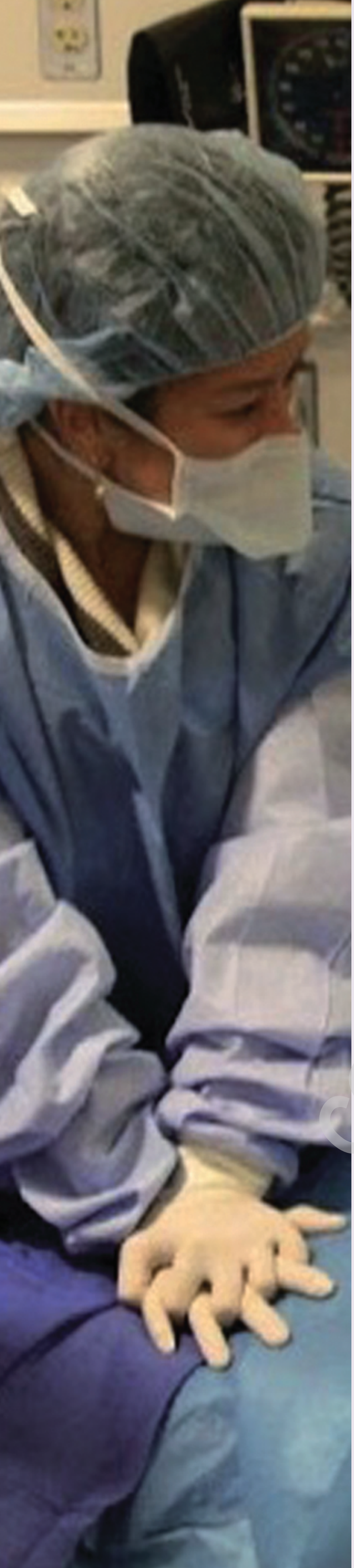

CHAPTER 1

Essential simulation in clinical education

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'The use of patient simulation in all its forms is widespread in clinical education with the key aims of improving learners' competence and confidence, improving patient safety and reducing errors. An understanding of the benefits, range of activities that can be used and limitations of simulation will help clinical teachers improve the student and trainee learning experience.' [1]

Overview

The use of simulation for the training of healthcare professionals is becoming more and more popular. The drivers of improved patient safety and communication have led to a significant investment in the expansion of facilities and equipment across Western healthcare organizations. For example, Royal Colleges in the UK are including mandatory training using simulation within their curricula and politicians have also jumped on to the bandwagon extolling the virtues of simulation training. The use of simulation in training is becoming synonymous with effective learning and safer care for patients and is fast becoming a panacea for all the perceived ills of teaching and training. However, simulation is not a substitute for health professionals learning with and from real patients in real clinical contexts. As Gaba reminds us:

'simulation is a technique, not a technology' [2, p. 2]

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Overview (ctd)

Other authors [3,4,5] note that we must take care in case the seductive powers of simulation lead to dependency, become self-referential and produce a 'new reality'. Simulation must not become an end in itself, disconnected from professional practice.

Ongoing and outstanding discussions include the following questions: What do participants learn from simulation? How are they expected to learn? How will the knowledge and skills be transferred to clinical practice? Will general or specific aspects of performance be transferred? Do our current methods and techniques make this transfer possible? When in a clinician's training should simulation be used? How should simulation be introduced into the curriculum? When should the team be trained as opposed to the individual? Can simulation impact on patient safety? Can and should we look for a return on investment when talking about simulation education?

This book will provide the reader with evidence around these questions and much more. The contents of the chapters build from the broader themes of history, best practice and pedagogy through to the practical aspects of how to teach and train with simulation and ends with examples and possible future developments. However each chapter can stand alone for those who wish to explore a single topic. Each is written by authors who are highly experienced in the development of simulation-based education. Our thoughts on and synopses of the various chapters follow.

History

Simulation in medical training has a long history, which started with the use of very basic models to enable learners to practice skills and techniques (e.g. in obstetrics). In spite of this early start, medical simulators did not gain widespread use in the following centuries, principally for reasons of cost and a reluctance to adopt new teaching methods. With advances in materials and computer sciences, a wide range of modalities have developed including virtual reality and high-fidelity manikins, often located in dedicated simulation centres. Chapter 2 describes these developments in detail, reminding us that the combination of increased awareness of patient safety, improved technology and increased pressures on educators have promoted simulation as an option to traditional clinical skills teaching. The chapter also defines and describes a classification for stimulation. Although a wide range of simulation activities exist, these are still often linked with specific medical specialities rather than 'centrally' managed or resourced. How simulation can best be supported in low-income countries, where the need is great but resources are not always available, is an issue still to be addressed. The impact of simulation on patient safety and health care improvements is still relatively under-researched although an evidence base is growing.

Evidence

There is widespread agreement, supported by robust research, systematic reviews and meta-analyses, on what makes for effective simulation. This theme is further explored in Chapter 3, which considers the evidence base underpinning the widespread use of simulation-based training in undergraduate and postgraduate contexts, general and specialty-based curricula, and clinical and non-clinical settings. Simulation supports the acquisition of procedural, technical skills through repetitive, deliberate practice with feedback, and also supports the acquisition of non-technical skills, such as communication, leadership and team working. The evidence base for the former is more extensive and robust than for the latter, which has been identified as an area for further research. The value of embedding or integrating simulation within curricula or training programmes is highlighted, as is the benefit of a programmatic, interval-based approach to simulation. In addition, workplace-based simulation for established multiprofessional teams (when supported by the institution's leaders) is seen as effective way of embedding sustainable changes in practice.

Teaching, learning and assessment

Simulation is no different from many other forms of education and training: instructors or facilitators need to be skilled and knowledgeable about educational theory and how this relates to their teaching practice. As with any educational intervention, activities need to be designed to enable learners to achieve defined learning outcomes and meeting their own learning needs. However, simulation offers particular challenges to both facilitators and participants: it requires some suspension of disbelief; it may feel threatening, challenging and unsafe (particularly for experienced health professionals); and it requires skills in giving feedback, both 'in the moment' and through more structured debriefings. Chapter 4 considers some of the most relevant learning theories and educational strategies that help to provide effective training and overcome some of the inherent barriers to learning through simulation.

Providing high-quality educational experiences is vital if learners are to engage in simulation with all its challenges; however, assessment drives much of learning, and simulation has a huge role to play in ensuring that health professionals are fit, safe and competent to practise. In Chapter 5, the authors consider the important elements which contribute towards effective assessment of both technical and non-technical skills at all stages of education and training. As with any assessments, those using simulation should possess the attributes of reliability, validity, feasibility, cost-effectiveness, acceptability and educational impact. Assessments need to be integrated within the curriculum and within an overall assessment scheme which utilizes a range of methods. Simulation can provide opportunities for both formative (developmental) and summative (contributing to grade or score) assessments, although appropriate levels of fidelity and realism need to be selected based on the specific context. Well-designed simulation provides excellent opportunities for learners to receive timely and specific feedback from educators and real, virtual and simulated patients and so helps develop and hone clinical and communication skills. Simulation also enables those involved in assessment to consistently and reliably assess clinical performance by using increasingly sophisticated technology such as haptic trainers which incorporate internal metrics and can measure fine motor skills and give in the moment feedback, or combinations of simulations (such as simulated patients and part task trainers) which can assess complex clinical activities or team working.

A large number of checklists and global rating scales have been developed, tested and validated in various settings which give rise to both opportunities and challenges for educators. Chapter 5 describes some of the most widely used instruments. The ability to measure performance more consistently and reliably provides assurances for patients and the public that healthcare professionals are safe to practice. However, the more reliable simulated assessments become, the possibilities of using such assessments in selection, relicensing and performance management increase. For such assessments, and also for high-stakes 'routine' assessments, educators must be satisfied that the assessment instruments selected are appropriate and validated, that the personnel and equipment involved and scenarios chosen are appropriate and that all those involved in delivering the assessment (including standard setting, development of checklists, marking and giving feedback) are suitably trained.

The people

Although the range and potential of simulation equipment and computer-based technologies seems almost infinite, without the continued involvement of trained, enthusiastic and skilled people, simulation education will not flourish and grow. Chapter 6 considers the recruitment, education, training and professional development of two of the main groups involved in simulation-based education: the educators or faculty, and simulated (or standardized) patients (SPs). As with any type of education, simulation facilitators (trainers, instructors or educators) need to be trained to teach, assess, give

Figure 1.1 Teaching using simulation requires an ability to use technical equipment and be able to work with simulated, real and virtual patients. Photo by Laura Seul, copyright Northwestern Simulation.

feedback and evaluate the effect of the education alongside other teachers on healthcare programmes. As a learning modality, simulation has some unique features in which teachers require development so that they can provide high quality educational experiences, such as using technical equipment and computers and working with simulated, real and virtual patients (Figure 1.1).

The challenging nature of some simulation encounters also requires educators to be explicit about and adhere to high professional standards and values so as to maintain a safe atmosphere which encourages learning. Educators also need to be able to adopt a range of styles, such as an instructing style for novices learning a technical skill or a coaching or facilitative style for an expert group, and be proficient in techniques such as giving feedback and the debrief. Educators must also be credible, whether they are clinically qualified or not; this may mean acquiring new skills or knowledge or team teaching with clinical colleagues. In common with many areas of practice, professional standards of educators are now being widely adopted alongside increasing regulation and quality assurance. Educators therefore need to be aware of these changes and prepared to take a lifelong learning approach to their own development.

SPs have been widely used in both the teaching and assessment of health professionals and provide a valuable adjunct to involving both real and virtual patients. SP interaction with learners can vary from fairly minimal interaction with limited responses to a highly standardized and scripted encounter, in which the SP might have a lot of flexibility in how they respond to the learner. The role of SPs in providing timely and accurate feedback from the 'patient's perspective' is one of the key advantages of involving SPs. Many SPs are also trained as educators who can work unsupervised in both teaching and assessment situations. As with any involvement in education, it is important that SPs are selected, trained and supported in their role, particularly when they are involved in high-stakes assessments or in evaluating qualified doctors' performance. SPs have also been used as covert patients to evaluate health services and the practice of individual doctors. Although planning and managing an SP service is time-consuming and can be costly in the initial stages, experienced SPs can replace clinicians in both teaching and assessments, which can lead to more standardized experiences for learners and cost savings over time. Recent international developments include consideration of SP accreditation, standards and certification as part of a drive to ensure high-quality education and training.

The skills: technical, non-technical and team working

Simulation takes place in a range of settings, but is probably most widely used and has had the most measurable impact in surgical settings, led by anaesthetists and surgeons. Taking an historical approach, Chapter 7 looks at surgical technical skills, highlighting some of the key drivers behind the introduction of simulation training and its impact on patient safety and error reduction. This chapter describes some of the key developments in developing and enhancing surgical skills. The need for further training and development via simulation training has been driven by the need to ensure higher standards of patient safety and error reduction; patient expectations of healthcare; the introduction of new operating procedures (such as laparoscopy); and technological advances (e.g. endoscopes, miniaturization of equipment and imaging technology). Technological advances have also enabled simulation to utilize different materials

Figure 1.2 Simulations enable doctors to improve their operating techniques. Photo by Laura Seul, copyright Northwestern Simulation.

and harness computing power in the form of virtual reality simulators and other devices that facilitate and measure haptic (tactile) feedback in real time in order to ensure surgical technical skills are of a required standard. Such simulations enable doctors to improve operating techniques, particularly in the learning curve stage, when patients are deemed most at risk (Figure 1.2).

As the dividing line between surgeons, radiologists and other physicians becomes increasingly blurred with the more widespread use of minimally invasive procedures and interventional radiology, virtual reality simulators are being used to train a variety of health professionals. This brings its own challenges and opportunities. For example, as we are better able to measure fine response times and technique, simulation-based proficiency tests that incorporate 'real-time' pressures and stressors (as used in aviation and military settings) may well be used to discriminate between applicants for specific posts. If the use of simulation training and assessment expands, then new simulation centres may need to be established that can efficiently utilize resources, equipment and expertise to train and assess large numbers of doctors and other health professionals. This would require a 'whole-system' approach to simulation.

Chapter 8 considers and explores the training and development of non-technical (social and cognitive) skills and the way in which human factors impact on patient safety. In many high-risk industries, human factors have been shown to cause the majority of errors and often these are not due to lack of knowledge or inability to perform a technical skill, but due to lack of so-called 'softer' skills like team working, communication, leadership and decision-making. This chapter describes the development and implementation of Crew Resource Management (CRM) and behavioural marker systems to observe, assess and give feedback to individuals and teams. Examples are given of scenarios and details of each of the steps required in designing training in alignment with defined behavioural markers.

The healthcare team has been called the 'cornerstone' of health services, yet teamwork failures are widely viewed as a major contributor to adverse health outcomes and errors. Chapter 9 explores some of the reasons why this is the case and discusses how simulation-based team training (SBTT) delivered by trained instructors can help address some of the common issues concerning poor or ineffective communication and differing perceptions about the goals of healthcare, team roles and leadership. A number of models and strategies are discussed in the chapter, along with their application and relevance for training uni- and multiprofessional teams. These strategies focus on improving team performance through enhancing team cognition, developing shared mental models and problem-solving approaches, and facilitating team members to challenge the attitudes and perceptions of other professional groups. Structured observation charts that focus on assessing behaviours help instructors and team members to give more helpful feedback. Because most teams are multidisciplinary, SBTT should also aim to involve different professional groups, ideally in authentic work situations, both in the actual workplace and in simulation centres.

The places

In many contexts, a dedicated simulation centre (whether established on a local or regional scale) is seen as an efficient and effective way of centralizing resources and expertise, particularly those around high-fidelity simulators or when large numbers of people are to be trained. For those involved in, or considering, establishing a simulation centre, Chapter 10 provides a highly detailed, step-by-step guide to all the factors that need to be considered. The authors draw from their own experience of running a large-scale simulation centre, providing many 'hints and tips' and ideas applicable to many contexts. Factors that need attention include securing initial and ongoing funding; determining training needs and the numbers of users of the centre; recruiting, training and retaining faculty; identifying the right equipment and ensuring that this is maintained well; providing high-quality training that is pedagogically sound that meets learners' (and funders') needs; and quality assuring all activities. Collaboration with key stakeholders is vitally important, especially to ensure sustainability of the centre and its activities, as is engagement with national and international simulation and clinical skills networks, whose members have wide expertise. At the operational level, administrative and technical staff are central to the effective and efficient delivery of training and maintenance of equipment and, as other writers have stressed, it is essential that simulation activities are embedded within curricula or training programmes so that learners gain the most benefit.

As health service and education budgets become increasingly constrained, many simulation groups are starting to explore more cost-effective solutions to delivering high-quality simulations away from dedicated simulation centres. Distributed simulation (DS) is one solution to these problems. Chapter 11 describes the work of the Imperial College London team in researching into the most effective ways of setting up effective 'portable' simulation activities in a range of settings and specialties. Working with a multidisciplinary team, the research group has drawn on the psychological theories of selective attention and applied these in the development of a range of DS models which can be applied in a variety of settings. This 'selective abstraction' is what makes DS so useful when resources are limited as only the most important features are used which help to generate a realistic scenario in any given context. Portability is achieved through the use of simple, user-friendly equipment for observing, recording, playback and debriefing, similar to that used in static simulation centres and practical, lightweight and easily transportable components which can be erected quickly by a minimal team. This gives the flexibility to recreate a range of clinical settings according to individual requirements.

DS could herald the way forward for future developments as it can provide a cost-effective, accessible and versatile approach to teaching and learning tailored to the needs of individual groups at the right level of fidelity. Although the preliminary exploration and validation work of the DS was conducted in a surgical setting with clinicians at different levels of experience and different surgical procedures, DS is now starting to be utilized in different hospital and community-based settings such as emergency medicine and, utilizing concepts such as sequential simulation, considering how to simulate care pathway modelling in different domains of medicine and support services. This has potential for widespread application in low income countries or contexts in which static, expensive simulation centres are unlikely to be established.

Doing it

Although the context and nature of the simulation activity might vary, including the types of participants, the locality and the purpose of the training, it is essential that simulation education provides a safe environment in which participants can actually learn. Because simulation is often perceived as challenging and sometimes threatening, simulation educators need to pay close attention not only to the achievement of learning outcomes, but to the process of group dynamics and individuals' psychological safety. In Chapter 12, the authors take a structured approach to designing effective simulation education, considering each of the components of the simulation setting, and suggest ways in which educators can help support learners gain the most from the encounter. As we have mentioned, simulation educators need to utilize best practice from other areas of education, including small group facilitation skills, giving constructive feedback and defining clear learning outcomes. However, the simulation encounter also benefits from attention to specific elements such as scenario design and the structured debrief. Ensuring that participants are appropriately introduced to the scenario, the simulation context and the other people involved in the simulation is very important. Also important is setting ground rules and either using a structured approach to simulation design and delivery, such as the event-based approach to training (EBAT), or making sure that educators have the skills and expertise to deliver training on-the-fly. The chapter also discusses the use of confederates, moulage and audiovisual equipment and provides an in-depth guide to the use of the debrief as part of the provision of effective and useful simulation.

Real-life examples

Chapter 13 introduces a fascinating insight into the practice of simulation 'on the ground' through a series of nine short, structured case examples of simulation teaching, learning and assessment activities in a range of different clinical settings with learners from various health professions at different stages of education and training. Examples are from Australia, the Netherlands, the USA, Africa and the UK, and from both primary and secondary care. Each worked example describes the background and context; what was done; the results and outcomes; take home messages; and hints and tips.

The case studies cover a range of topics and uses of simulation:

- using the simulator Harvey™ to teach cardiology
- assessing leadership skills in medical undergraduates
- interprofessional learning of airway management
- a multicountry and multicultural study using simulation in emergency care
- clinical skills assessment of postgraduate paediatric trainees
- a national assessment programme for 'doctors in difficulty'
- the use of incognito standardized patients in general practice
- team-based simulation for rural and remote practice
- trauma team training in a university hospital.

All the case studies demonstrate the importance of evaluating interventions so that practice can be improved. Evaluation needs to be not just of the simulation activity itself, but also aimed at improving health outcomes. The case studies also indicate the clear links between simulation, policy and practice and that simulation-based education needs to be located as near as possible to the workplace (at the very least to workplace needs and involving clinicians) and that interprofessional and multiprofessional working enhances the experience for all. The case studies also demonstrate the value of, and indeed the need for, collaboration: among professions, disciplines, organizations, teams and countries. Lessons learned and hints and tips provide valuable ideas for those developing and establishing simulation-based activities.

The future

The final chapter comprises three sections. In each section the authors give their personal perspective on what they see as some of the key developments in simulation and how these will impact on future development and implementation.

The first section focuses on the use of simulation technologies, specifically in surgical training and education, to improve patient safety and reduce errors in the operating theatre and associated settings. Taking the concepts of a patient's and surgeon's journey, the section considers how simulation can help provide more seamless care as well as support the professional development of surgeons throughout their working lives. The use of virtual patients, three-dimensional high-definition holographic technology to simulate real patients' anatomy and physiology and team-based training will enable the surgical team to plan and deliver personalized optimum pre-operative, surgical and post-operative interventions, to practise complex skills and manoeuvres, and to rehearse strategies should complications arise (Figure 1.3). As technologies develop, the use of laparoscopic, miniaturized and robotic surgery will increase; thus surgeons will need regular updating, training and refreshment of skills and techniques. Selection (for general surgery or for sub-specialties) might also involve simulation once technologies can provide reliable, consistent and accurate estimation of performance. Simulated

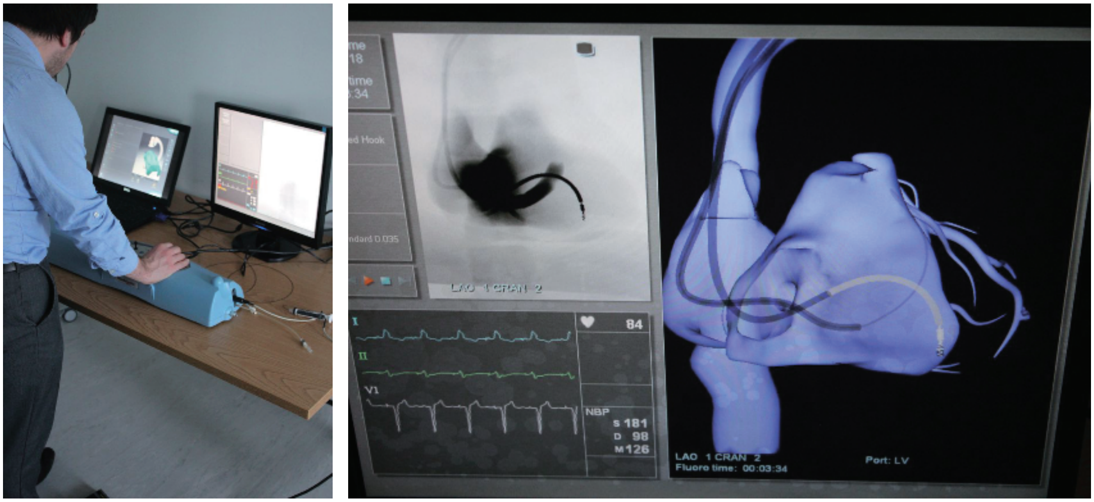

Figure 1.3 Coronary angiography simulator (a) and screen shot (b). Courtesy of Jivendra Gosai, Hull Institute of Learning and Simulation.

environments or worlds such as SecondLife™ will enable non-technical skills and activities (such as handover or discharge planning) to be practised safely using avatars (Figure 1.4). Over time, as part of the drive to reduce error and improve performance, ‘black box’ recorders might be placed in all theatres to measure and record real time performance.

The second section takes a different look at simulation-based education and its role and place within a changing education and training context. Taking two main paradigm shifts in medical education, the shift from time-based to competency-based education and the move towards lifelong learning, the authors explore how simulation can help to support and drive these shifts. The move towards competency-based education is more goal oriented and requires deliberate practice and ongoing measurement and assessment of skills, both technical and non-technical, or competencies at all stages of training. To demonstrate mastery at defined levels, accurate, reliable assessments are needed. Simulation is well placed to help provide opportunities for deliberate practice, integration and mastery and assess defined competencies through formative and summative assessments without the need for practice on real patients all the time. This can help accelerate learning and skills,

Figure 1.4 Avatar example. Courtesy of Henry Fuller. http://secondlife6750.wordpress.com.

and thus move away from a time-based model of education towards one that acknowledges and is responsive to the needs and attributes of individual learners throughout life. To evaluate the high-level impact of simulation interventions, more scholarly research is required and educators need to be supported and equipped with the expertise and time needed to develop research, evaluation and writing skills. Medical education research units that are populated with qualified and experienced educators can support education scholarship by collaborating with and mentoring clinician educators. The importance of gathering the right evidence to evaluate interventions is highlighted, and the Kirkpatrick evaluation hierarchy is cited as helping guide the rationale for education interventions and the quality and impact of teaching innovations.

The final section considers the future of training in simulation through consideration of three interlinked elements: curriculum integration, resources and faculty development. As many writers have emphasized, simulation needs to be integrated within a curriculum or programme to enable learners to achieve defined learning outcomes. It is suggested that simulation should be thought of not just as a method of learning or assessing 'content', but as significantly influencing the content of the curriculum. Through engagement with simulation activities, educators from many disciplines (e.g. psychology, anthropology, computer and materials sciences, as well as biomedical scientists and clinicians) have together co-created curricula and learning interventions that would not have been considered possible decades ago. A vision for the future of simulation training is of groups of healthcare workers coming together to rehearse and practice and prepare for the introduction of new clinical challenges or new protocols or ways of safely implementing new practices. Faculty development will also continue to be informed by simulation through involvement of multiple stakeholders including those from performing arts, psychology and business.

In common with all areas of education, increasing constraints on resources mean that educators and managers have to provide robust evidence of value for money and efficiency. As well as essential resources such as time, space, administrative and practical support, simulation activities require specialised (and often expensive) equipment and technology. Many developments have only been made possible because of close collaboration between simulation users, commissioners, manufacturers and even regulators. In the future this will require more robust mechanisms to ensure that the resources required for investment are likely to bring about a significant return and that transparent and meaningful quality assurance mechanisms are established. It is also important to ensure that resources are focused towards areas of need, such as low-income countries, where well-designed simulation can have great impact. The final challenge highlighted is that of continuing to develop and understand the theoretical basis that underpins simulation-based education and devise models and explanatory frameworks that can be used in scholarly practice and research. Taking a programmatic approach to this work through international collaboration provides the best way forward to ensure simulation-based education trains and prepares health professionals to deliver safe, high-quality healthcare and meet tomorrow's global challenges.

SUMMARY

We hope that the ideas, thoughts and concepts in this book will stimulate readers to think about how they can improve learning with simulation. Those who are involved in the development and delivery of simulation healthcare education need to have a better understanding and the most recent evidence of its use. If simulation education is used by those that are not aware of its challenges or previous work, the outcomes could be costly and lead to the technique being abandoned. Keeping pace with the implications of published research, new technologies and influences from other disciplines is important.

Discussion in the literature can tend towards the sceptic, such as editorial headlines of 'High fidelity and fun: but fallow ground for learning?' [6]. The article the editorial refers to concludes that some participants do not perform as well as others if under too much stress during simulated scenarios [7]. Other published research discusses how surprising or unanticipated events (which are inherently stressful) in an immersive virtual reality game can foster deeper learning [8]. Both these results, though conflicting at first, emphasize that learners are individuals; however, current research tends to look at how groups respond to simulation education. Which brings us back to the question: what is simulation education for? The range of modalities, uses and applications means that simulation based education cannot be purely labelled as good and bad for any one healthcare professional or team.

Evidence suggests that simulated scenarios have to be distinct, novel and incremental in their learning objectives for those who have repeated exposure to simulation training. This has been described as 'episodic' training and been postulated as the way forward for sustainable improved clinical performance [9]. The use of social media in clinical simulation education and training programmes, for example the use of smart phones to provide short, sharp 'teaching points' either with blogs, podcasts or interactive questions before and after training is increasing. When it comes to new technologies, the pace of development is probably not matched by those who develop and deliver simulation education. We are often constrained by our own education, experience and imagination when it comes to truly utilizing the full range and benefits of simulation education. With rapid advances in technology and expanding research programmes in simulation in clinical education, one might speculate that the best is yet to come.

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