cheaply achieve the same.

Differences: Experience for Patients

It is obvious but vital to be aware of patients in the proximity of simulation. If a patient understands the intended outcome of the event as being aimed at improving performance and patient safety they are much more likely to be accepting of the process, when it is happening in an adjacent cubicle. In fact, more than accepting, patients are often reassured that training appears to be occurring. As a general rule, debriefing should probably not be carried out within earshot of patients. The reason for this is that through the process of debriefing participants may be moving from having displayed a performance gap towards conceptualising the underpinnings of that and considering strategies for the future, all of which is likely to be out of context and sound concerning from the outside. Letting patients know that simulation is going to be happening is essential and giving handouts and even having