Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Our Patient Simulation Center is located at St. Michael's Hospital in downtown Toronto, Canada. This inner-city teaching hospital is fully affiliated with the University of Toronto, and is one of the busiest trauma and emergency centers in Canada. Our Simulation program services all disciplines and is under the Department of Clinical Education. Our simulation experience has been gained from the 11 years we’ve been in existence and from interactions with a supportive and sharing simulation community, locally and internationally.

10.1 Simulated Realities

In 19th Century Art, painters in the style of realism drew their inspiration from life around them and cherished their interest in visible reality. They accepted the doctrine of mimicking nature and striving for realism in their art. In crafting a painting, an artist need only provide so many elements to create the illusion of reality. In other words, not every single detail is needed to create a complete picture for the viewer. Seeing a painting of a head from the neck up exhaling smoke, the viewer will likely conclude that the person is not internally on fire but is smoking, even though objective evidence is not visible in the painting.

Patient simulation offers clinical educators a new type of “canvas” where they can apply the same principles of realism. We can’t perfectly duplicate or replicate reality with simulation and we don’t need to, but we can present cues that are sufficiently realistic to get buy-in and elicit desired actions and behaviors from the learner. A fake wound on the mannequin’s back with a bloody sheet underneath and a low blood pressure should lead the learner to believe there is significant blood loss occurring with their "patient.”

Realism is what you make of it, using what you have to work with to convey a scenario. The Oral Tradition of telling tales is a fundamental teaching tool common across all human societies. The mere creation and reception of sounds was all the fidelity employed. The teller and the listener provided all the realism. With limited resources, the creators focused on the intangible aspects of the human condition to convey their tales. When crafting a simulation scenario, the realism worth considering is that which will stimulate the learner’s imagination.

While having the latest high-tech robotic patient simulators emplaced within fully functional clinical spaces is great, that alone doesn’t provide enough realism. Naïve people are
generally impressed by the mannequin and its capabilities, but the “patient” is the most artificial thing about simulation. It’s more important to use the technology as a lens to focus on the human aspect of interactions. In our quest for realism, we create context by placing the mannequin in a simulated or real environment, breathe life into it with human interaction, and take advantage of the learner’s imagination.

10.2 The Orientation

To facilitate learners being more receptive to us, our Center always presents a supportive and nonthreatening atmosphere. Our goal is to provide experiential acquisition of skills and judgment, allowing lessons to be learned from errors made. Before starting, learners are familiarized to the environment and the mannequin, and provided with a set of ground rules. This is done on a need-to-know basis, being careful not to cognitively overload the learners with too many rules. There is no need to share all the capabilities and limitations of simulation or to explain how the props work. Keep it simple and user friendly. The rules will vary with the different levels of learners and with how they utilize simulation. Directing learners on how to approach simulation makes it easier for them to participate fully, once they have a better idea of the playing field and rules of the game.

Our primary rules are:

- Approach the mannequin like he’s a real live patient, talk to him, and he will respond realistically appropriately or not.
- Do what you would normally do and treat the situation like it’s real.
- Ask for whatever equipment, procedures, or services you want.
- A drug isn’t given until it’s given, please announce which medication and the dosage.
- There will be a “clinician” in here to help you, so don’t worry about what you should or shouldn’t do, but this helper usually never initiates, that is your responsibility.

In our early days of simulation, the orientations were done poorly. Everyone usually received a familiarization, along with an inconsistent set of ground rules and presentation of realism. Learners were told any number of the following: pretend to do chest compressions and defibrillation (due to limitations of the MedSim Eagle mannequin), inject the intravenous drugs in this port, and if you can’t find the drug you need then just pretend, but call out what and how much is being given, you need to ventilate your “patient” for real or he’ll go into a death spiral desaturate and arrest, auscultate for breath sounds at the nipples where the speakers are because there are acoustical dead zones, do not restrain your “patients” arm movements or you will strip the gears, and the list went on. There were times when we would direct the learners with too many rules, and times when we neglected to inform them with enough. We came to realize the negative influence it had on our simulations and ultimately on the learners.

One particular simulation that brought this to light for us was an operating room scenario: The OR Pipeline Failure. The learners are Junior and Senior Anesthesia Residents, and the case is a carotid endarterectomy. After cross-clamp of the carotid artery, an OR pipeline and backup gas system failure occurs, complicated by an empty backup oxygen tank at the rear of the anesthesia gas machine. The objectives are to recognize the gas failure, secure a backup oxygen source, a self-inflating manual resuscitator, ventilate the “patient” with room air until an O2 source arrives, and eventually change the O2 tank at the back of the gas machine. The learner was a Senior Resident who was outstanding in the real operating room, and had handled previous simulant off, she quickly recognized the failure of her anesthetic gas machine and secured the manual resuscitator. She hooked up the resuscitator to an oxygen flowmeter on the wall outlet and proceeded to turn it on. The ball of the flowmeter went up and down quickly as it depressurized. She watched this happen, hesitated for a moment, shrugged her shoulders, and proceeded to ventilate the patient. Afterward, we discovered that she assumed the O2 flowmeter was one of the pretend elements, accepted it and continued the case. This didn’t change the outcome of the scenario as she realized the objectives, but it was revealing to us the errors made on our end. Interesting enough, the residents loved this scenario because they valued highly the lesson of how to change the O2 tank applying the Pin Indexing Safety System. This scenario also provided us with unexpected data implying a gap in the Residents’ education.

The lesson learned was that our orientations were setting a confusing tone for the simulation, and as a result, learners were being misled. For learners with previous simulation experiences and performing at high levels, there is less room for mistakes on our part. Following this incident, our orientations have become consistent, clear, and concise with a distinct purpose. We know the objectives before the simulation and focus our orientations toward that. We now use the orientation to put the learner at ease, reduce the gap of unfamiliarity with the mannequin, and to set the simulation off in the right direction.

10.3 The Medium of Simulation

In crafting their work, artists will respect the limitations and capabilities of their medium. The medium is the materials which an artist chooses to use, whether it is collage, oil paints, water color, stone, etc. With patient simulation, the medium is a collage of the clinical scenario, the simulation theater, the mannequin, props, and human elements.
10.4 Clinical Scenarios: Who are the Scenarios for?

Write the scenarios to address the learning objectives, but design the simulation to the level of the learners, keeping in mind the limitations and capabilities of the medium:

- The best scenarios are taken from real life or clinical events, producing believable simulations and helping to deal with the “That will never happen in real life” issues. The OR Pipeline Failure scenario described earlier was taken and modified from a real-life event. What truly transpired was a construction crew digging right in front of the hospital and cutting into the underground lines, causing simultaneous failures in oxygen and electric power.
- Develop scenarios relevant to your environment. Try to reproduce clinical content unique to your hospital. For example, if your institution is located in a colder climate, create scenarios that encompass hypothermia (ice bags on the simulator’s hands and feet for a few minutes before the students come into the room are a great way to provide thermal cues).
- When fewer resources are available, try presenting the scenario in a different context. As a teaching hospital, many clinical situations have unlimited staff and resources during daytime hours. Simulation can’t provide all these resources, but we can manage this limitation by changing the context of the scenario to the setting of a rural community hospital in the middle of the night.
- Explore different scenarios keeping the versatility of the medium in mind. Look at scenarios that can promote interprofessional education, bringing different groups together to manage a clinical problem. Use the scenarios to create situations that will address behavior and communication. Find scenarios that address your institution’s and students’ future needs, like patient safety. These are all real issues for future clinicians and their patients alike.

An example of versatility is the variety of different groups that scenarios can include for simulation. Our hospital Chaplaincy and Spiritual Care Department utilizes patient simulation in a most simple but effective way. The scenario has a Chaplain Intern on her way to the Neuro-Trauma Intensive Care Unit, to meet with the parents of a 22-year-old fatally wounded gun shot victim. When she arrives at the “ICU,” she will be immersed in an unfamiliar environment, seeing the “patient” intubated, ventilated, and connected to a host of different equipment. The injuries sustained are too extensive and the parents have agreed to withdraw life support. They are by his bedside angry and confused, and have asked for the presence of Chaplaincy for the withdrawal. Some of the main objectives for the Chaplain Interns are to practice and improve their ability to provide spiritual care, and to increase their ability to function as a fully participating member of the health care team.

If scenarios can exploit the capabilities while avoiding the limitations of the medium, then a higher degree of realism should prevail. Realism will be further heightened once we place a scenario into a simulated clinical environment with the props and include the human elements.

10.5 Simulation Theater: Design for Effective Story Telling

You can approximate the clinical reality of a physical space by recreating it in your own simulation environment with equipment, props, and a mannequin. Alternatively, you can bring the mannequin into the real clinical environment and produce simulations there. To duplicate clinical settings, visit different areas in the hospital and gather the necessary references. If your resources are unlimited, then duplicate the settings down to every last detail if you want (which isn’t necessary). With limited resources, try to approximate just those items essential to establish a sense of place and provide devices with just enough functionality that the human senses directly perceive. Remember that not every physical detail is needed to convince the learner of where they are. If the resources are severely limited, dress up the physical space with whatever equipment is available, and remember not all of it has to be functional. Beg, borrow, or whatever. Some institutions/centers use painted/printed backdrops and curtains, similar to those used in a real theater – these are rapidly changeable. Once you add the mannequin, a few props, and some humanity, there should be enough elements to convince the learner.

- Think the scenario through as you write the script, perform a technical rehearsal, and then a full-dress rehearsal – just like in live theater. This should help establish what equipment and props are needed and reveal possible shortcomings that require revision. Put yourself into the shoes of a learner, act out a specific scenario, and explore the possible routes they may take.
- The theater should be equipped with a public announcement (PA) system and a telephone (the former is easily installed hardware of microphone, cable, and powered speaker). This PA system provides overhead calls for
arrests, traumas, pages, etc. A duplicate configuration can be installed under the mannequin’s head to provide a quality “patient’s” voice.

- The telephone allows a learner to call for X-ray, have someone paged, or order blood from the blood bank. The phone calls are routed into the control room where someone will answer as the appropriate “personnel” and interact with the learner in the scenario. Conversely, the control room can call back into the theater as the service being paged, or as the laboratory with the results.

- The telephone also provides a communication link between an actor in the theater and the operator in the control room. Phone calls are excellent ways for actors to exchange stage directions with the hidden simulator operator without the learner’s awareness. This is an important link as simulations are dynamic and encompass many details. Communication between the actor and control room operator is inevitable, as situations will arise during the simulations that require this link to help troubleshoot the problem (malfunctions, missed details, etc.) and preserve the realism.

- A major barrier to realism occurs when the learner walks into a highly realistic “clinical environment” and is confronted with an artificial patient. The most powerful way to instill reality around an obviously unreal mannequin is for the instructors or simulation coordinators providing the orientation to behave toward their simulated patient with all the respect and human-to-human interaction that they (should) do with live patients. Likewise, the simulated patient should respond in character to the extent that it can be made to do so. All people while in student status are Lorenzian ducklings, and will all too blindly accept and respond to their instructor’s directions. Make extensive use of this innate ability.

- The second most powerful tool you can take advantage of here is to provide a high-quality human voice for the mannequin. Adding a believable voice to the mannequin brings it to life, and the “patient” can now engage the learner, making a human connection. The mannequin becomes a real “patient” when it can offer feedback and challenge a learner for not observing patient dignity by asking “Hey who are you and what are you doing to me?” It can add to neurological assessments, providing responses for physical examinations. The “patient” can also take on different personalities: scared, aggressive, unstable, offensive, or abusive. Write these strategically into the scenarios to heighten stress levels as well as to create intentional distractions.

- Finally, a voice can be used to add human context to a scenario. A “patient” can say in a worried voice “where is my family?” or “I feel like I’m dying, please call my wife.” These are not always scripted into the scenario, and are sometimes improvised depending on the progression and level of buy-in from the learner.

- The mannequin can be further enhanced with a little spontaneous movement, if it has this capability. Our Eagle Medsim mannequin can move his arms and blink his eyes. With our Laerdal SimMan, we expand the use of dynamic functions like trismus and decreased cervical range of motion to mimic normal patient movement. Even though they were not developed for these reasons, it works effectively when timed appropriately. These functions create only subtle movements, but they add another dimension to the mannequin which further humanizes it.

### 10.6 Props: Place and Purpose

Props can be just one of the many elements enhancing the realism or they can have a more significant role influencing the learner. Props provide two essential contributions to simulation success: a sense of place and tools to perform expected actions. They can be as simple as a large printed image representing a wall or more complex like a fluid-feeding “dry” suction system. The following is a short list of examples:

- **Patient Charts and Identification:** Both of these props will help humanize the mannequin. Some scenarios require a patient chart and others will need operating room records. Obtain blank forms from your hospital and fill them with clinical information relevant to the patient and simulation. Allergy bracelets are simple accessories that can be used to provide vital cues in a scenario.

- **Images:** Images include X-rays, computerized tomography, electrocardiograph (ECG) tracings, etc. Images will support patient symptoms and provide the learner with a broader context. Acquire real images or get them from the Internet. Use hard copies or electronic ones with their respective viewing devices ready for the learner to see. These props are easy to obtain and can be banked for use in future scenarios. Do remove all real patient-identifying information, and where possible, replace with that of the patient in the scenario.

- **An Intravenous System:** This prop is both visual and tactical for the learner. If they decide to increase fluids, they must perform the action and confirm administration to the patient. Have functional flowing IV systems that can support fluid drug administration though a cannulation in the mannequin’s arm and into a hidden reservoir. Another option is having a closed IV system consisting of a source bag connected in series by two sets of IV tubing to a receiving bag. The IV tubing is taped to the mannequin arm and hidden under gauze, giving the illusion of the cannulated system. With this closed system, the liquid from full bag flows through to the empty bag, and when the IV runs “dry,” you can discreetly reverse the system for your “new” IV bag.
• Remember that much like live theater, things don’t actually have to fully happen for the viewer (in this case, the learner) to believe it’s happening. For example, a learner opens an IV valve and sees a solution flow into the patient’s arm, followed by a change in heart rate and blood pressure. They don’t know that the IV tubing is just taped to the mannequin arm and is actually flowing into a hidden collection reservoir. Likewise, hidden pressure bags can propel fake blood and other fluids into the student’s field of view.

• Medications: We use containers of expired drugs if they are available. Otherwise, we use prefilled syringes with water. It’s a limitation, but usually not a factor affecting our simulations. The drugs are still injected for real through an IV port or Luerlock stopcock. We accept this as one of the “pretend” elements, as most of our current scenarios are not focused on drawing up medications.

• Suction System: Suctioning the mouth of full-function mannequins has always lacked acoustical and visual feedback for the learner since really introducing liquids of (simulated) vomit would most likely destroy the airway and lungs. This can be overcome with a self-feeding suction-fluid system. An internal system feeding the tip of a suction catheter provides fluid (“blood” or “secretions”) to be suctioned into a canister. The learner gets tactile feedback and the mannequin is protected.

Please see Appendix 10A.1 “The Wet/Dry Suction System” for construction and use instructions.

• Wounds: There are different ways to dress up a mannequin with wounds. One way is to make them with clear craft “window” paint and some acrylic colors. Even if the injuries look a little fake, it’s one less element of pretend. The visual cue is better than having the learner ask “what do I see here?” or us saying “Pretend you see this here...” Imagine producing a simulation with a plain mannequin who was involved in a bicycle crash, has respiratory distress, tachycardia, and decreasing oxygen saturations. Now, picture the scenario again after dressing up the mannequin with bruising along the ribs, facial abrasions, and cuts on the hand. Reusable wounds are made quickly and easily, and are placed anywhere on the mannequin. Peel them off afterward and store properly for future use. Please see Appendix 10A.2 “Making Wounds” for materials needed and illustrated instructions.

• A Cell Phone: This functional prop adds reality and stress to a scenario. The cell phone can be planted in the pocket of a “trauma patient,” and as the scenario unfolds, a timely call is made by a “loved one.” The caller is unaware of the trauma and from there you can have the phone call play out in many different ways. It can be used to add context, increase stress, provide distraction, introduce communication issues, etc.

10.7 The Human Elements

For patient simulation to mimic reality, human elements need to be prevalent. It is the common thread pulling everything together. We try to define it in terms of anything that provides humanity to the mannequin and the simulation, thereby improving realism.

There is a lot of crossover and many of the elements previously mentioned have humanizing qualities. In this section, we will focus mainly on what actors can contribute to bringing realism into simulation. When we use the term actor here, it refers to one of our own simulation coordinators playing clinical or nonclinical roles. An actor can:

• Simplify the orientation with fewer “ground rules.” The learner can be instructed with “treat the patient like he’s real, do what you would normally do, there will be a clinical person in the scenario to help and guide you if needed.” This makes for a simple and concise set of rules.

• Reduce the gap of unfamiliarity to the environment, allowing the learner to behave more naturally. The presence of an actor, who knows where all the supplies are located, provides this resource. Unfamiliarity with the environment can be used as part of a scenario, forcing the learner to communicate and utilize their resources effectively. The unfamiliarity can also be an unwanted distraction leading the learner away from the objectives, as they become fixated looking for a piece of equipment and their frustration grows.

• Enhance the realism of a scenario or can be used to add stress and distraction.

Sometimes we encounter a learner who is having a hard time buying into the simulation; they go through the motions without commitment even during the crisis. The actor can recognize this situation and intervene naturally. As the “patient” deteriorates in a prearrest state, the actor will stay in character and show urgency or stress with his body language and tone of voice, as he would normally in a real emergency. When reluctant learners see someone else behaving like the patient’s outcome matters, they sense the tension in the air, feel the urgency, and the simulation becomes more real for them. This initial intervention is sometimes not enough, necessitating further action. It may be that the learner needs additional context for the scenario before we can achieve buy-in with them. One example was with a hypothermic scenario we ran. The simulation was for Paediatric Emergency Fellows, and the scenario involved a baby being brought into the Emergency Department by a stranger who found him outside in below-freezing temperatures. The objective was to recognize that resuscitation with drugs is ineffective until you warm the “patient” up. When the scenario started, it was clear from the body language of the learner in charge that she was not
III How to Fit in while Standing Out

buying into the simulation. She went through the motions of resuscitation, and kept repeating “... it doesn’t matter the baby’s cold and dead.” The other participants were urgently working away with the resuscitation, articulating several times to the learner in charge that the baby should be warmed before declaring death. This comment was met with no response. The actor recognized this impasse and quickly notified the control room to phone into the theater. He made sure everyone heard the phone ringing and proceeded to answer, making up a story that the police had arrived with the parents. They were hysterical and wanted to know what’s happening with their baby. Then the question “what should I tell them, they want to come in” was posed to the learner in charge. Again, there was no verbal response, but this clearly caused a physical shift in her appearance and a definite change in her approach, resembling more of a buy-in and commitment to the scenario. She then proceeded to be more aggressive in implementing additional warming techniques, before any further drug resuscitation.

The phone call provided the additional context for the scenario and the baby, and widened the scope of the realism. However, we’re not entirely sure why the phone call worked, it may have been the additional context, it may have triggered a parental instinct, or it may have been the threat of the parents coming in. In retrospect, we should have asked what was going through the learner’s mind at the time. To gain acceptance from the learners, we should be aware that each and every learner, and all instructors for that matter, perceives “realism” in their own way. Thus, with every session, no matter how rigid the presentation, we need to allow for these variances in perception and be prepared to improvise.

Additionally, the actor can take on roles to heighten the situation with stress and distraction. Actor roles may include family, staff, or student, and can be attributed with a host of different human characteristics. The actor can play an overprotective and emotional family member, an overbearing and challenging staff person, a scared student paralyzed with fear, etc. You can take simple scenarios made for junior learners, add these elements, and produce more complex scenarios suitable for more senior learners. Participating in simulations is inherently stressful for most learners and exhausting for most instructors – use additional stress and distraction judiciously.

- Help modify a learner’s approach to the simulation if needed. Some learners come with experience in web-based simulations and will approach patient simulation in the same manner. For example, the learner asks for a medication without the dosage and proceeds to look at the patient monitor for its affect. The actor’s response would be to act out what was conveyed in the orientation. He would ask the learner “how much?” or “in what concentration?” and then proceed to draw up and give the drug, followed by closing the loop with an announcement that “x” amount of medication has been given. This illustrates a desired approach for the learner, and can help redirect him toward more realistic actions.
- Offset limited resources (equipment and personnel). For example, during a difficult airway scenario, a Resident may ask for a bronchoscope and for the staff Anesthesiologist to be paged. The actor can place the calls and respond with “the staff Anesthetist has been called down for an emergency caesarean section and is unavailable right now” and “the bronch is being cleaned, it will be ready in 20 minutes.” Faced with these plausible responses, the learner can move on to consider other strategies.

The actor’s role is indispensable, multifunctional, enhances, and protects the realism we painstakingly create for each simulation. The additional advantage of having a simulation coordinator in the theater as the actor is the protection of the mannequin from inadvertent physical abuse. With heightened adrenaline levels, some learners can become too aggressive, and we need the mannequin alive for a successful simulation program to continue.

10.8 Conclusion

When you can incorporate as many humanizing elements as you can into a simulation, it goes to producing a higher caliber of realism. Take advantage of the fact that patient simulation involves the participation of human learners. As you present enough elements of reality for a simulation, their imagination is stimulated and this will facilitate the intention of achieving an interactive buy-in from the learner.