The 2019 WACEM Expert Document on Hybrid Simulation for Transforming Health-care Simulation Through “Mixing and Matching”

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Abstract

With the multitude of options available under the umbrella of “simulation” today, we have a larger repertoire of choices in our educational journey and outreach. These provide a platform for us to really transform health-care simulation from the traditional, unimodality simulation, to more complex, high fidelity, integrated, and engaging multimodality techniques. The main thrust must be to enhance clinical decision-making in patient care, to solve real-world clinical problems. Hybrid simulation (HS) utilizes at least two different simulation modalities, whereby combining them will enable one type of simulation modality to enhance the other, with the proper alignment, coordination, and interfacing between the modalities. Although the term is often used interchangeably, HS is slightly different from multimodality simulation. The latter refers to the use of multiple types of simulation in the same scenario or place. The main objectives for using HS have to be as follows: (1) for the acquisition of knowledge and skills by the best combination of methodologies, (2) for clinical performance improvement at all levels of care through the creation of as close as possible to real-world situation and problems, (3) to be able to sustain motivation and passion of our spectrum learners in their educational continuum, and (4) to provide a rich, exciting, and stimulating learning platform and environment, which can trigger deep learning and understanding. This article will also share some examples and cases utilizing HS in transforming health-care simulation.

Keywords: Hybrid simulation, manikin, modality, standardized patients, transformative learning

INTRODUCTION

Health-care simulation represents an instructional medium utilized for the purpose of education, assessment, and research. It encompasses several modalities that when put together and is well integrated, is able to reproduce, to a certain extent, and characteristics of clinical reality. Simulation in health-care education is today being utilized on a variety of platforms. It is used from undergraduate to graduate education for faculty development and continuous learning. The types of equipment and technology available today have also increased from the simple plastic molds and models, task trainers, low-Fidelity Manikins to high-Fidelity Manikins, to the use of virtual and augmented reality capabilities. Simulation-based educational activities and training mostly tap on the principle of experiential learning, in an immersive environment that is created.

Not everyone or every institution should jump on the bandwagon and use all these technologies. The fidelity and use of these modalities should only be as high as it needs to be and not any higher. An often misperceived notion is that increased realism of the simulator means enhanced fidelity. This need not necessarily be so as can be seen the use of a standardized patient (SP) (which offers very good training, together with actual verbal and nonverbal communications cues), which provides a high level of realism, but the actual simulation is low fidelity, by definition.
When looking at simulation, one should not omit the bigger and broader span of medical education, which has been in existence for 100 years, strewn with tradition, professionalism, and even the use of the apprenticeship models. This has to be coupled and viewed in the context of the development of medicine in general. The younger generation of learners we have today, their changing needs, demands, and expectations too have to be borne in mind. There is a need to sustain the interest, motivation, and enthusiasm of our younger learners, excite their curiosity and be engaging at the same time. Experiential learning is still very much used today, as a spin-off of the traditional apprenticeship model.

With all these in mind, educators continue to explore newer modalities, techniques, and approaches to learning and teaching. Even as this article focuses on simulation in medical education, it is important to be aware, and it also plays a big role today in health-care decision-making on a larger scale. An example would be computerized simulation of the emergency department flow of patients for bed, management purposes. Hybrid simulation (HS) models which utilize system diagnoses and also discrete event simulation can be used to study the influence of long-term population changes on the demands of a health-care system or service. Both cohort and demand simulation modeling using HS can assist with projections for financial planning and forecasting future volume and patient load. It also has applications to study workflow in a variety of health-care settings and many more.[1,3,4,7]

The reason why simulation is making a big impact on medical education today is likely because there are less live patients’ exposures and thus less hands-on experience with real patients for trainees and residents. In some institutions, due to changes in hospital dynamics and restructuring, the patient load may be lowered and at times skewed to certain types of case mix. In some countries, there is a decrease in the numbers workplace-based training opportunities. In institutions with structured residency training programs, the work hours have also been reviewed and reduced accordingly, to ensure appropriate work–life balance. The move from time and experience-based to outcomes-based medical training can also be another reason for this. Furthermore, in the current climate of increased liability and enhanced patients’ expectations, there are more challenges to provide students and trainees the widest repertoire of experiential learning with actual patients. Patients today wish to be managed by practitioners with experience and competence and feel it less acceptable to be cared for by one for the 1st time, without prior training. One other reason for the adoption of simulation is the enhancement and awareness of patient safety issues, which has become heightened. The options simulation offers ranges from enacting a clinical scenario in part or in its entirety, and this flexibility and versatility makes it popular and accessible. However, at the end of the day, when balancing our books, we have to ensure cost-effectiveness, in the process of delivering the best possible educational combination.

**HYBRID SIMULATION**

Health-care simulation represents an instructional medium used for both education and research. HS utilizes at least two different simulation modalities, whereby combining them will enable one type of simulation modality to enhance the other, with the proper alignment, coordination, and interfacing between the modalities.

Although the term is often used interchangeably, HS is slightly different from multimodality simulation. The latter refers to the use of multiple types of simulation in the same scenario or place. Examples of multimodality simulation would be using a SP and a manikin in a scenario or a task trainer paired with an SP for venipuncture. An example of HS is most commonly applied to the situation where a Part Task Trainer (PTT) (e.g. a urinary catheter model) is realistically affixed to a standardized/simulated patient, allowing for the teaching and assessment of technical and communication skills in an integrated fashion.[1,3,9]

There is another terminology which is used, at times interchangeably with HS. This is patient-focused HS. This is essentially integrating technical and procedural skills, while communicating and building rapport with the patient/SP, at the same time. It is similar in principle to HS and helps with contextualizing the educational experience. Handling a skill through the use of a PTT such as a lumbar puncture simulation set or learning breast examination on a model, in isolation, decontextualize the skill. However, when these models are coupled in an innovative way and affixed to a patient actor or SP, it will help put the context in perspective and ensure the experience is closer to reality. This is also a part of the spectrum of authentic learning. Both context and authentic learning are important concepts, which educators should focus on when planning learning activities.[8,12]

HS is increasingly popular today and essentially it will combine the benefits and virtues of each type of simulation modality that is utilized. The coming together helps capture both the discrete and continuous elements as in the real-world settings that is being modeled for education. Some examples of the combination would include situations where a PTT is coupled with a SP or actor, whereby it will facilitate the teaching or assessment of a technical skill in combination with communications skills, in an integrated fashion. Theoretically, any modality of the spectrum of simulation can be used for HS. However, to reflect realism, as close as it can get, proper interfacing of the combination modalities need to be planned and executed. Some may view this as the performance at the inter-related macro and micro levels, moving from simple to complex, or from lower fidelity to higher fidelity or it also utilizes the two principles for simulation-based training, that is:

1. Repetitive practice till one reaches competence or mastery (the concept of deliberate practice) and
2. The ability to “transfer” the skills learnt to the real-world situation and systems.
HS can help achieve a more complete picture and representation of real-world problems that may not be possible with only one simulation methodology. It can also help integrate more stakeholders to address the range of complex problems in patients. This is in line with the promotion of interprofessional practice.

HS can be used to train for both technical and also nontechnical skills (communications, decision-making skills, leadership, coordination, and oversight). It may represent one of the newer paradigms in medical education. It can help meet the needs of learners, especially when educators are told “not to teach in isolation” but to link to a narrative, a patient, a scenario, to make it come alive and create an “experience.” Thus, linking a surgical skill to communications and explanation as well as informed consent to be undertaken for it does contextualize the experience to a certain extend. Using HS well can help in integration of knowledge, patient care, problem-solving, and decision-making skills, as well as communications skills. With the richer, more realistic experience HS offers, retention can be better, deeper, and longer, and more efficiently transferred to the clinical environment and practice. In this context, HS should also not be used in isolation but linked to other modalities such as pre-learning through reading, video use, and even flipped classroom modeling.[13-17] Even with virtual reality (VR) simulation, educators must develop realistic interfaces with the clinical environment. Synthetic models, combined with VR can help bridge gaps in learning through integration of the real and the virtual world.

HS can certainly help address some of the challenges by combining techniques and methodologies. A word of caution when using simulation-based learning or HS is that when teaching novice and young learners, especially those who are using simulation for the 1st time, it is crucial to introduce and orientate them adequately to understand the concept and perspectives. Some familiarization will be required for them to maximally benefit from the experience.

**Hybrid Simulation Training and Scenarios**

Medical education scenarios involve mixing and matching methods, teaching tools and elements, as well as the interactive components into an educational model, with a set of learning objectives. This will help improve both theoretical knowledge as well as performance competencies. It will be superior to a solitary, didactic model of teaching. In the process of combining modalities, it is important to consider the acuity of the scenarios and its impact on learners at the various levels, the level of interaction, and the hands-on opportunities being offered.[18-17] Considering the desired learning outcomes is also important. The consideration of context too is important as it will help enhance the authenticity of the scenarios for learners. Properly planned and executed HS scenarios can increase confidence, self-efficacy, team efficacy, and level of motivation of learners.

There are many good examples of the use of HS in the literature as well as those being used in innovative ways by various institutions [Table 1]. HS offers a powerful educational platform to also teach clinical reasoning and assess it. At the same time, it can help promote the more conscious practice of medicine, with the deliberate practice capabilities, and it can offer learners at all levels. Assessors and faculty can even impart lessons in logical and analytical thinking, which can be a difficult skill to master and takes time, especially for the younger health-care learners. Theme-based HS is also another popular concept, especially with larger scale simulation such as disaster site simulation, operating theater simulation, and mass casualty incidents. These utilize the advantage of multiple simulation modalities so as to enhance the level of realism. This can help increase the learners degree of satisfaction in their learning process.[17-21]

**Preparation for Hybrid Simulation**

There are various ways to prepare for HS trainings. Some of the common types of HS used in health-care simulation will be:

- SP with task trainer
- SP with high-Fidelity or low-Fidelity Manikin
- High-Fidelity or low-Fidelity Manikin with task trainer.

The use of different combination techniques of HS depends on the learning objectives and the desired outcomes. Using different techniques will help to enhance the realism and learning experiences for the learners. Therefore, it is important to plan the learning objectives so as to determine which is the most effective combination.

Often, a task trainer is used for teaching hands-on skills for the learners to practice. However, if HS is used, it creates more realism and includes an interactive element where the learners can communicate with the SPs during the process. As such, the training not only teach practical skills but also soft skills such as communications.

With all the new development and innovation with HS, there are still gaps which can only be addressed through the contact with actual patients and take the example of learning auscultation sounds. The development of the auscultation torso and “harvey” were significant in helping young learners identify the sounds. They could repeatedly come back to familiarize themselves with the sounds and even feedback can be given to them by the faculty. However, till today, it is challenging to demonstrate position-dependent heart sounds and murmurs, even with some modifications to the manikin through positioning such as in the supine, upright, and left lateral positions. Even with SPs, usually normal sounds are easy to teach, unless the SP is known to have some condition with the appropriate signs.[9,16-18]

**Gaming as a Part of Hybrid Simulation**

Gaming is interesting, motivating, and can sustain the interest of younger learners. It is appealing and readily accessible on
learners’ own personal and mobile devices and tablets. There is the fun factor in gaming which is always engaging. However, in serious gaming, the important part is the imparting of the skills and knowledge through frequent play, practice, and familiarization of the repetitive patterns. In this modality, it is crucial to strike a balance between the educational element and the fun or gaming element. Combining gaming with another simulation modality in HS can help train complex skills in a fun and educational way. It can help retention but the bottom line is, can the learners improve their performance, which is the measurable and desired outcomes. More design-based research is important to answer some of the questions educators may have in this aspect.[22-26]

**Challenges**

Just like any other models, there are challenges in using HS. The following are some examples:

**Standardized patient with task trainer**

It is essential that the SP has some form of training or relevant experience to be able to portray the clinical or medical scenario required. With such criteria, the pool of trained SPs can be relatively small, and hence, it can be challenging to get sufficient numbers of experienced and good SPs if HS is used on a frequent basis.

**Standardized patient with high-Fidelity or low-Fidelity Manikin**

Disruption is often the challenge faced during the interchanging phase from SP to a manikin. Such sudden disruption can cause the learners to disengage from the simulation training as learners need to readjust themselves, thus causing an impact on the learning experience. Therefore, it is important to have a presimulation briefing so that learners will not be surprised by the sudden change.

**Limitations**

Even as we try our utmost to make HS as close to the actual clinical environment, it will never be the same. The need for buy-in and suspension of disbelief by learners as they agree to the “fiction contract” at the beginning of the simulation is critical. There have been observations whereby on seeing the manikins (especially for the first timers), some learners did not take the scenario seriously and may even have delayed resuscitation and management. These behavior can be addressed during the presimulation briefing and also during debriefing.[15] However, at times, facilitators find that they may have to “intervene” with a mini time out debrief, before the final debrief, if the behavior gets too much in the way of running the scenario.

Some learners may attend these sessions just to get their skills “signed off” in their log books for procedures. Others may get very little encouragement from their departments to support them utilizing these skills in their day-to-day practice.

Conducting HS is very labor intensive, especially for clinicians who already have a very hectic schedule, and many may not have dedicated time allocated to plan simulation programs. In utilizing HS for assessments and high stakes examinations, it is also crucial to have a proper standardized metrics for marking and simulation formulation.[26-29]

**Conclusion**

With the wide range and spectrum of simulation techniques available today, HS brings simulation in healthcare one step closer toward realism and authenticity [Table 2]. It is an interesting area, and there is a lot of interest about the innovation and developments. However, the desired end goals must be to achieve better and deeper learning, clinical reasoning, and enhancement of a more conscious practice through the interaction offered with the combination and integration. The newer technology is sexy and inviting, but combining the traditional (e.g. SPs) with the modern (e.g. VR) can be better than the sum of individual parts. When utilized appropriately and effectively, simulation-based training can help metacognitive awareness among learners as they migrate into the real world, realizing also the problems in the latter are
complex and may have more than one way of doing or have more than one right answer.\textsuperscript{10,28,29} Hopefully, the simulation training help learners anticipate problems before the actual patient encounter, which can be challenging, dynamic, and often, relatively unpredictable.

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Conflicts of interest
There are no conflicts of interest.

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Table 2: The spectrum of simulation techniques

| Spectrum of simulation techniques |
|----------------------------------|
| 1. Simple task trainers or part task trainers (assessing one skill) |
| 2. Complex task trainers (assessing for more than one skill) |
| 3. Low-to-moderate fidelity manikins |
| 4. High-fidelity manikins |
| 5. Computerized models, computer applications, computer screen-based simulation, avatars |
| 6. SP, actors |
| 7. Cut-suit technology |
| 8. Confederates |
| 9. E-learning technology |
| 10. Virtual and augmented reality technology, virtual patient, virtual world |
| 11. Other innovative and home-made models |

SP: Standardized patient

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