CHAPTER 11

Consistency in simulation: A measurement perspective

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> **KEY MESSAGES**
>
> - There are 3 different measurement strategies that can be of assistance in developing and running simulations.
> - The first, event validity, is simply the explicit comparison, over a series of iterations of the simulation, of the events resulting from the simulation to those that occurred in the real-life situation on which the simulation is based.
> - The second, Generalizability Theory, should become one of the standard analytical techniques for studies of the impact of simulation and its use as an assessment tool.
> - The third, Rasch scaling, could be used to classify the difficulty of simulations on a scale, or to build a taxonomy of simulations.
> - Although many simulations are imperfect, they nevertheless are useful tools with established validity evidence that may, in a relatively short time, augment or replace workplace-based learning.

Overview

The use of simulation in healthcare education has been expanding since the early 1970s. Recently the pace of development has increased rapidly, as the result of technological advances and significant investment from government and business sectors. Narratives of these many developments are included in this book. Although there has been much interest in the measurement of elements of the simulation environment, and the replication of specific experiences or simulated parameters through computer control and other means, relatively little attention has been paid to what metrics can be used to capture the value, difficulty and performance of the elements of the simulations we use. This chapter makes some suggestions, from among many alternatives, around how recent developments in psychometrics can be used to measure simulation characteristics. What we still lack is a complete taxonomy of simulation, and this book may contribute to its development.

Introduction

Using simulation is a valuable strategy to create learning activities and events that cannot usually be guaranteed to take place in the course of day-to-day clinical placements. Simulation can be used as a means of ensuring that health professionals have basic skills, such as taking blood, examining ears or soft tissue therapy, that can be learnt without subjecting patients to excessive risk from novice practitioners. It has also been used extensively in the development of assessments at both undergraduate and advanced levels in a wide range of professions, including medicine, nursing and police training [1–3]. In the early days of simulated patient (SP) development, a large number of papers were written about the effectiveness of the methodology, employed as both a teaching and an assessment strategy, without authors paying very much attention to reporting the characteristics and development of the simulation itself [4]. For example, details about the repeatability of SP performance, and the style and length of the training involved, were often absent entirely from some reports of projects involving SPs [4]. Furthermore, because SPs were generally very much like real patients, the validity of the experience from the learner's perspective was often assumed, rather than critically examined.

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Particularly in the assessment mode, the issue of measurement has been prominent, but often the assessment instruments used in these simulations have taken a back seat to the focus on the simulation activity. In this chapter we will outline three different measurement strategies that can be of assistance in developing and running simulations, and in using data from those simulations in an assessment and/or developmental capacity.

Simulation event validity

In a classic early paper on the validity of simulation, Hermann [5] identified this lack of testing the assumptions in the following terms:

> Probably no approach to model validity is reported more frequently than the subjective estimates of experimenters or observers or human participants as to the correspondence between the model's operation and their perception of the actual phenomena which the game or simulation represent. (p. 221)

Hermann proposed a set of criteria for simulation validity, some of which focused on the internal structure of the simulation. This is important to recognize, as the current interest still seems to be very much in how participants perceive the simulation rather than what actually happens. One of these internal parameters Hermann termed *event validity*. Event validity is simply the comparison, over a series of iterations of the simulation, of the events resulting from the simulation to those that occurred in the real-life situation on which the simulation is based. This is primarily a qualitative endeavour; the details of the originating event are written down, and each time the simulation is used, the events unfolding are also recorded. Over time these data will give rise to a frequency distribution of events, some of which may be the intended outcomes and some of which may be quite novel and/or disruptive. If these novel or disruptive events are too frequent, the simulation may be suffering from some corruptive influences. When Hermann wrote his original paper, the availability of computing power was such that these recordings would have been a tedious and cumbersome process. With today's sophisticated programming and laptop/tablet capabilities, augmented by voice-to-text conversion software, there is the possibility of generating these comparisons and databases quite easily. Although validation of simulations is extensively used in computer models of real events [6], and many of the methods used are not applicable to healthcare educational simulations, event validity is one of those that has utility.

The importance of event validity to the use of simulation in assessment tasks should not be underestimated. Subtle changes in the simulation arising from any number of sources could result in different outcomes in the simulation. Candidate behaviours related to the intended outcomes may be inhibited by such changes, and replaced by behaviours that do not attract a value or a score within the simulation. Given that someone who may not have been involved with the station's generation, or the training that the SP received, often scores simulations within the objective structured clinical examinations (OSCEs) as a kind of fly-in, fly-out assessor, this increases the likelihood that these changes will go unnoticed. Recording data for the event validity comparison can reduce this effect. It is also useful from time to time to benchmark performance in the simulation by getting an expert to undertake the simulation, just to confirm that, in such circumstances, the appropriate events do take place.

Other approaches to reliability in simulation

Two longstanding issues in the study of simulation were the difficulty of obtaining unbiased ratings of participants' performance in the simulation and the lack of an appropriate framework in which reliability or consistency could be investigated. The event validity already described goes some way to overcoming the issue of consistency across different iterations of a simulation event, as far as outcomes are concerned. However, there are still issues of measurement consistency when SPs contribute ratings to the assessment process, as well as biases transmitted by the perspectives of assessors (whether SPs or faculty) and the complex issue of *case specificity*. Case specificity is the persistent phenomenon that the performance of students and trainees varies substantially from case to case, even though the same so-called generic skills (e.g. history taking) are used across all cases [7]. In a simulated scenario, there is the added unpredictability that not only do the cases differ, the precise way in which they are portrayed by different SPs may also differ, and the variance introduced by the SP (as both actor and assessor in some cases) may enlarge or reduce the variability across cases. This introduces another layer of complexity into the measurement situation.

Reliability or consistency of performance in the simulation

As discussed elsewhere [8], a candidate's score in an assessment based on simulation will have a number of sources of variance: the candidate themselves; the particular case; the assessor; the simulated patient; and the interaction between all these components. Where the purpose of the assessment is to rank the candidates in order of ability, ideally the candidate should be the largest source of variance. In these complex measurement situations, a common procedure is to look at the intercorrelation of the measures. For example, several observers or instruments may be used to assess the events in a simulation, or a suite of simulations, on different occasions, involving several different SPs and so on. All the different measures would be intercorrelated with each other, producing a large matrix of correlation coefficients. However, this is a very inefficient way of using these data.

Those methods have been supplanted in recent years by a technique called generalizability or G theory [9, 10]. In this technique we make use of all the data to quantify all sources of error (candidate, case, assessor, SP and interactions between these components) and their relative contribution to the candidates' variance in scores. Then the actual values of these variances (called variance components) for each variable are combined to express the extent to which differences between candidates reflect reproducible differences. This results in a coefficient between 0 and 1, called the generalizability coefficient (G). A value for G of 0.8 is the accepted level of reliability required for a high-stakes assessment. In addition, the data can be used to model what the most efficient assessment strategy would be. For example, if it were found that the variance component for SPs had a major influence on candidates' scores, this would indicate either that more training and standardization would be required for the SPs, or that a greater number of SPs (and by implication a greater number of simulations) would be needed to assess the candidates' performance reliably.

A series of studies using G theory on simulated patients in a large-scale examination was performed in the early 1990s, with largely favourable results [11, 12]. However, many recent studies have been undertaken without using G theory. In one example [13], the authors concluded:

> Verbal portrayal by SPs did not significantly differ for most items; however, the facial expressions of the SPs differed significantly ($p < .05$). An emergency management station that depended heavily on SPs physical presentation and facial expressions differed between all four SPs trained for that station.

Yet without measuring the impact of these differences on the overall scores of candidates across the OSCE using G theory, the relative size and potential impact of the SP differences would not be accurately assessable. G theory should become one of the standard analytical techniques for studies of the impact of simulation and its use as an assessment tool. For more information on the power of generalizability analyses, see articles by Downing and Smit [14, 15].

Scaling simulations

In occupational therapy and physiotherapy, patients are frequently given tasks or exercises to do that start simple and get progressively more complex and/or intricate; a so-called hierarchy of skills. The therapeutic principle behind this is simple: patients who have had strokes or trauma injuries need to learn to do the simpler things first, and be successful at those, before going on to harder ones.

The means by which the patient tasks are organized in occupational therapy and physiotherapy is called scaling, and it is a spin-off from a branch of psychometric theory called latent trait theory [16], developed by Georg Rasch, a Danish mathematician. In latent trait theory, the ability of test takers (the stroke patient, for example) and the difficulty of the tasks are viewed as points on the same continuous latent variable or 'trait'. For example, in occupational therapy tests, 'task' parameters characterize the difficulty of tasks, while 'person' parameters exemplify the ability or attainment level of the patients who are being assessed. The higher a person's ability, relative to the difficulty of a task, the higher the probability of successful completion of that task. In Rasch terms, when a patient's location on the latent trait is equal to the difficulty of the task, there is, by definition, a 50% chance of a successful response. When applied to tasks of varying complexity, this simple principle allows the tasks to be arranged along a continuous scale.

In the health sciences, patient-reported outcomes are often used for assessment of clinical trials, where measures of patient improvement and/or deterioration are required. Rasch analysis underpins this concept, providing a transformation of an ordinal score into a linear, interval-level variable. Originally developed for use with dichotomous items (i.e. right/wrong), it has been applied to items with a greater bandwidth. In addition, it has been applied to constellations of items that are much more complex and relate to ratings that might be seen as multidimensional. (The original idea was that the items should link together in a unidimensional fashion. However, enough work has been done with multifaceted items to suggest that the technique is applicable, as long as the items are also 'held together' in particular constellations by an umbrella concept such as maturation, rehabilitation recovery from stroke, or remission from psychiatric illness.)

The Rasch measurement model is now established as the psychometric approach to outcome scales. It provides a useful tool for bringing coherence to the key issues of unidimensionality and category ordering, within the framework of measurement science. The basic strategy of the Rasch approach is to assume that the construct under study is unidimensional and then to look for evidence to disprove that assumption. It turns out that this evidence is harder to find than one would think, which makes Rasch scaling both possible and useful in a wide range of contexts.

One of the benefits claimed for simulation as a learning strategy is that it allows the degree of challenge for the student to be titrated against their ability or year level. However, the design of these simulated tasks can be quite a complex process and there is not necessarily a coherent approach to their planning and delivery.

Using Rasch analysis for simulation event monitoring or assessment scales may be very productive in being able to develop scales for particular simulations that would allow much greater control over the educational frameworks and strategies that we use in healthcare [17].

Take the example of 'non-technical' or professional skills, a recent addition to the curriculum in specialty colleges in medicine [18]. These often diverse techniques and skills include, for example, patient advocacy, graded assertiveness, empathic utterances, negotiation, situational awareness, communication, decision making and leadership/teamwork. Each could be broken down into components, and these could then be subjected to Rasch scaling using data from the simulations to address each one. These data could then be used to order those simulation events into a hierarchy that would allow participants success at basic skills before being engaged in quite complex tasks. It would also allow scaling of different combinations of modality in hybrid simulations.

Disadvantages and advantages of simulators in assessment

Some cautions have been issued about the use of simulations for presenting 'real-time' data within a scenario. This is, in a sense, a specific example of the event validity that Hermann described. Gilpin et al. [19] highlight the relative lack of data on the accuracy of the physiological models used as part of simulations of human function, suggesting that some studies reveal that these models can be inaccurate. They identified that such simulations can be based on two different modes of operation: *static models*, in which various different rhythms, such as electrocardiogram traces, are stored and then virtually cut and pasted into the simulation; and *deductive models*, in which an underlying algorithm drives the appearance of the data on the output from the mannequin, or hybrid computer/human, simulator. They point out that 'a direct consequence of using "static" datasets is that when the simulator switches from one dataset to another the transition may appear unrealistic or jerky' (p. 703). However, the algorithmic approach requires much greater insight around the real physiological functioning of patients, both from the simulation designers and from the participants in the simulation. The 'static' datasets also do not allow the simulation to reflect the changing nature of clinical conditions, where anomalous information or vacillations in the clinical picture being presented take place. Therefore, they might only assess relatively simple skills or pattern recognition, and not the capacity to respond to fluctuating patterns of data.

Nevertheless, Gilpin et al. [19] do point to a situation in the not too distant future where computer algorithmic and data-based physiological simulations will be highly tuned to real events, and will need to be delivered by clinicians with the expert knowledge to manage a simulation that is as subtle and complex as real life.

In other domains evidence is rapidly emerging that simulation-based assessments often correlate positively with patient-related outcomes. Recent meta-analyses by Dawe et al. and Brydges et al. [20, 21], only two of a number emerging in recent years, suggest that although many simulations are imperfect, they nevertheless are useful tools with established validity evidence that may, in a relatively short time, replace workplace-based learning and assessment for select procedural skills, and maybe much more.

Key term definitions

Event validity: A parameter of simulation that indicates the frequency with which events within the real-life scenario on which the simulation is based occur within the simulated event. These frequencies are sometimes compared with the frequencies of extraneous events within the simulation.

Generalizability theory: A statistical framework for conceptualizing, investigating and designing reliable observations. It is used to determine the reliability (i.e. reproducibility) of measurements under specific conditions.

Rasch analysis: A unique approach of mathematical modelling based on a latent trait that accomplishes measurement of persons and items on the same scale, so that item values are calibrated and person abilities are measured on a shared continuum that accounts for the latent trait. In simulation terms the latent trait might be the ability to place a catheter in a simulated vein, or the ability to manage a rapid response team.

Scaling: The capacity to place a series of items, tests or tasks on a continuous scale, for example of difficulty, complexity or value.

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

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CHAPTER 14

Faculty development in healthcare simulation

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KEY MESSAGES

Impactful and sustainable faculty development programmes:

- Are educationally literate.
- Are clinically relevant to a variety of healthcare contexts.
- Are plainly operationally focused and of obvious benefit to local or national administration or healthcare management.
- Are clearly aligned to the staff and healthcare governance aspirations and challenges of local or national organizations.
- Consider both synchronous and asynchronous components to mesh with the competing demands of time-poor clinical teams.
- Are distributed in design and provide ongoing faculty support.

Overview

Faculty development is an essential component of successful simulation programmes or activities, yet it is often overlooked. Beyond purchasing appropriate equipment and fitting out learning spaces, the third pillar of success is the realization of, and support by management and staff for, initial and continuing faculty development. This section highlights strategies used across a variety of settings to ensure that faculty development is recognized at an organizational level as a mandatory component for the establishment and ongoing business of planning, delivering and evaluating simulation learning activities.

Introduction

Simulation-based education (SBE) is an effective methodology that can be employed to develop and improve performance [1]. In healthcare, simulation is widely used to:

- Safely develop competency in the novice, through the rehearsal of designed experiences.
- Allow the clinician expert to engage with rare but impactful clinical scenarios.
- Facilitate the development of high-functioning teams through in-situ systems testing or planned scenarios.

In the hands of the violin maestro a Stradivarius will transfix the audience; in the hands of a novice it will sound terrible. The same is true of SBE, where efficacy is not inherent within the physical environment, equipment or technology being used. Instead, the activities and attributes of educational faculty associated with the planning and delivery of high-quality simulation are based on learned skills [2].

Faculty development has been described as a 'range of activities that institutions use to renew or assist faculty in their roles' [3]. Therefore, the goal of a faculty development programme in a simulation context must be to nurture its faculty so that they might make best use of whatever mode of simulation they are employing. Reviews of the literature have highlighted the importance of debriefing as a key part of faculty development programmes. However, a faculty should be skilled in all aspects of simulation, from instructional design all the way through to evaluation of impact. Still, there remains limited published work to describe the other key components and organizational infrastructure

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needed to support a valid and impactful programme of development.

This chapter will give focus to the current evidence supporting the ideas and concepts of how to achieve and deliver a high-quality faculty development programme, along with commentary from the authors' own experiences. From the original BEME review [2] to recent focused reviews on the pivotal role of debriefing in faculty programmes [4], examples of successful models from around the world will be referenced, as well as some specific worked examples from the national programme in Scotland. This will sit alongside illustrations of strategies used to ensure that faculty development is recognized as an indispensable component for the establishment and ongoing business of planning, delivering and evaluating simulation learning activities.

The case for faculty development

As we have alluded to in the introduction, the delivery of efficient and efficacious interventions using simulation as a methodology requires an educational faculty trained specifically in this approach, ideally within an ongoing development and quality management infrastructure. In the authors' experience, developing and maintaining a high-quality, skilled and active simulation faculty results in individuals who act as catalysts, supporting positive change in their clinical workplace.

Healthcare simulation has evolved in many cases from unplanned purchasing of simulation mannequins, which often remained in their box for the majority of their 'life', to an era of coordinated clinical educator enthusiasm. The modern educator is keen and enthusiastic, desiring to free the caged mannequins and use 'them' for all manner of educational activities: team training, development of competency, testing of competency, rehearsal of uncommon incidents, assessment of performance, testing of clinical systems and so on. Whereas the former situation was challenging from a resource waste and underuse perspective, this new-found enthusiasm, without support for the novice faculty, can result in misuse through educational inexperience, leading to psychological harm and disengagement [5].

Within the broad spectrum of uses of clinical simulation, feedback (including debriefing) has been identified as the most important feature [2]. This requires a skilled, trained faculty capable of applying a known and rehearsed model of debriefing to the simulated event. However, in addition to the debriefing skills that are more obvious to new faculty, using simulation for planned learning requires individuals capable of meticulous application of 'constructive alignment' [6]. This means that the teacher aligns the teaching and assessment methods with the learning activities. In simulation this translates as meticulous attention to intervention design, running and debriefing in order to align it with the learning objectives.

Most simulation debriefing methods require a trained facilitator capable of constructing and maintaining a safe learning environment, managing the learning needs and personalities of the participant group, and bringing structure and direction to the conversation [7]. When simulation is employed for a specific use, the faculty will need particular knowledge and skills to optimize the activity in terms of efficacy and efficiency. For example, using simulation for complex system testing and developing of team performance in a clinical setting requires a faculty competent not solely in running immersive 'high-fidelity' and debrief-rich simulation, but also in methods such as process mapping, failure mode and effects analysis (FMEA) and table-top simulation. Equally, when employing simulation for assessment, faculty will require a clear understanding of or access to expertise relating to activity validation and assessment methodology.

From the instructional design literature [8–10] and the authors' experiences, the ideal faculty development programme appears to be one consisting of graded, periodic interventions to provide ongoing longitudinal support aligned to a form of governance with overarching quality management. Programmes perceived to be of high educational value need to be:

- Educationally literate – based on evidence and supported by expertise.
- Clinically relevant – lessons learned applicable in varied healthcare contexts.
- Operationally focused – of obvious benefit to the administration and acknowledging of challenges in healthcare management.
- Aligned to the staff and healthcare governance aspirations and challenges of host organizations.

In the next section we will consider how this can be achieved.

Structure and components of an effective faculty development programme

In the broader context of medical education, reviews of faculty development programmes describe a spectrum of structures, activities and interventions, including workshops, seminar series (both face to face and web based), time-bound courses, longitudinal programmes (e.g. fellowships) and individualized feedback [11, 12]. The use of experiential learning, provision of feedback, development and support of effective peer relationships and diversity of educational methods represent some of the key features of effective faculty development activities [12]. Equally, the diverse origins of, and populations comprising, the recipients of faculty development suggest that a 'one-size-fits-all' model will be neither acceptable nor impactful. Faculty development therefore must not only be of high quality, but also adaptable to the context in which it is being deployed.

Let us consider what structures currently exist as exemplars or may be considered to support these components.

Delivery of the faculty development programme

A superlative syllabus is not effective if it fails to reach the desired audience. Therefore, before we consider the content of a faculty development programme, we must first address the mechanisms of delivery. Ultimately, these will be determined by local factors such as geographical distribution, time allocated and resources available. The following broad principles may be helpful:

- Delivery of the faculty development programme cannot be purely a one-way channel of communication, such as a 'how to' guide distributed to all potential faculty.
- Some face-to-face component is desirable. Observing expert faculty facilitating a debriefing allows novice faculty the opportunity to appreciate the subtle techniques employed by the former in ensuring an effective debriefing. In addition, being observed by expert faculty gives novice faculty the opportunity to receive immediate feedback on their performance. Although expert faculty can provide feedback on recorded debriefing, evidence from other areas would suggest that immediate feedback is more powerful [13].
- There are numerous ways of delivering educational content and space constraints do not allow us to review the pros and cons of each. However, the 'mastery learning' work of Barsuk et al. and McGaghie et al. [14, 15] has shown the benefit of a baseline assessment followed by deliberate practice with feedback. This model of competence progression could easily be applied to developing faculty.
- In order to make any face-to-face component as effective as possible, it is useful to consider what material can be front-loaded and made available in the weeks preceding the meeting. One must remain aware that some participants will not be motivated to engage with this material.

Delivery examples

- *SCSC^{HF} (Scottish Centre for Simulation and Clinical Human Factors):* Delivery of the initial aspects of the SCSC^{HF} faculty development programme occurs at a face-to-face two-day course held at the national simulation centre and on a mobile unit, which tours the Highlands and Islands of Scotland.
- *MSR (Israel Center for Medical Simulation):* The MSR's introductory faculty development programme is run at the Israel Center for Medical Simulation. It also offers to run workshops at other facilities.
- *BMSC (Bristol Medical Simulation Centre):* BMSC runs a two-day faculty development programme 'training the trainers' at its centre.
- *CMS (Boston Center for Medical Simulation):* CMS runs workshops at its headquarters in Boston, MA and at other host sites around the world (e.g. Spain, Colombia, Chile). It also offers an online workshop covering the Debriefing Assessment for Simulation in Healthcare (DASH) evaluation tool.
- *NHET-Sim (National Health Education and Training in Simulation):* This Australian government-sponsored training programme offers a comprehensive online training package of modules and aligned country-wide and state-delivered workshops.

Who are the participants?

Faculty composition can present a challenge to an effective faculty development programme. Simulation faculty members often have a diverse educational background and professional clinical governance structure.

Some may have no qualifications or registrations, while others may have postgraduate degrees and be subject to guidance from professional bodies, such as a nursing or medical council. In addition, the use of simulation in healthcare is widespread and in some places has been established for many years. This means that although there are many novices, there are also many experienced, although not necessarily expert, faculty members. The mechanism of delivery must therefore be able to seek out, engage and motivate a variety of faculty.

The first challenge lies in motivating and engaging people with faculty development. How a planned programme is structured must first attend to this question of 'why'. Continuing professional development (CPD) aligned to healthcare professional practice is well regulated and provided for in most countries, but the same is usually not true for simulation.

Of equal importance to consider is that many of the best educators are also busy clinicians, and implementing a robust faculty development programme with various mandatory activities may run the risk of losing talented educators [4]. That said, considering the cohort of legacy talent, while attempting to develop that future talent pool and raising the educational bar for all, is a laudable aim. It is therefore useful to have an obvious and easily accessible entry point into simulation faculty development. This acts as an induction for the simulation-naive and also 'resets the clock' for people who have been using simulation but not necessarily staying up to date with current best practice. This entry point could be either an assessment or, more engagingly, a baseline course.

Individuals also respond to incentives. In the context of faculty development this could take the form of access to national or international simulation experts, a simulation centre specialist library of scenarios or even sharing of resources (staff, equipment and material, for example). People may require skills and certification for another part of their professional practice and if the development programme can be aligned to the relevant professional frameworks, there is a clear link and motivator for potential faculty.

Participation examples

- *SCSC^{HF}:* The SCSC$^{\mathrm{HF}}$ accepts all types of healthcare professionals into its faculty development programme and is demand led. The typical introductory course consists of a range of participants, although specific courses are run for teams such as the Emergency Medical Retrieval Service.
- *NHETSim:* This Australian faculty development programme's target was an impressive 4595 completions, with the aim of engaging multiprofessional learners participating or interested in simulation-based educational activity.
- *Royal College of Emergency Medicine (RCEM):* The UK-based RCEM focuses on the development of emergency medicine trainees. As an example of mandatory participation, all consultants who wish to deliver college-approved courses must attend the RCEM two-day faculty training course.
- *STELI (Simulation and Technology Enhanced Learning Initiative):* This UK initiative [16] promoted a rollout of simulation funding to support the purchase of equipment and developing infrastructure in the London hospitals. The funding support was accompanied by an explicit statement of intent from the chief executives of each of the hospital trusts involved to support individuals and teams with time and resource to develop competence in simulation-based medical education (SBME).

Programme design: stratification of content and interventions

Stratification in SBME describes the adoption of a tiered approach of courses and content with varying 'levels' aimed at mitigating the challenges of educator heterogeneity. Stratification may also assist with the concerns of balancing the time commitment needed to attain competency and the need to grow a sufficient pool of competent educators. Instead of attempting to train all simulation educators to expert level in all components of the methodology, the programme can focus on the needs of its faculty and their learners. This phased approach is clearly more appealing to healthcare delivery managers, who must often balance the challenges of running a clinical service while permitting clinical staff to spend time away from the 'front line'.

As an example of phasing and stratification:

- Help faculty to understand the concepts of constructive alignment [6] and the importance of learning objectives.
- Let them design a scenario around learning objectives.
- Help them to edit it and run and debrief it for them.

- Help them reflect on what they created, specifically in terms of the design, as you, the expert, will have run and debriefed the scenario.
- With developing debriefing skills, once they have an understanding of debriefing strategies and a model, let them perform one part of the debriefing model under your direct supervision.
- This does not even have to be in an actual debrief. Using scripted (or unscripted real) video of scenarios and debriefing can be very useful in getting faculty to practise questioning styles and debriefing strategies.

Many of these techniques will be referenced further in other chapters. Key to this style of design is a constancy of purpose; that is, an explicit overall road map of intent by the host agency shared with faculty educators and potential development programme attendees. Breaking down the skill sets can make the process more manageable for novice faculty and more obvious for the host organization and staff as to the relevance and impact of individual components in various clinical settings.

Design examples

- *CMS (Boston):* The CMS offers two introductory instructor courses, a generic course and a course designed for interprofessional operating room teams. It then offers an advanced debriefing course for graduates of these introductory courses.
- *SCSC^{HF}:* The SCSC$^{\mathrm{HF}}$, in collaboration with NHS Education Scotland (NES) and a number of other stakeholders in Scotland, has developed a National Outcomes Framework for SBE faculty development. This allows both courses and programmes to map their outcomes to three different levels of SBE: awareness, introductory and advanced [17].

Educational Governance

Individuals and organizations supporting the educational development of staff or faculty have a general responsibility to provide the most impactful learning using the least resources possible, over the shortest amount of time; that is, to be efficient and effective. With simulation it is all too easy to choose the most functional mannequin in the most realistic environment and simply recreate clinical cases.

Historically, governance within simulation-based clinical education has been sparse and usually within specific clinical education courses (e.g. Resuscitation Council life support courses). This paucity of quality statements is due in no small part to the lack of a national or international competent authority in SBE. However, like healthcare itself, governance and assurance are fast becoming overarching principles to promote effective and efficient use of this particularly expensive resource. The belief that expertise in a clinical field translates into expertise in educating others in (or outside) that field does not hold true, and this is especially the case where simulation is concerned. With so much activity within the field of simulation-based clinical education, coupled with a relative lack of governance, helping people to engage with standards in SBE is challenging. For this reason, the authors suggest that any approach that mandates components such as specific training or credentialling will be less engaging and powerful than something that is flexible, adapting to individuals and providing internal motivation. Of course, any governance and quality assurance will employ both of these dispositions, but the balance between them is key.

As an example, the faculty development programme should detail the minimum standards required of the faculty instructors. Personnel delivering the faculty development programme should be experts in SBE and effective coaches [18]. The very best facilitators are not necessarily the best coaches, and it is therefore essential to judge their effectiveness. This may include, for example, the number of courses to be run per year and the type and amount of feedback gathered from participants and observing faculty.

Governance Examples

- *AoME (Academy of Medical Educators):* There are increasingly more examples of recommended core values and standards for individuals providing clinical education. One comprehensive example is the Professional Standards document from the UK Academy of Medical Educators [19]. This describes five domains to be evidenced by individuals as part of continuing professional development in medical education:
  - Domain 1: Design and planning of learning
  - Domain 2: Teaching and supporting learning
  - Domain 3: Assessment and feedback to learners
  - Domain 4: Educational research and evidence-based practice
  - Domain 5: Educational management and leadership

  The previous version of this document was adopted by the General Medical Council for Recognition of

Trainers as part of medical doctors' revalidation or professional licensure during a process of annual clinical appraisal. Providing evidence of development in each of the five domains will therefore become a mandatory component of maintaining the position of GMC Recognized Trainer in the UK. Although these domains do not specifically mention simulation-based education, they are of course applicable.

- *NES (NHS Education for Scotland):* Scotland has a simulation-specific National Outcomes Framework for Faculty Development, referred to earlier, which outlines the broad content that would be expected in any provision for faculty development courses or programmes within simulation. This allows any individual or organization providing faculty development to map their activity to the framework and, more importantly, for developing faculty to understand what is on offer with different providers.
- *RCEM:* As already referred to, the RCEM mandates that RCEM-approved courses need to include an instructor who has attended the RCEM instructor course. In addition, the college recommends that the instructor teaches on a minimum of two courses per year [20].
- *American Board of Anesthesiology (ABA):* The ABA runs a Maintenance of Certification in Anesthesiology (MOCA) programme that mandates that its members complete a simulation course every 10 years. The course must be attended at a center endorsed by the American Society of Anesthesiology (ASA). This process of ASA endorsement involves a fee and other evidencing of requirements such as demonstration of an effective evaluation process focused on the course, the instructors and the programme.
- *Australian and New Zealand College of Anaesthetists (ANZCA):* The ANZCA requires trainees to complete the Effective Management of Anaesthetic Crises (EMAC) course. In a similar manner to MOCA, ANZCA provides accreditation to specific centres that run the EMAC course. Accreditation includes an onsite review by a college representative to ensure that it meets the requisite standards.

Final considerations to ensure longevity and impact

Operationally Focused

The primary driver for a faculty programme must be a desire to support the development and delivery of educational interventions resulting in a sustained improvement in the participants' knowledge and skills. The stated aim of any course or programme therefore must be to deliver high-quality educational experiences to support clinical excellence. This is the key link to convince commissioners to invest in educational programmes where the alignment of the intervention is to their benefit, focused on staff and healthcare governance principles and promoting risk management and safety principles relevant to the local clinical context.

Clinically Led

Recruiting, supporting and retaining faculty are vital for the sustainability of any programme. While reflecting on the meaning of teaching and an individual's motivation to teach, Steinert and MacDonald [21] describe five themes from physicians who teach medical students and residents. Teaching:

- Is an integral part of individual identity.
- Allows a form of repayment of former teachers for one's own training.
- Gives an opportunity to contribute to the development of the next generation.
- Enables learning for the teacher.
- Is personally energizing and gratifying.

Although this small study was within a specific group of individuals, the principles are recognizable across all educational domains. Organizations taking the time to consider how to make some or all of these components highly visible to their faculty will help in motivating them to continue engaging with and supporting educational activity.

Educationally literate

Organizations must carefully weigh the trade-off between the increased time and commitment required of their clinical educators to participate in these faculty development programmes and the impact of any intervention. The continuing development of educational standards both generically and in the domain of SBE, although in its infancy, will be the primary driver for quality improvement in simulation-based education over the next decade.

Using the educational principles outlined in this chapter and others will allow commissioners to choose wisely the high-quality interventions best aligned to their organization's needs and promote the realization and support by management and staff for initial and ongoing faculty development activity.

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CHAPTER 15

Programme development and sustainability in healthcare simulation

Komal Bajaj, Michael Meguerdichian, Jessica Pohlman & Katie Walker

KEY MESSAGES

- Business cases and project plans underpin successful programmes.
- Space design, delivery location and equipment considerations are key to providing the right simulation experience for the learners.
- Simulation programmes provide political legitimacy when they are aligned to the organization's mission and vision and are responsive to organizational needs.
- Adding value, maintaining political legitimacy and nurturing operations are guiding principles towards sustainability.
- Determining appropriate metrics to measure success is necessary and requires careful consideration.

Overview

Developing a healthcare simulation programme with longevity involves mindful consideration of the many elements required to ensure that the programme is relevant for all stakeholders [1]. A well-planned programme delivers a curriculum through a range of simulation modalities, has trained and certified simulation educators and specialists (technicians), is aligned to the organization's mission and vision and is delivered in an environment where reality is maximized. The authors will describe the necessary elements of simulation programme development, the impact of the centre design and equipment considerations. A public value-creation theory and sustainability model will be presented, including governance and management considerations to ensure that programmes meet organizational goals and deliver on training objectives, while providing safe, efficient and transparent outcomes. Using this literature for simulation centre sustainability may help us better understand value in the public sector and how to measure it more effectively.

Introduction

The administration of healthcare simulation programmes is maturing as the field continues to grow. The use of business plans and project plans during development, as well as the application of public-sector business theory when addressing sustainability, are critical managerial aids to establish programmes that will flourish over time. An understanding of the external environment is key to establishing a programme where enriching collaborations can be nurtured. Being cognisant of the internal environment, where the programme resides in terms of the organizational structure and who the simulation director reports to will determine visibility and leverage for the programme. Careful consideration of programming, space utilization and equipment purchases will start the simulation centre on a stable foundation. Thinking about the programme in a way that will add value to the organization, where political legitimacy is cultivated, and one where operations are nurtured, will provide sustainability in a thoughtful way.

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

Development

Developing a business case and project plan

Business case and project plan development will assist both the centre director, their team and their supervisor to clearly delineate challenges as well as resources that will be required. Bartlett Ellis et al. [2] describe the headings of the business plan as including:

- Problem identification and alignment with strategic priorities
- Needs assessment
- Stakeholder analysis
- Market analysis
- Intervention implementation planning
- Financial analysis
- Outcome evaluation

A fundamental project-planning template would include a list of tasks, each with an assigned, well-described cost, timeline and personnel responsible for completion. A Gantt chart may suffice to record this information [3]. There are a plethora of business planning and project management templates online. Use a template that will meet your needs without being too complex. Some organizations have their own templates and it would be prudent to use your organization's template before looking further. Funding for simulation programmes can come through different channels, such as grant funding (both direct and indirect), budgeted line item or philanthropy, and more often is a mix of all three. Being cognisant of these different modes can help maximize the funding allocated to the simulation programme. Careful consideration of the gap the programme addresses, the faculty who will need to be trained, the curriculum developed and how the simulation experience will be deployed – at point of care, in the hospital environment or in a standalone simulation centre – will expedite the development and delivery process [4].

Programming and space considerations

Designing a simulation space is a process that requires resources, creativity, organization and attention to detail. When considering construction, there are key elements that demand attention prior to the first nail being driven in. In such a project that combines education and design, we must think about mission and vision, members of the team, centre size, movement and flow, room types and audio/visual/environmental considerations.

Mission and vision

It is important first to perform a needs assessment of the institution to determine where the resources are going to be applied. This can be achieved by identifying important stakeholders who will drive the utilization of the centre. Stakeholders should include the faculty, who will be utilizing the centre as they will be driving the curriculum and programmes. Other stakeholders to consider include the administration that holds the purse for the programme. This group will control the amount of resources available to both build and sustain a programme, and will help define its mission and vision. Having an 'if you build it, they will come' philosophy, without a mission and vision, is not likely to bear fruit. By constructing the vision of the programme, you create the core values and purpose of the simulation centre as well as a direction for its future [5]. Once you have identified your programme's needs and the deliverables, you are able to start thinking about design as part of the mission.

The team

A simulation design team must include at least project manager, architect, contractor, owner, faculty and simulation design consultants. Simulation design consultants are team members who have had previous experience with simulation education; if none is available this can be outsourced to consultants. With this team, it is important to determine what type of simulation space is going to be pursued. Will it be a mannequin-based programme? Does the institution want to create a virtual hospital? It is important to ask questions like these, relying on the mission and vision of the programme to better understand how the space can best achieve its needs [5].

Centre size

The size of the simulation space depends on many factors. First, what type of space exists at the institution? Are you retro-fitting an old space or are you building a completely new space? If you are retro-fitting the space, you may not have a choice about the dimensions of the area. If you are creating a new space, think about the number of people using the space simultaneously that the space will need to accommodate.

If you are given one room, think about the types of functions the room will need to achieve. Are you teaching 40 students central line insertion using part-task trainers? Are you teaching interdisciplinary code response teams teamwork strategies? When you are given only one room, the room needs to be modular and to adapt to the programme's educational needs.

If you are given multiple rooms, think about how each of the rooms will adapt to certain educational activities. Will you have an operating room that differs from the critical care suites already provided? Will you have clinical rooms where simulated patients perform objective structured clinical examinations? Once again, tailoring the size to the needs based on the mission and vision as well as to the faculty deliverables will guide the team towards success.

Flow

How people will move through the space during an educational activity is also important. Will your learners need to debrief in the same room where they have performed their simulation or will they move to a room next door? Is the classroom a separate area that requires a five-minute walk to get to from the simulation experience? Will the location of the bathrooms necessitate longer breaks or delays during a learning activity? Proximity of storage rooms where equipment is held will affect preparation and breakdown times. Thinking about how wide the hallway needs to be to get equipment like stretchers and storage carts through has to be part of the plan. Attention to ensuring that the facility complies with local accessibility standards should not be overlooked. Discussion with your contractor regarding the type of flooring needed to accommodate heavy traffic will avoid early maintenance.

Room types

In situations where there is more than one room, the room types will once again be defined by the requirements of the programme. Does there need to be a conference room that will have direct instruction? When considering assessment, will you need a direct observation room or will video transmission suffice? If there is an audio-visual component to the programme, will a separate room be required to house the server? Will the room need cooling? If moulage is anticipated to be a large part of your programme, will a separate prep room be dedicated to this? The control room will house your simulation operators, who will manage the magic behind the glass. As cases become more complex, attention to sound and ability to see will become more important.

Storage is an often overlooked necessity of the simulation centre. It is imperative to have a clean, dedicated and secure space to house equipment and supplies. A quarter to a third of the total space dedicated to the centre should be allocated to storage space to allow for programme growth and expansion. In addition to clinical rooms, here is a list of possible room types:

- Observation rooms
- Storage room
- Audio-visual room and/or an IT room
- Changing room/locker room
- Bathroom
- Control room
- Kitchen
- Debriefing room
- Conference room/auditorium
- Offices
- Copy room
- Preparation/moulage room
- Apartment (home care/extraction room)
- Lobby/entrance

Audio-visual/environmental considerations

Identifying whether the centre needs an audio-visual system is part of the project plan. Anticipating if faculty will want to broadcast a simulation in real time or video-record it for playback affects the range of educational strategies available. Placement of cameras and microphones needs to be pre-determined. Are you considering low-tech options such as cell-phone video or higher-tech options such as an integrated system that allows for bookmarking and more comprehensive reviewing?

Depending on the size of the centre, having different zones may help cut costs for heating and electrical. As mentioned, cooler zones for audio-visual systems may be needed, while more adjustable heat zones will be appropriate for higher-traffic areas. Ask your contractor what type of lighting and sound insulation would be best in the space.

Equipment selection considerations

Long before making equipment purchases, one must have a clear understanding of the courses and types of simulation sessions that will be conducted. The more long range you can predict, the better your equipment purchases will be. It is best to consult all stakeholders to determine what their key training needs are and that these align with the organization's mission and vision. Not all training needs can be addressed via simulation, due to either financial constraints or limitations of simulation. It is also prudent to consult with other key players in your healthcare delivery system – infection control, risk management and so on – to ensure that the equipment selected meets hospital-wide training initiatives. Finally, it is important to locate under- or unutilized equipment that may already be present in your facility. It is advantageous to collaborate with departments that have purchased such equipment – an optimal solution might be one where the simulation centre gains additional equipment that you do not need to purchase and the department can begin training on equipment that was not being optimally utilized.

Once you are clear what you will be delivering, it is time to match the best equipment to your intended simulations. It is important to think of the skill level of your learners and how they will use the equipment. Are you teaching novices, when as a result your training will almost all be procedural-based skills? Are you teaching teamwork and communication to interdisciplinary teams? Such questions will help focus your search on the various categories of equipment: partial-task trainers, full-bodied mannequins and virtual reality trainers. Furthermore, it is important to weigh up how simulated patients will be utilized within the programme and how this will affect your equipment needs.

The process of purchasing equipment can be tedious – it requires careful investigation and evaluation of various types of equipment. Price should not be the driving factor in equipment selection. It is best to spend your budget on a smaller number of carefully selected pieces of equipment that will work hard for your centre, rather than to purchase large quantities of lower-cost equipment that may not meet your needs or will not stand up to prolonged use. Identify the list of 'must have' features, as well as the 'nice to have' features from your stakeholders. Begin your research by looking for Items that have all of your 'must have' features. Talk to neighbouring simulation centres and ask them what equipment they are currently using and if they would purchase that equipment again in the future. After narrowing your search down to a few good options, invite those vendors in to demonstrate their products.

Assemble a team of stakeholders to evaluate the equipment. Members of this team should be available to evaluate all of your potential options and provide their preferences. Determine the pieces of equipment that will provide the best value to you: pieces that allow training on a multitude of skills or that can be used in a variety of applications are often the best options given the limited secure storage space that most centres have. Ensure that skills are not being duplicated in other equipment purchases. If equipment pieces are narrowly focused or address skills that are necessary but costly, see if you can make agreements with neighbouring simulation centres to purchase that equipment together and share it between the facilities.

Finally, when equipment funds are tight, determine whether you can make low-cost trainers or models yourself. Not all simulation equipment needs to be commercially purchased. Think outside the box and see if there is a way in which you can replicate the skills in a part-task trainer with items from a craft store or hardware store.

Sustainability

There are several complex factors to consider when developing strategies to ensure the ongoing sustainability of a newly created simulation programme. Dr Mark H. Moore, an authority in public management, provides a theoretical framework to help identify sources of support as well as challenges when trying to move an agenda forward [6]. The next section describes the three components of Moore's strategic triangle as illustrated in Figure 15.1 – public value, political legitimacy and operational capabilities – as well as providing practical suggestions and tools to explore these areas to find programme-sustaining solutions.

Creating public value

Value itself can have multiple dimensions, depending on its context or from whose point of view it is being ascertained. For example, Benington identifies several dimensions of value-added in the public realm, including 'economic', 'social-cultural', 'political' and 'ecological' value [7]. Furthermore, he posits that value is a 'contested concept which depends upon a

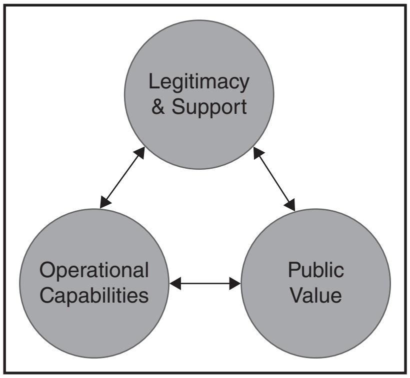

Figure 15.1 Moore's strategic triangle. Source: Reproduced with permission from Moore M. Creating Public Value: Strategic Management in Government: Harvard University Press; 1997.

deliberative process within which competing interests and perspectives can be debated' [8]. Therefore, since value greatly depends on the unique environment and challenges in which it is being discussed, being clear about what that value means to different individuals is an important first step in creating substantive value.

REFLECTIVE EXERCISE

What value does your programme create? Consider value from different stakeholders' perspectives.

For (a) your superiors, (b) your peers and (c) your trainees/other subordinates:

- What problem are you solving?
- What is your goal?
- What is your guiding message?

Cultivating political legitimacy

Political legitimacy is a vital ingredient in the survival of a simulation programme. Legitimacy can come from a variety of sources and often catalyses the actions necessary to create or maintain value.

REFLECTIVE EXERCISE

When attempting to attract the resources needed for sustainability, consider the following target areas and list what support each may offer in advancing your mission: (a) institutional interests, (b) directives from regulatory organizations, (c) legal and ethical mandates, (d) media coverage and public relations, (e) Your professional network.

Professional social networks themselves are complex and are often the hidden avenues through which meaningful action takes place (or is undone) within organizations [9]. Networks comprise many different associations (individuals, groups, institutions) who interact for a multitude of reasons, including advice seeking, task sharing and information gathering. Recognizing the structure of your own network will help you be a more effective advocate for your agenda and circumvent challenges.

REFLECTIVE EXERCISE

When contemplating strategies to harness your professional social network, consider the following to identify important individuals/groups in your network:

- Who are the important individuals who support or block your agenda? What are their sources of power (title, expertise, network centrality, social influence, funding, other)?
- What are the important groups/organizations that support or block your agenda?
- How are these individuals and groups related?

Draw the network surrounding you and your agenda. Begin by drawing a circle in the middle of the page called 'us'. Next, place those with whom you have strong ties with a connecting line in green and those with whom you have weak ties with a connecting line in red on the page, so that people in the same organization are near each other. Use a green marker for supporters and a red pen for blockers. Finally, draw circles around people in the same organization and add any other organizations from the list of blockers and supporters you identified (again using red and green to distinguish supporters and blockers).

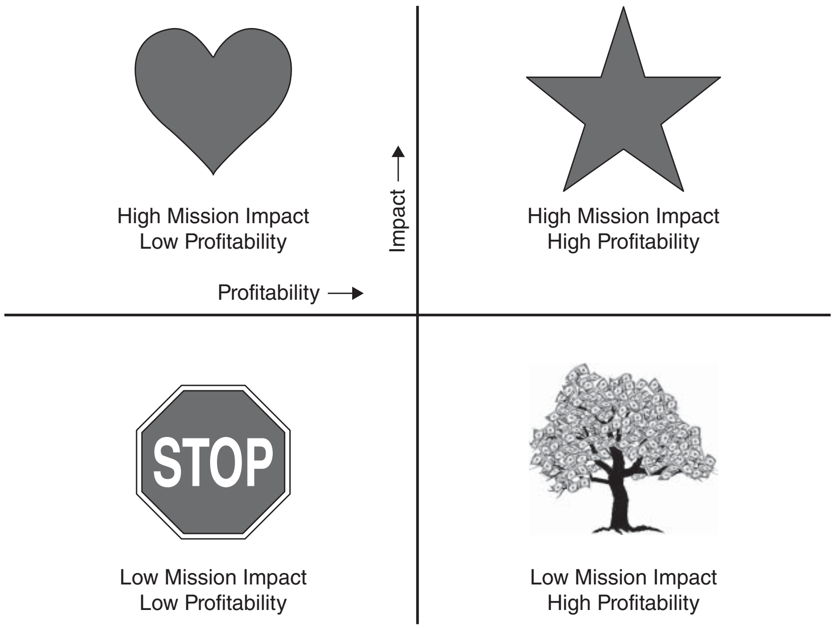

Figure 15.2 Sustainability matrix map. Source: Reproduced with permission from Bell J, Masaoka J, Zimmerman S. Nonprofit Sustainability: Making Strategic Decisions for Financial Viability: Jossey-Bass; 2010.

Nurturing operations

The first half of this chapter discusses development of a simulation programme and the critical role that vital operations play from inception to opening. Moore's triangle focuses managers on considering what operational capabilities (including innovations) the simulation programme currently relies on (or needs to develop in the future) to deliver value.

REFLECTIVE EXERCISE

Bell et al. [10] think of success in not-for-profit organizations as the relative impact or value of the programme versus the profitability. In Figure 15.2 is a grid where you can plot your programmes to understand more fully the value they are adding both to the organization and financially. You may decide to stop delivering programmes that fall into the lower left quadrant, for instance. Plot your existing products and services as well as initiatives that you are considering on Figure 15.2.

Depending on which quadrant an activity is placed in on the matrix map, a strategic imperative emerges. This helps clarify the actions that would most likely strengthen your simulation programme's value and improve the organization's sustainability.

Conclusion

The groundwork for a sustainable simulation programme is laid during its inception. This chapter has highlighted key elements that require deliberate attention during all phases of planning and execution. Every simulation programme is different depending on its mission and vision and the sector of the healthcare or education system it is serving. Consideration of space and equipment and how and where the programme will be delivered is essential. Thinking of the value the programme adds, its political legitimacy and how to nurture its operations are key to long-term success.

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CHAPTER 18

Designing simulation-based learning activities: A systematic approach

Debra Nestel & Suzanne Gough

KEY MESSAGES

- The literature reports many approaches to designing simulations and simulation frameworks.
- Systematic approaches can assist the quality of the educational experience.
- Irrespective of simulation modality, professional discipline and setting, there are commonalities in simulation-based education.
- Phases of simulation include preparing, briefing, simulation activity, debriefing/feedback, reflecting and evaluating.

Overview

In this chapter we provide an overview of simulation practices relevant for any immersive simulation experience. We start by describing a simulation framework used in a national training programme in Australia (NHET-Sim): preparing, briefing, simulation activity, debriefing/feedback, reflecting and evaluating. We illustrate the simulation phases using a hybrid simulation for learner surgeons in a formative assessment. We acknowledge that there are many approaches and offer this as one that has widespread application.

Introduction

The literature offers several valuable approaches to designing simulation-based learning activities. For example, Jeffries published a simulation framework for application in nursing education [1]. Dieckmann based his framework on interprofessional mannequin-based simulations [2], while Gough describes a framework for simulation derived from her studies in cardiorespiratory physiotherapy education [3]. Although from different professional practices and based on different simulation modalities, these frameworks have commonalities that reflect effective educational design. Systematic approaches to simulation design can strengthen practice and promote learning [4, 5]. Chapter 2 acknowledges theories that inform healthcare simulation education, including deliberate practice, which offers further guidance to simulation practice.

Simulation practices are also informed by standards offered by professional associations (see the additional resources at the end of this chapter). These standards have relevance at different levels of application: centre, programme, scenarios, facilitators and so on. Our focus in this chapter is consideration of simulation design at the level of the individual simulation event.

We use a systematic approach offered by a national simulation educator programme in Australia [6]. The NHET-Sim programme was designed for individuals working with any simulation modality, in any setting and across professions. The systematic approach focuses on the design of simulation events rather than a whole curriculum, but can be scaled to accommodate the system in which the simulation event is to be located; that is, the broader workplace and curriculum activities of the learners. The phases enable practitioners to share a common language for designing and communicating about simulation-based education (SBE). We illustrate this systematic approach with a simulation designed to support trainee surgeons in managing effective communication with a patient undergoing removal of a mole (Box 18.1).

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Box 18.1 An example of a hybrid simulation using the NHET-Sim programme's six phases.

Preparing

Topic
Removal of a mole

Summary
Mr Brian Remington has come for removal of a mole on his upper arm. He is cooperative, although anxious because his sister died from malignant melanoma and he is concerned this may be a melanoma. The surgeon will explain the procedure, inject anaesthesia and close the wound.

Learning objectives
Trainee surgeon demonstrates competence in:
- Identifying the correct patient
- Explaining the procedure
- Identifying and acknowledging the patient's concerns
- Making empathic statements
- Communicating with the patient while operating
- Communicating with the nurse
- Checking the patient knows the next steps

Requirements

Simulated patient	Dissection and suturing instruments
Nurse to assist	Specimen container for pathology
Simulated patient's notes/patient chart	Trolley
Barrier sheet	Suturing pack
Fenestrated drape	Sutures
Mole model/skin pad	Sterile gloves
Velcrose holder	Local anaesthetic – Lignocaine 1% plain
Procedure/operating room	Syringes (5 ml and 10 ml)
Chairs	Needles (green and blue)
Procedure couch	Sharps container
Mole skin pad with perspex holder	Bin
Fenestrated adhesive disposal drape	

Task for trainee surgeon
Mr Brian Remington has come to the day surgery clinic for removal of a mole on his arm. You are required to manage the consultation and remove the mole.

Information for the simulated patient (SP)
You are Mr. Brian Remington, aged 56, and you have come for removal of a mole on your upper right arm. You are cooperative, although anxious because your sister died from malignant melanoma four years ago. The surgeon will explain the procedure, inject anaesthesia and close the wound. The learning objectives are as listed earlier.

Behaviour
You are cooperative and communicative, but you have an underlying worry about cancer.

SP questions and prompts
Answer the trainee's questions honestly, but do not elaborate information unless the trainee facilitates this by pausing and staying with your answers. While the trainee is removing the mole, mention that your sister died of skin cancer. If the trainee acknowledges what you have said, then go on to ask if your mole could be malignant. Our experience is that often the trainees do not hear or acknowledge your comment while they are operating.

If information is not presented about the removal of the stitches, ask about what happens next towards the end of the interaction. 'Do these stitches just dissolve?' 'How do I get them removed?' Other questions to ask across the interaction, depending on the flow of communication, include: 'What exactly is a mole?' 'Why do people get them?' 'Will it come back?' 'Will I get others and what should I do about it?' At some point touch the drape while the trainee is watching unless they have already asked you not to do so.

In addition to considering the communication issues that occur during the procedure, there are a number of other points in playing this role. The trainee needs to inject local anaesthesia prior to the mole being removed. The injection will sting, so grimace. Sometimes trainees ask you to look away, but you need to watch so that you can respond at the precise moment. The trainee will wait a short time (a couple of minutes) and then is likely to test the site for numbness by poking around it with a blunt instrument. If asked if you can feel anything, say 'no'.

The trainee will use a cutting instrument to remove the mole and then stitch it closed.

Do not engage the nurse in conversation unless the trainee promotes discussion.

You are concerned that you may have cancer and also about the scarring on your arm ('I remember my sister had a great hole on her shoulder. It was really disfiguring.')

History of present illness
You first noticed the mole six months ago. Two weeks ago, you visited your general practitioner (GP). Your GP assessed the mole and believes that it is benign, but has referred you to the hospital for removal of the mole. The mole has not

grown in size since you first noticed. You are concerned that it might be cancer because of your sister's history.

Past medical history
Nothing significant.

Social history
You are a landscape gardener – you will need to get back to work. Your parents are alive and have no health problems. You sister had a mole on her left shoulder for several years, but it changed about two years before she died. 'She had it removed a couple of years before she died, but obviously it had already become malignant. It was terrible. Still is difficult. Her kids are managing though. Amazing what kids can handle.'

Family history
You are married to Susan and a father of two boys, Joseph (aged 14) and Lewis (aged 16).

Considerations in playing this role
You will have a suture pad velcroed around your right upper arm (wear a short-sleeved top that is not bulky) and the pad will have a surgical drape covering it to create the impression that the mole is on your arm. The pad has a hard perspex backing to protect your arm and can get uncomfortable, so we will remove it whenever possible.

Briefing
The facilitator briefs the trainees. In addition to the usual actions described in the text, including sharing the learning objectives, the facilitator seeks the following information:

- Have you done this procedure before? In the skills lab? With real patients? How did it go?
- How are you feeling? How confident are you? How competent do you think you are at this? What are the most likely challenges you will face? How do you think you will deal with them? Have you conducted any similar procedures? Are there similar skills needed for this procedure? How easy/hard will it be to use them here?
- What did you do well the last time you did this procedure?
- Did you have any particular difficulties? If so, what were they?
- What are you most hoping to learn?
- What would you like us to observe?
- From the patient's and nurse's perspective, is there anything you would like feedback on?

The facilitator allocates tasks for the observers (other trainees).

Simulating
The facilitator observes.

Debriefing/feedback
The focus of the debriefing/feedback relates to exploring how the trainee felt during the procedure, what went well and identifying what did not go so well/as planned. The facilitator should invite the SP and observer trainees to offer their perspective and draw on information from any observational rating tool (Table 18.1). This is crucial for developing the trainees' insight. Self-regulated learning goals may be discussed and, where a trainee has indicated specific points to be observed, feedback should be provided, drawing again on the SP and observers. Finally, how will the trainees make use of the experience? It is important to make a summary of what has been discussed and refer trainees to review any digital resources provided (e.g. a DVD of the simulation). Alternatively, other debriefing tools can be used to structure the discussion [7,8].

Reflecting
During the debriefing/feedback, ask learners to think about how they may apply this learning experience to their practice. What is similar? What is different? What conditions will align? What will be different? How will they check on whether they are progressing? What further practice do they require?

Evaluating
Faculty including SPs and learners will be asked to consider the extent to which the simulation event enabled them to meet the learning objectives. For the faculty, was there enough time?

Source: Adapted from a scenario developed for the ICARUS research project, Imperial College, London. Authored by D. Nestel, R. Kneebone and R. Aggarwal.

Figure 18.1 illustrates the phases and their cyclical relationship. The figure appears in its most basic form and can be adjusted to accommodate contextual variations. The *preparing* phase refers to all the activities that take place before the simulation event starts, such as identifying learners' needs; setting learning objectives; designing the scenario, sourcing simulators, medical equipment, props and so on; booking rooms; recruiting and identifying faculty, confederates and simulated patients (SPs); scheduling the learners; catering and so on. The range of tasks will depend on the local simulation facility and practices.

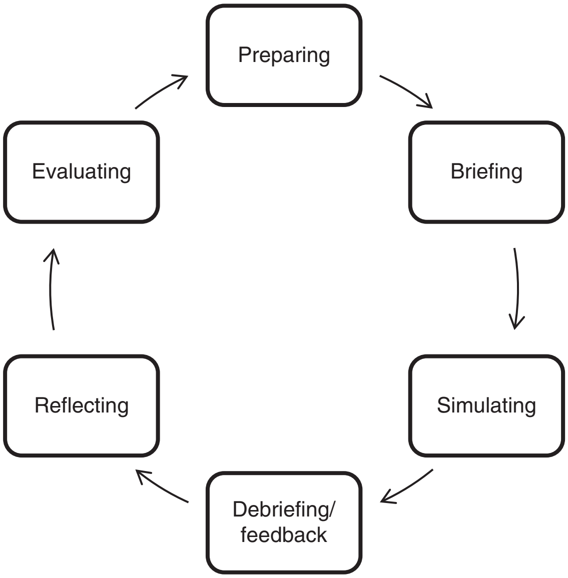

Figure 18.1 Phases in simulation design. Source: Adapted from the NHET-Sim Programme.

In our example, the activities associated with *preparing* will include identifying competencies required for learners, their prior experiences, anticipated challenges for learner(s) and so on. Given that the scenario (in Box 18.1) involves communication, an SP-based scenario is most likely to be appropriate, and because the task involves a procedural skill that can be easily simulated with a task trainer, a hybrid simulation will be suitable. The scenario will need to be developed to offer a level of sufficient challenge to learners. When working with groups of learners, this is complex because of variation in their levels of experience with the procedure. Approaches to scenario design vary and when SP based usually include an SP role in which the character and personal history of the SP are set out, as well as clinical features relevant to this particular scenario [3, 6]. To ensure that a patient voice is represented, seeking advice from lay people and SPs is important to ensure authenticity and feasibility. The SP will need to be trained to play the role, including in the extent to which standardization is important. As this scenario is being used in a formative assessment, a tight 'bandwidth' of performance will be less important than if the scenario was a summative assessment. The scenario may trigger an emotional response for the SP that could make their performance unsettling for them, so they will need to be asked whether they think they will be able to manage. Approaches to training SPs are beyond the scope of this chapter, but refer to the additional resources.

The simulated setting in which the simulation takes place will need to be created, and consumables and other medical equipment checked for availability and functionality. It is important to do a 'run-through' of the whole procedure to ensure that the timings are appropriate for the task. Positioning of the SP and equipment within the setting will also need to be tested to ensure that observers have audiovisual access. The debriefing will be facilitator led and observers will use the rating form in Table 18.1. In this scenario, the SP will provide verbal feedback on the learner's performances with respect to the learning objectives. The facilitator will assist them in sharing this information using a protocol.

The *briefing* phase is given relatively little attention in the literature, but is really important in setting up valuable learning experiences [3]. To other faculty and SPs, the briefing will include the learning objectives, the learners' characteristics, logistics such as time frames, starting, pausing and ending the simulation activity, simulator programming, technical support, communication with the control room, audiovisual capacity, debriefing and feedback processes, reflective exercises and evaluation forms. Additionally, during the briefing it can be important to explore faculty's prior experiences of the scenario and their feelings about it. An opportunity for final questions can ensure smooth functioning. Sometimes SPs are briefed separately to learners for their first encounter within the simulation. Briefing learners will include most of these elements and may also include inviting learners to set their own goals relative to those prescribed and their experiences [9]. We provide an example in Box 18.1.

Orientation of learners to the simulation is important. This will include explicit discussion on what is similar and what is different to reality. This is linked to what is called a *fiction contract*.

Some learners find simulation stressful and it may be important to normalize the experience during the briefing. This involves acknowledgement that learners often find simulations stressful. Creating a safe learning environment involves several strategies and learner-centred attitudes from faculty. This can be achieved through several strategies, including clear explanation of the

Table 18.1 Observational rating form.

Patient-focused communication skills for procedural skills		Not done	Done incorrectly	Done correctly
	Opening			
1	Greeting	0	0	1
2	Introduction – full name	0	0	1
	– role	0	0	1
3	States purpose of procedure	0	0	1
4	Assesses patient's understanding of procedure	0	0	1
5	Establishes consent/agreement to proceed	0	0	1
6	Asks if patient has any questions	0	0	1
7	Asks if patient has any worries or concerns	0	0	1
	During procedure			
8	Explains procedure appropriately	0	0	1
	Closure			
9	States what has been done	0	0	1
10	States what will happen next	0	0	1
11	Checks patient's comfort	0	0	1
12	Checks patient's understanding	0	0	1
13	Asks if patient has any questions	0	0	1
14	Thanks the patient	0	0	1

Appropriate use of non-verbal communication (e.g. eye contact, body language, touch, facial expressions)				
Not at all		Sometimes		Consistently
1	2	3	4	5
Responds to patient's verbal cues (e.g. questions, requests for explanations, worries)				
Not at all		Sometimes		Consistently
1	2	3	4	5
Responds to patient's non-verbal cues (e.g. facial expression of discomfort)				
Not at all		Sometimes		Consistently
1	2	3	4	5
Appropriate use of silence				
Never		Sometimes		Always
1	2	3	4	5
Uses unexplained jargon				
Throughout		Sometimes		Not at all
1	2	3	4	5
Interrupts patient appropriately				
Never		Sometimes		Always
1	2	3	4	5
Makes empathic statements				
Never		Occasionally		Throughout
1	2	3	4	5
Shows warmth				
Never		Occasionally		Throughout
1	2	3	4	5
Perception of clinician's anxiety				
Very anxious		Moderately anxious		Not at all anxious
1	2	3	4	5
Overall rating of patient-centred communication skills				
Very poor		Satisfactory		Excellent
1	2	3	4	5

Comments:

simulation phases and their responsibilities in each, clarity over who is observing, what will happen with audio-visual recordings, confidentiality among those involved, seeking their buy-in with respect to doing their best, the orientation or familiarization of the simulators and setting.

During the *simulation activity* the learner(s) participate in the simulation. It is important to indicate a clear start to the simulation and observe for the physical and psychological safety of those within the simulation [5]. Minimal talking is often desirable to facilitate acute observation. Encouraging observers to make notes to enable specific feedback during debriefing can be valuable (see Box 18.1). If there is a pause and discuss option, then enact it as planned. Respond to cues for finishing the scenario. Depending on the simulation modalities, during the simulation activity cues may need to be pre-programmed onto the simulators (e.g. mannequin) and/or given to confederates, SPs and learners [4, 5]. Facilitators often develop their own approach to notation (electronic or hand written) and should be ready to commence as the simulation starts.

Once the simulation is over, observations of participants and observers can be really important in helping the facilitator to frame the opening debriefing statements. During this transition period there can be a lot of emotion expressed that is relevant to the debriefing and feedback. Encouraging participants to regroup and spend a few minutes thinking about what has just happened can be useful, including asking them to think about what worked well and what could have been improved. If observer tools are being used, then this is a good time to complete them (an example is provided in Box 18.1).

On ending the scenario, participants move to the debriefing room. It is helpful to organize the physical space, paying attention to seating arrangements, whiteboard and/or TV screen if video-assisted debriefing is used. As facilitator, it is helpful to have the learning objectives in your notes in order to stay focused. It is easy to be completely sidetracked by participants' responses. Remember to turn off recording devices. Follow the processes outlined in the briefing, although flexibility is also important to ensure learner-centredness. Invite observers, confederates and SPs to participate. Use opportunities, especially for communication-based scenarios, to rehearse micro elements of the scenario. This can be a valuable way of getting observers involved.

The *debriefing and feedback* phase complements the briefing, almost as bookends to the simulation activity. See Chapter 21 for further information. This phase is often reported to be the most important part of SBE that leads to learning [10–12]. Facilitators explore participants' feelings, address goals and learning objectives, seek other perspectives, summarize, affirm positive behaviours, explore unplanned issues and seek to establish new goals [13]. One goal of the debriefing is to promote reflection. However, we include this as a separate phase to highlight the importance of the locus of control for learning residing with the learner once they have left the simulation event.

Evidence of the effectiveness of debriefing has been reported [10, 11, 13–17]. Debriefing formats vary and debriefing is usually undertaken immediately after the simulation event (warm) or delayed (cold) [18]. Formats can be relatively unstructured to highly structured. Examples of debriefing tools, including the *diamond debrief* [7] and others, are provided in the London Handbook of Debriefing [18]. Similarly, debriefer rating tools such as the Objective Structured Assessment of Debriefing [6, 7, 18] and The Debriefing Assessment for Simulation in Healthcare [19] have been developed to provide evidence-based guidelines for conducting debriefings in simulated and real clinical settings. Guidelines for video-assisted debriefing have been published [20–23], but their optimal use remains unclear.

For the *reflecting* phase, learners (usually individually) are encouraged to make sense of the simulation in the light of their own experiences and those they plan. Similarly, faculty and SPs are encouraged to reflect on all facets of their contributions too. Reflecting is usually an individual activity; while debriefing is often collective and connected to the simulation activity, reflecting has a wider reach. During briefing, learners can be informed of reflecting activities and reinforced after the debriefing. Of course, there is overlap between these phases and reflecting can occur before the debriefing. There are several approaches to reflecting that have been adopted in SBE [24–26].

Learners can be directed to evidence their reflective practice following simulations by uploading and tagging digital learning resources (audio, photographs, video and podcasts etc.), within an e-portfolio [3] or blogs, social networking sites and wikis. Permissions need to be considered with respect to use and storage of these images. A case study using video reflexivity following simulation is provided in Chapter 23.

Evaluating refers to the success and limitations of the session in meeting its goals, rather than assessment of the individual. This phase benefits from the involvement of all stakeholders, although in practice it is often only learners, faculty, confederates and SPs who participate. It is well recognized in the literature and evident in simulation frameworks that evaluation is a crucial element of driving improvements in education, healthcare practice and ultimately patient care [1, 3].

While it is essential to consider the degree to which the SBE intervention has supported learning, meaningful evaluations require more sophisticated methods. Complex learning interventions require equally complex evaluations, using qualitative and quantitative methods to draw on multiple sources and triangulating data alongside exploring multiple levels of impact.

Conclusion

This chapter has introduced systematic simulation practices relevant for any immersive simulation experience. We acknowledge the restriction of the depth and detail permitted within the chapter, in relation to the phases and theoretical approaches underpinning the design, development and evaluation of SBE. However, reference has been made to other chapters within this book where more specific detail and examples can be located. This chapter has explored a systematic approach offered by an Australian national simulation educator programme and provided exemplar resources in Box 18.1.

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Additional Resources

1 http://www.inacsl.org/i4a/pages/index.cfm?pageid=3407: A link to the standards associated with simulation as proposed by the International Nursing Association for Clinical Simulation and Learning.
2 http://www.sih.org: The Society for Simulation in Healthcare, for core standards and teaching and education standards.
3 www.spn.org: The Simulated Patient Network, a website that provides information for training simulated patients to participate in simulations.