Essentials of Scenario Building for Simulation- Based Education

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Simulation Pearls

1. Use a scenario-building process. Many simulation educators attempt scenario design in a haphazard fashion, which can lead to unintended and inconsistent learning outcomes. The process outlined in this chapter (although not the only one) is thorough and has proven useful to the authors through several years of use.
2. Consider which elements of engineering and psychological fidelity are most important to the curricular goals and target audience when designing the scenario. Be cognizant that higher fidelity does not always equate to improved learning.
3. Use distraction techniques wisely. The use of distraction can improve and ensure exposure to specific learning objectives and as such can add great value. However, when used inappropriately, they can also frustrate learners and detract from other potentially more important objectives.
4. Allow time to practice your scenario before full implementation. There are usually important considerations that did not come up in the early phases of the design process that will need to be accounted for prior to having learners participate in the scenario as part of their curriculum.

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Introduction

Scenario design is a fundamental component of simulation-based education (SBE). Each simulation scenario is an event or situation that allows participants to apply and demonstrate their knowledge, technical skills, clinical skills and/or non-technical (teamwork) skills [1]. Effective scenario design provides the basis for educators to meet specific learning objectives and provide a meaningful learning experience for the participants.

This chapter is divided into two main sections. The first part provides the theory and rationale for a scenario design process as well as discussing some of the important considerations one should keep in mind during the design process. The second part of this chapter provides a practical approach to the scenario design process involving six main steps.

Taken as a whole, this chapter should provide not only an understanding of why the design process is important, but also rationale for making difficult design choices and a practical approach to designing scenarios applicable to educator and learner needs.

Objectives of the Chapter

The scope of SBE is broad. This chapter focuses primarily on designing scenarios for high-fidelity immersive simulation sessions, although many of the concepts explored can be applied to scenarios involving modalities ranging from low-fidelity task trainers to standardized patients. The principles of scenario design discussed here are important to consider regardless of the educational intervention being planned, whether it is low-stakes practice, high-stakes assessment or simulation-based research. The degree to which these theories are applied and the degree of rigor and standardization of scenario design will vary for these different contexts.

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Table 2.1 Dimensions of fidelity

Physical fidelity	Conceptual fidelity	Emotional fidelity
Environment (in situ or simulation lab)	Concerns theory, meaning, concepts, and relationships	The holistic experience of the situation
Mannequin (size, sex, capabilities, etc.)	Logical sequence (*If-Then* relationships)	Complexity/difficulty level of the scenario
Clinical equipment (pumps, IVs, carts, monitors, etc.)	Appropriate physiologic responses to changes	Appropriate addition of distractors and *stressors*
Moulage (wounds, fluids, smells, etc.)	Appropriate diagnostics available (and in their usual format)	Level of activation and feelings (pleasant or unpleasant feelings)
	Usual resources (human and equipment) available (or accounted for if unavailable)	

IV intravenous drip

Rationale for a Scenario Design Process

The perceived need for an educational intervention comes from many different triggers. It could be the result of a generalized approach to curriculum development or a specific identified gap in knowledge or procedural skills. While the use of simulation can be an effective technique to fill these needs, the approach in designing an effective scenario can be daunting. By using a structured process, a road map is created to define specific educational goals and to set the stage for the participants to suspend disbelief. It also allows for a recognizable format that can be more easily reproduced and followed by other educators. In our experience, a well-planned, structured, yet flexible scenario will be the springboard to a higher level of experiential learning.

Considerations and Theoretical Underpinnings

Simulation scenarios are designed for many purposes. They can be intended as tools to teach and train individuals or teams, to test systems in order to enhance efficiency or patient safety, to answer research questions, and to perform assessments [2]. The design of the scenario should reflect the intended purpose. For instance, when a scenario is used within a research study or for high-stakes assessments, the design should be specific, reproducible, and take into consideration all potential threats that may challenge the validity (or standardization) of the scenario for research or assessment purposes [3]. In this section, we will explore some additional considerations that should be taken into account when designing a scenario.

Curriculum and Scenario Design Within Simulation-Based Education

Simulation scenarios can be presented as isolated, one-time events; however, it is increasingly common for them to be integrated within a larger curriculum [4–6]. It is important to realize that each scenario's placement and purpose within that curriculum will influence its design. Specifically, the goals and objectives of the scenario(s) should be derived from the goals and objectives of the curriculum. The overall curriculum will also affect the time it will be possible to allot to each scenario, the number of participants and facilitators required, and potentially what financial, human, and physical (space) resources will be needed to deliver the scenario.

It is important to identify which objectives are best met using simulation and which simulation modalities are the most appropriate (e.g., task trainer vs. high-fidelity mannequin, etc.) when designing a scenario [7–9]. Simulation should be reserved for those objectives which are most appropriate for its use and cannot be adequately addressed using other less resource-intensive educational modalities.

Scenario design, although one component of SBE, provides a foundation for the other components to build upon and provides a venue for participants to explore their learning objectives. An effective design allows the scenario to reliably address the stated learning objectives. The experiences from the scenario are then used as a jumping-off point during the debriefing to help learners identify learning issues and close gaps in knowledge and performance [10].

Fidelity/Realism

Another consideration in the scenario design process is the degree of fidelity that will be incorporated [11]. Fidelity is a measure of the realism of a simulation. It is an area of active research and debate. Our understanding of fidelity, particularly in the realm of SBE, has been greatly enhanced through the work of pioneers like Dieckmann and Rudolph [12, 13]. One of the most important developments is the realization that in order to engage our participants deeply in simulation, we need to recognize that humans think about fidelity in at least three dimensions: (1) the physical, (2) the conceptual and (3) the emotional (see Table 2.1) [13].

Physical fidelity refers to whether the simulation looks realistic [9, 13]. It concerns the mannequin itself, both its form and capabilities, as well as the surrounding environment and equipment. Conceptual fidelity concerns theory, meaning, concepts, and relationships. It is embodied in the *if-then* relationships such as "If there is significant hemorrhage, then the blood pressure will decrease"[13]. Finally, emotional fidelity concerns actions and relations of an emotional kind. These aspects of the simulation may relate to the participants' level of activation as well as how pleasant (or unpleasant) their experiences are perceived [13].

Historically, there has been a popular opinion that simulation experiences and outcomes improve as the precision of replication of the real world improves [9, 12, 14]. Specifically, assumptions have existed for some time that fidelity is the single critical determinant of transfer and that the higher the fidelity, the better the participants can transfer learning to real-life situations. However, this notion has recently been challenged [9, 12, 15]. When comparing the learning outcomes of high-fidelity to those obtained with low-fidelity simulations, the gains have only been found to be modest (in the range of 1–2 %) and generally not statistically significant [9, 14]. Following in this vein, leading thinkers in the field have called for a reconceptualization of fidelity in terms of the primary concepts which underlay it, namely physical resemblance and functional task alignment [15]. In our opinion, thinking of fidelity in terms of the different subtypes described above can help to understand how tailoring different aspects of the scenario design may improve resemblance and alignment in order to enhance transfer, learner engagement, and suspension of disbelief.

When designing a scenario, you will still be required to make decisions regarding the degree of fidelity, weighing the potential benefits of increased physical resemblance, and/or functional task alignment against resource utilization and increased cognitive load. Important choices with respect to types of mannequins, use of confederates, etc. will need to be made. One needs to consider, for example, if transfer, learner engagement, or suspension of disbelief are optimized through the use of a high-fidelity mannequin or perhaps a low-fidelity version or even a task trainer that can suit the objectives equally well. Similarly, the location of the scenarios is another important consideration. A simulation lab is convenient and generally efficient but may not be as realistic as performing a scenario in the participants' natural working space (in situ) (see Chap. 12). If your objectives relate specifically to the environment in which the participants usually work or will be working, then the scenario should take place there. Otherwise, it may be reasonable to use the lab instead.

When choosing the mannequin you are going to use for your scenario, consider your learning objectives and which mannequin functions will be important to facilitate meeting those objectives (see Chap. 10). Examples include the need for eyes that open and close, accurate representation of the patient's physical size, accurate representation of a patient's airway, the ability to create difficult intubating conditions, accurate representations of heart and lung sounds, or the ability to make physiologic changes in real-time in response to the participants' actions (or lack thereof). Similar thought should be put into the other areas of physical fidelity listed earlier. Sometimes, the scenario will require high physical fidelity in order to maximize psychological fidelity and allow the participants to behave as if the situation were real (i.e., suspension of disbelief). Other times, maximizing certain aspects of fidelity may hinder you from addressing learning objectives at all (e.g., you are too busy operating a complex mannequin to hear what the participants are saying or, alternatively, your participants are overwhelmed by all they are seeing).

Some of the ways that conceptual and psychological fidelity are increased include having a well-written scenario which makes sense to the participants, having the mannequin respond physiologically the way a real patient would, having appropriate and typical diagnostics (radiographs, lab results, electrocardiograms (ECGs), etc.) and having the participants' usual resources (equipment, references, and people (i.e., consultants)) available to them.

Psychological and conceptual fidelity are arguably more important to learning than physical fidelity [9, 12]. However, this has not yet been demonstrated definitively in the literature. One study that specifically manipulated psychological fidelity showed a clear advantage for greater realism [16]. According to Dieckmann, "When learning is the focus, the flawless recreation of the real world is less important. It is necessary to find situations that help participants to learn, not necessarily the ones that exactly mimic any clinical counterparts" [12].

Teamwork

There are two related issues regarding teamwork that might influence the design process. First is the importance of including interprofessional and teamwork objectives in the design. Secondly, we also advocate strongly for the value of having actual interprofessional input into the scenario design process.

One of the main uses of SBE is to teach teamwork and interprofessional skills (see Chaps. 4 and 15 of this text) [17–19]. These objectives are sometimes overlooked in favor of those that focus specifically on clinical knowledge and technical skills. Although teaching clinical knowledge and technical skills are an important part of SBE, one of the values of simulation is the ability to promote team training and the development of interprofessional team skills. Thus, in the design process, the importance of including objectives related to interprofessional skills and teamwork (as well as higher order clinical skills) should not be underestimated [5, 20].

The development of a simulation scenario can be optimized by employing an interprofessional and collaborative strategy in scenario design. Through involving members of different healthcare professions in the design process, potential issues around the interprofessional objectives can be more easily predicted. In addition, the realism of the scenario as it relates to each individual profession will also be maximized. This approach will indirectly maximize the individual engagement of the participants who attend from the various healthcare professions. Similarly, we recommend involving not only healthcare providers, but where possible others such as educators and simulation operators/engineers/technicians. While there is no direct evidence that such an approach is beneficial in the design phase of SBE, there are examples from engineering and clinical medicine [21, 22].

When designing a scenario which includes teamwork-related objectives, there are many strategies which can be employed in order to maximize the opportunity to trigger teamwork issues [23]. One such method is challenging the team with multiple tasks/problems (e.g., hypoglycemia, seizure, hypotension, and respiratory arrest). Another strategy is called the *wave effect*. This is where team members are introduced sequentially into the scenario (e.g., nurses, then residents, then fellows, etc.). The benefit of this strategy is that each time a team member is introduced, there should be some sort of communication between new and existing team members. Other methods include (but are not limited to) introducing junior team members, introducing parents or team members who are distractors or who make mistakes, using phone calls, and providing fewer than normal team members [23].

The Use of Distraction

One commonly used element of scenario design is distraction, referring to elements either indirectly or tangentially related to the clinical material being presented, but which aim to add an element of complexity to the scenario. The general goal of distraction is to draw the attention of the caregivers away from the task at hand. Distractions generally come in the form of either personnel issues (e.g., anxious/distressed parent or caregiver, argumentative consultant, phone call with unexpected lab results, etc.), equipment issues (e.g., an endotracheal tube that has a faulty cuff or is plugged, a piece of equipment missing from the crash cart or that is not working properly, etc.), or environment issues (e.g., mass casualty incident (multiple patients), fire in the operating room, etc.).

Distraction can be a powerful tool for bringing particular learning objectives to light. These techniques can ensure that particular objectives are met when they may not arise spontaneously within a scenario. For example, if a learning objective for a scenario is to manage the chaotic environment of a resuscitation, adding a confederate (i.e., scripted actor) who plays the role of a distressed family member will ensure that there is at least some chaos to manage. Another example might involve a scenario where the primary objective is to manage a respiratory arrest, with a secondary objective to teach a systematic approach to managing hypoxia in an intubated patient. As such, a faulty endotracheal tube may be placed in the scenario to meet this purpose. In both of these examples, the use of distractors ensures the participants will encounter the situations that force them to deal with the stated learning objectives.

Some designs also employ distraction to increase the degree of difficulty in the scenario for more advanced participants. One example of this is to have a confederate playing a patient's caregiver be more distressed and difficult to calm down when a more skilled learner group is participating in the scenario. Similarly, a consultant might strongly (and more vehemently, based on the skill level of the learners) suggest an inappropriate course of action. However, distraction needs to be used very carefully and with specific objectives in mind. Distraction can also lead to the team becoming derailed and not meeting other important learning objectives because they become fixated on or even overwhelmed by the distracting issue/objective. The concept of cognitive load theory is extremely relevant to the use of distraction in scenario design (please see Chap. 1) [24–26]. These distractors increase the intrinsic cognitive load of the participants and have the potential to impair acquisition of the primary learning objectives. It is our experience that while early in their careers, many educators underestimate the difficulty of the scenarios they are developing, and subsequently plan on adding one or more distractors in order to make the scenario more appropriately challenging for their participants, while ultimately creating a scenario the learners find difficult and confusing. This is another reason why piloting of a scenario would be both appropriate and helpful.

Summary of Pediatric-Specific Scenario Design Issues

There are several elements unique to the design of pediatric scenarios. Since pediatrics spans many age groups and sizes, it is essential to have mannequins of an appropriate size to maximize realism for the age of the patient in the scenario. For example, it would be challenging for participants to effectively perform a realistic neonatal resuscitation on a toddler-sized mannequin or perform a scenario meant for an adolescent on an infant-sized mannequin. Ensuring the presence of age-appropriate clinical supplies is also important. This includes appropriate sizes of airway equipment, intravenous catheters, and defibrillator pads, among others. The availability of these adjuncts will enhance realism and lessen the frustration of the participants who may feel they were lead to be unprepared if given inappropriate materials to work with in the scenario. Quite often, the simple fact that the scenario is an acutely ill pediatric patient itself leads to more profound stress reactions in participants, as compared to those involving adult patients. Anticipating more profound emotional reactions when designing the pediatric scenario will allow one to design a scenario that does not overwhelm participants. Being cognizant of a higher performance anxiety in participants involved in pediatric scenarios will also help anticipate the debriefing approach (refer to Chap. 3).

Lastly, given the nature of pediatrics, a caregiver is a frequently used confederate in pediatric scenarios, independent of planned distraction. When used appropriately, confederates can give essential historical and physical findings to the participants and simulate the typical confounder of dealing with caregiver and patient simultaneously, especially if the patient in the scenario is pre-verbal and cannot answer questions themselves. The addition of a confederate into the scenario needs to be well-scripted and the confederate must thoroughly understand the case objectives [27]. If not, they may actually hinder your participants' achievement in the scenario by distracting them from the primary objectives, giving incorrect or poorly timed information or missing important aspects altogether.

The Scenario Design Process

Introduction

Designing a high-quality simulation scenario involves many different factors. The goal is to recognize the educational needs of the participants and, through a simulated environment, produce a realistic experience to maximize specific learning objectives within the confines of physical space, time, finances, and available resources. To help design and develop a high-quality simulation scenario, six key steps have been identified to assist in making the process more efficient and effective (see Table 2.2) [1].

Target Audience, Learning Objectives, and Simulator Modalities

The first step in designing a scenario is identifying the learner(s) and their educational needs. This will be the basis for writing objectives that are relevant to the level of the participant. Scenarios often skip this critical step and attempt to use a set of objectives that are inappropriate for the level of the learners. For example, designing learning objectives that are appropriate for an experienced healthcare team that involves complex resuscitation skills would be inappropriate for undergraduate students, and would likely lead to frustration for both the facilitator and the learners. Targeting the learner groups' needs and not the facilitators' wants is an important element of scenario design. Investing time to recognize the needs of the learners is essential in good scenario design. Sometimes, this information is available from an established curriculum, while other times this information requires a formal needs assessment of the learner group. Designing appropriate scenario objectives will also allow other facilitators to easily review the scenarios and decide whether the scenario written meets the educational needs of other groups.

Table 2.2 The six-step scenario design process

The six-step scenario design process
1. Target audience, learning objectives, and simulator modalities
2. Case description and scenario environment
3. Staging needs: equipment, moulage, confederates, and adjuncts
4. The script: scenario framework and stages
5. Computer pre-programming
6. Practice scenario

As simulation scenario design is a dynamic process, there may be several layers present when writing objectives. It is important to have primary objectives, which are felt to be essential goals of participating in the simulation scenario. These objectives will inform the primary debriefing discussion and the *take home* learning messages. There may also be secondary objectives, which, while important, are not the critical message that is being delivered. For example, while a primary objective may be to teach medical students endotracheal intubation in an infant, the secondary objective may be discussion of different sedating agents to achieve sedation in the context of the intubation. Secondary objectives may be reviewed and discussed during the debriefing, but the primary objectives cover the areas that are designed to be taught in the scenario and should be covered during the debriefing. While it is essential to have objectives, the facilitator must also be flexible enough to teach about issues that the participants identify during debriefing. A successful scenario and debriefing will cover all the primary objectives and still have an opportunity to address any other specific learning needs of the participants.

One of the pitfalls of writing objectives for simulation scenarios is that it is easy to become overzealous or overinclusive. Writing too many objectives can make the educational plan unachievable in the desired time allotted for both the scenario and the debriefing. The length and complexity of a scenario will help determine how many objectives to write. In general, a scenario may have 2–4 primary objectives that the facilitator feels are essential to teach and then several secondary objectives that may be covered. It should be remembered that in many scenarios, not every secondary objective is covered; however, a list of primary objectives will help ensure the most important educational material is not missed.

Another important pitfall of writing objectives is they are not modified with piloting or running through the scenarios. Sometimes, a scenario that has been run through several times may have the participants repeatedly identifying issues not initially identified as an objective. In this circumstance, the scenario design as written is likely highlighting different objectives and thus the original objectives should be re-examined to determine if these new issues should be added as new objectives or replace other objectives that are not being identified.

In general, objectives can also be subdivided into knowledge, skills (procedural or technical), and behaviors or teamwork (communication, roles, resource utilization, awareness, etc.). Some scenarios focus more on one area than others, but in general a mix of all three objective subgroups often forms a well-rounded and well-structured scenario. Once the objectives are written, the preferred simulation modality can be chosen. There are several considerations in choosing a simulation modality. The objectives will help direct which simulation modality is most appropriate for each scenario. In general, high-fidelity simulation sessions are most useful for complex clinical knowledge-based objectives and for practicing teamwork skills. Low-fidelity simulation sessions are often useful for practicing procedural or technical skills and less complex scenarios, especially when an appropriate team is not available. The level of realism required will also help determine the simulation modality needed. In situ high-fidelity simulation with diagnostic adjuncts (e.g., laboratory results, ECG, diagnostic imaging) may be necessary to achieve realism for certain participants seeking experiential learning. Other scenario objectives may dictate that this high-fidelity level of simulation and realism will actually be distracting and irrelevant to the learning objectives and a low-fidelity simulation may be the best option.

Case Description and Scenario Environment

The case summary describes the initial patient clinical presentation and gives details such as past medical history, allergies, and vital signs. It is the case vignette that the participants receive to start the scenario. It also gives the participant details of the location where the scenario is taking place, available resources, and the participant's role (e.g., a staff physician in a tertiary emergency department or a nursing student in the patient's room of a rural hospital). This element is essential as it sets the stage for the remainder of the scenario.

Scenario cases are typically either developed from the memory of actual cases or are completely invented in a prototypical fashion. Each method has its own advantages and disadvantages. Real-life cases are soundly based in the accuracy of the scenario and can include important subtleties of the clinical presentation, which enhances realism. This realism may allow for faster buy-in from participants. Also, participants often feel more truly prepared for a future critical event in their own working environment if they feel they have just been exposed to a real-life scenario. While a real case can often be easier to design because the adjuncts for the case (laboratory results, ECG, diagnostic imaging) are readily available, the overall access to these cases may be limited, particularly if these cases are rare. Furthermore, choosing which real-life adjuncts and details to include in the scenario is extremely important. Sometimes, real-life scenarios have details that are not as important during a simulation scenario and there is a risk of overloading the participants with too many of these details. While these scenarios are historically accurate, they might be confusing and distracting to the participant especially in the compressed time of a simulation scenario.

The prototypical case is an excellent option for the more routine types of cases that require fewer clinical details. A brief febrile seizure scenario for medical students often does not need to be steeped in all the details of a real case. If, however, the case has specific and important clinical details, the pitfall of the prototypical case is that the subtleties of the case may be missing and the scenario may become unrealistic. Rare presentations are also well-suited for prototypical scenarios since the initial need is to be exposed to the case prior to the true clinical exposure. Attention to detail is a critical component of these scenarios so that they are not misleading or inaccurate. Often, diagnostic adjuncts from other sources need to be used (such as the Internet) and careful attention to the specific details of these adjuncts needs to be given. For example, a chest X-ray of a patient with a right-sided pneumonia should match the physical findings outlined in the scenario. Giving participants a chest X-ray of an intubated patient, which has not yet occurred in the scenario, or using an ECG where the heart rate is significantly different from what the learners are seeing on the monitor causes confusion and contributes to a lack of realism.

Often a combination of real-life and prototypical case scenario designs can be very successful. Taking a real-life case and modifying some of the details to fit the desired educational objectives allows for a blend of realism and clinical accuracy while still meeting the specific learning needs of the participants. For example, while a clinical case of a seizure in a 5-year-old may be readily available, expanding on the initial presentation to include other clinical features of intracranial tumor (e.g., vomiting and headache) may be factitiously added to the scenario to form a new case that is uncommonly seen.

When using real-life scenarios, privacy must always be ensured. Specific consent must be obtained from the patient or family for use in this educational environment. Any patient identification from labs, ECG, and diagnostic imaging must be removed. Furthermore, the name given to the mannequin in the scenario should not reflect the actual patient's name (or any perceived association by the participants). It is imperative to be aware of the background of these real-life cases as your current staff members may have experienced the actual scenario firsthand and still have emotional concerns associated with the case. If prototypical cases are being used, the web has a large compository of clinical pictures, video, ECG, and diagnostic imaging. In these cases, avoiding copyright infringements is important and at a minimum the sources should be identified.

Staging Needs: Equipment, Moulage, Confederates, and Adjuncts

Equipment

The specific details of how to enhance the learning experience of the participants with equipment, moulage, confederates, and other adjuncts is the next appropriate step in scenario design. Using similar equipment to what the participants would actually use in their regular clinical practice enhances the realism of the scenario. It also allows the participants to more accurately practice the specific subtle physical skills related to the pieces of equipment in question and more confidently translate these physical skills to future clinical practice. For example, participants who use the same type of defibrillation unit in simulation as they do in actual practice will be quicker and more confident when they need to perform this action in a real-life defibrillation situation. In contrast, using equipment that is either outdated or not likely to be used by the participants in future experiences may frustrate participants because they may feel they are learning a skill not relevant to their practice. As an example, nurse participants who are required to use intravenous pumps not relevant to their usual clinical practice may make them feel confused and disconnected as they feel the scenario is not in touch with their own clinical needs. Furthermore, although not often a preplanned learning objective, participants often gain valuable experience reviewing the use of clinical equipment during simulation. For example, while the intent of the simulation scenario may not be to discuss application of defibrillation pads and their connections to the machine, the participants often highlight this as an important learning experience that would otherwise be missed without having appropriate similar equipment available. However, clinical equipment that requires significantly long set-up should be avoided, unless its use is a specific objective within the scenario.

Ensuring a complete and comprehensive list of all equipment and supplies needed for the scenario is essential for the environment to be adequately prepared for the scenario. This list should include the type of monitors to be used or displayed, intravenous fluids, lines and pumps, specific medications that may be requested by the team, typical medication resources, documentation records, and other ancillary clinical equipment that is commonly used (e.g., glucometer, otoscope, penlight, etc.). In some facilities, empty vials of medications or previously expired medications are collected and refilled with water in order to allow the teams to draw up and administer the medications in real time. When doing in situ simulations, great care must be taken to ensure the simulated medications are not mistaken for real medications and accidently mixed into the patient care clinical supplies. Some facilities label their medication as *simulation only* or *teaching use only*, while some facilities do not allow for the use of expired medications in active patient care areas.

Moulage

Moulage is another important consideration of scenario design that can enhance realism and provide actual physical cues to the patient's physical condition. Moulage may take many different and complex forms. A few simple examples would be a wig with long hair for a female patient, a red dye-soaked bandage applied to a forehead to simulate a traumatic laceration, a leg bandaged with gauze to simulate a fracture, an open bottle of nail polish remover to simulate ketotic smell of diabetic ketoacidosis. The more complex use of paints and gels from *moulage kits* can be used to create wounds, rashes, burns, etc. However, moulage can be extremely time-consuming. As such, the use of photographs and video can be as effective as more complicated moulage techniques. While complex moulage can significantly enhance the level of realism, this must be balanced with the time, effort, and finances (human resources) available for each simulation (Fig. 2.1a, b, c, d, e, f, g).

Confederates

Confederates are another useful adjunct to consider in scenario design. Confederates can be simulation staff or volunteers as well as trained actors depending on resources available. Confederates are particularly useful in pediatric simulation scenarios since young children will almost always have a caregiver by their side. The confederate can divulge important patient information as well as confirm physical characteristics that are difficult to simulate. For example, a confederate mother with her anaphylactic child may comment that she feels her child's swollen lips are progressively worsening (or improving) or that the urticaria seems to be spreading more. Adding this element can be a critical point in adding appropriate realism to a scenario. Confederates can also be a significant source of distraction. This distraction can be useful if their involvement enhances realism or the learning objective is to manage the child as well as an anxious parent. However, confederates need to have a specific script that does not distract from the scenario. Overacting or inappropriate drama may detract from the scenario and the learning objectives. Consider using the confederate only if it is truly felt to enhance the scenario's realism and support the learning objective. Additionally, the confederate should have only one role. It often gets confusing to participants if the confederate is the paramedic at the beginning of the scenario but then becomes the father later in the scenario.

Other Adjuncts

Other adjuncts can be added to the scenario design process depending on the level of the learner and the desired learning objectives. Laboratory results, diagnostic imaging, ECGs,

Fig. 2.1 a–g Moulage photos. (Photo with permission from James Huffman)

video clips, photos, patient charts, and nursing flow sheets can all be collected in advance and available to the facilitator. Photos and videos can be especially powerful adjuncts to engage the learners, especially for things such as rashes or seizures. The more advanced the learners or the more complex the scenario, the higher the demand for realistic and complete adjuncts. However, trying to anticipate in advance every adjunct the participants may want can be a challenge. Choose adjuncts that are most important to supporting the learning objectives rather than attempting to include every possible option. Reevaluation of the scenario design following piloting will help identify which adjuncts may need to be added or removed. As discussed earlier, all real-life patient adjuncts must have patient identifiers removed and any images or video accessed from the web should be acknowledged to avoid copyright infringement.

The Script: Scenario Framework and Stages

The next step in scenario design is deciding on how the flow of the scenario should ideally take place. The scenario is often divided into individual stages or frames. Each stage or frame often comprises either a key event or a change in the condition of the patient (Table 2.3). Building on the case vignette, the first stage may represent the patient's initial vital signs and has an identifiable problem that the participants must address. For example, a child that presents with hypoxia and altered mental status requires the participants to effectively obtain a pertinent history and physical exam, treat the hypoxia, and address possible causes of the altered level of consciousness. The length of the stage will vary with the sophistication of the learners, but these issues need to be addressed before proceeding to the next stage. Once the participants have had an opportunity to manage their patient and address immediate concerns, the next stage may be advanced to continue with the scenario. For example, once the participants have addressed the issues of the aforementioned patient with hypoxia and altered mental status, the next key event will have the child experience a tonic–clonic seizure. This new event will require ongoing management by the participants. However, some groups may not get through even the first frame during the allocated time. Either way, significant learning points will be highlighted in the post-scenario debriefing. These stages continue with each key event or change in patient condition and should reflect the objectives outlined. Having defined objectives for each stage often makes the scenario flow more smoothly. In some scenarios, key events may occur regardless of the learners' actions, but they should give the participants time to respond

Table 2.3 An example of a scenario script of foreign body upper airway obstruction in a 4-year-old

Scenario transitions/patient parameters	Effective management	Consequences of ineffective management	Notes
1. Initial assessment: Child is sitting up with obvious distress. Intermittent stridor at rest especially when approached by medical staff **T:** 37.2 **HR:** 142 **RR**: 32 **SAO_2**: 98 % RA **BP**: 90/62 **Resp**: No WOB Chest clear Stridor **CNS**: crying intermittently **CVS**: CRT 3 s **Rest of exam**: normal	Participants should recognize signs of impending airway compromise. Initiate patient monitoring including pulse oximetry Vital signs are available, but patient upset with IV attempt and drops O_2 sat (Oxygen Saturation) and drools. Keep the child comfortable and do not force him to wear a face mask. Consult ENT for rigid bronchoscopy in operating room Consult anesthesia		ENT and anesthesia will be available in 20 min
2. Patient develops progressive stridor and drooling and has periods of cyanosis	Participants should consider airway options and prepare. Best option in stable patient: await ENT but have double set up ready. (Oral intubation with ketamine and surgical circothyroidotomy ready and prepped) Participant may ask for CXR and lateral soft tissue neck Labs and ECG are unobtainable	Attempting to lie patient down will cause immediate cyanosis and bradycardia	Discussion of sedating meds Discussion of surgical circothroidotomy

ENT ear, nose, and throat specialist, *T* temperature, *HR* heart rate, *IV* intravenous drip, *RR* respiratory rate, *SAO_2*Oxygen Saturations, *RA* room air, *Resp* respiration, *WOB* work of breathing, *CNS* central nervous system, *CVS* cardiovascular system, *CRT* capillary refill time, *CXR* chest radiograph, *ECG* electrocardiogram

to the change in parameters as they progress through the stage.

In the framework presented, a list of other educational reminders for the facilitator can be added. For example, a reminder of a point-of-care serum glucose checked in a patient with an altered level of consciousness (whether hypoglycemia is the core element of the scenario or not) can be useful. This column should include the results of any similar tests in order for the facilitators to feed back this clinical information to the learners.

Computer Pre-programming

Depending on the simulation mannequin platform, varying degrees of pre-programming are available. Some facilitators like to pre-program the mannequin's computer to run a certain scenario regardless of the actions of the participants. These are typically designed for less complex scenarios (e.g., short advanced life support course scenarios) or scenarios that need to be standardized (e.g., research scenarios, testing scenarios). As an example, running a standardized pulseless ventricular tachycardia scenario that degenerates over 5 min to asystole may be pre-programmed and will be unchanged regardless of how the participants perform. These scenarios have the advantage of allowing the facilitator to focus on the participants' behavior and not be distracted by the computer. The disadvantage of this approach is the lack of flexibility in participants' approach to patient care.

The next level of pre-programming allows the facilitator to pre-program each specific stage. In stage one, the computer will display the initial vital signs and other physical parameters pre-programmed for the baseline of the scenario but will not progress to the next stage until advanced by the facilitator. Once the facilitator feels it is the appropriate time in the scenario, the facilitator will advance the computer to the next stage of pre-programmed vital signs and other physical parameters. This allows the facilitator to control how quickly the scenario runs and is responsive to the actions of the participants. It does not, however, allow full flexibility when the participants perform actions clearly not anticipated by the facilitator in advance.

The next level of programming is to begin with initial vital signs and physical parameters but have no further pre-programming. This allows the facilitators to change the computer parameters with each of the participant's actions and allows for the most amount of flexibility. It is often the most realistic approach, especially in more complex patient scenarios, since participants often do not perform consistently in every scenario. The disadvantage of this approach is the challenge of managing the computer as well as trying to observe and analyze the actions of the participants in terms of

Table 2.4 Common issues with simulation and potential solutions in the scenario design phase. (Used with permission from Angèle Landriault)

Common issue	Solution
Learning objectives are rarely met/encountered by participants	Limit the number of learning objectives and design scenarios to specifically address predefined learning objectives
	Considerations when determining the reasonable number of objectives include Time Resources Realism Past training (level of the learner)
A confederate undermines the participants' learning or causes confusion during the scenario	Carefully script simple confederate roles designed to ensure that predefined learning objectives are attained
	Discuss the case and their role with the confederate ahead of time
The scenario design cannot accommodate a participant's actions (i.e., they ask for a reasonable resource you had not planned on providing)	An interprofessional design team will help predict more possible actions participants may make
	Ensure there is at least one practice run of the scenario prior to implementing it in your curriculum (may need more for high-stakes/research simulations)
Participants complain that the scenario is not realistic for them	Carefully consider all aspects of realism when designing your scenario
	Address known realism issues in the pre-briefing
Scenario is not proceeding as planned (recognized while ongoing)	Instructors adjust patient condition or direct confederates to provide hints in order to guide progress of simulation to address predefined learning objectives
Scenario adjuncts/AV materials not available when requested	Interprofessional design team and practice runs will help create a list of needed resources beforehand

AV audio-visual

preparing for the debriefing. While this is the most responsive and dynamic approach, it often requires an advanced facilitator, two co-facilitators or a facilitator and a computer programmer/simulation technician to be successful. A hybrid of both pre-programming and *on the fly* facilitation allows for the greatest amount of flexibility related to the actions of the participants (whether expected or unanticipated by the scenario creator), while reducing the amount of tasks needing to be performed simultaneously by the facilitator.

Practice Scenario

The final stage in scenario design is to pilot the scenario and perform a test run. Often, elements that were not considered when the scenario was first designed become blatantly apparent in the practice run. Participants often invest significant time and energy when agreeing to partake in a scenario and expect that the scenario will run smoothly. They may be confused and feel that they are being tricked if the scenario is missing important key elements. Ensure all necessary equipment, laboratory results, imaging, and other adjuncts are appropriate for your scenario. If confederates are part of the scenario, ensure that these roles are practiced and the scripts are adjusted accordingly. Review the scenario to ensure it unfolds in such a way that the participants' educational objectives are being met. It is tempting to avoid this step, particularly with experienced scenario designers, but we strongly advise to practice before you perform. Table 2.4 lists several common issues and offers possible solutions [1].

Conclusions

Scenario design is a complex but fundamental component of SBE. Time spent in consideration of each of the individual components will ensure the scenario is appropriate for the learners and will more likely meet their learning objectives. In addition, by following the six-step approach outlined in the second part of this chapter, the resulting scenario will contain all the necessary elements to ensure a high-quality scenario is being delivered to the learners.

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