Simulation Centers and Simulation-Based Education during the Time of COVID 19: A Multi-Center Best Practice Position Paper by the World Academic Council of Emergency Medicine

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Abstract

COVID 19 struck us all like a bolt of lightning and for the past 10 months, it has tested our resilience, agility, creativity, and adaptability in all aspects of our lives and work. Simulation centers and simulation-based educational programs have not been spared. Rather than wait for the pandemic to be over before commencing operations and training, we have been actively looking at programs, reviewing alternative methods such as e-learning, use of virtual learning platforms, decentralization of training using *in situ* simulation (ISS) modeling, partnerships with relevant clinical departments, cross-training of staff to attain useful secondary skills, and many other alternatives and substitutes. It has been an eye-opening journey as we maximize our staff's talent and potential in new adoptions and stretching our goals beyond what we deemed was possible. This paper shares perspectives from simulation centers; The SingHealth Duke NUS Institute of Medical Simulation which is integrated with an Academic Medical Center in Singapore, The Robert and Dorothy Rector Clinical Skills and Simulation Center, which is integrated with Thomas Jefferson University, Oakhill Emergency Department, Florida State University Emergency Medicine Program, Florida, USA and The Wellington Regional Simulation and skills center. It describes the experiences from the time when COVID 19 first struck countries around the world to the current state whereby the simulation centers have stWWarting functioning in their "new norm." These centers were representative examples of those in countries which had extremely heavy (USA), moderate (Singapore) as well as light (New Zealand) load of COVID 19 cases in the nation. Whichever categories these centers were in, they all faced disruption and had to make the necessary adjustments, aligning with national policies and advisories. As there is no existing tried and tested model for the running of a simulation center during an infectious disease pandemic, this can serve as a landmark reference paper, as we continue to fine-tune and prepare for the next new, emerging infectious disease or crisis.

Keywords: "TraceTogether", computer-based simulation, COVID 19, simulation centers, simulation-based learning, social distancing

Introduction

When COVID 19 struck, everyone and every system went on high alert. It was declared a global pandemic by the World Health Organization on 11 March 2020. Every nations' and institutions' emergency preparedness was now being put to the test. COVID 19 presented a plethora of hard lessons about resilience and adaptability. Worldwide, health-care providers

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were faced with an unprecedented situation, with rapidly changing dynamics and patient load.[1-3] Clinical care began to take the focus, especially with the increased numbers of patients coming through emergency departments (ED). The challenge of transformation in workflow processes and triage mechanisms, the long hours at work in personal protective equipment (PPE) and sheer exhaustion began to engulf health-care workers. Educational and research activities had to make way for clinical care and medical services. COVID 19 disrupted the usual course of medical education and provided a platform for us to look for viable and sustainable options and alternatives. During these initial phases, the majority of face to face teaching and training sessions were put on hold. Where possible, staff from nonpatient-facing departments were deployed to the frontline to help colleagues in handling the increased patient load. Residents and students' rotations were suspended temporarily to reduce cross interaction between staff in different departments. Educators and education committees were kept busy reviewing the new platforms that would be possible for medical education to continue. There was also a need to overhaul the curriculum for competency-based training in some specialties. One of the areas definitely affected by all these changes was simulation-based education as well as the operations of simulation centers.[4-7]

The Accreditation Council for Graduate Medical Education (ACGME) in the USA or the equivalent undergraduate and postgraduate accreditation bodies would have defined the core competencies that all educators and education committees need to meet to remain in good standing. These core competencies ensure that resident physicians are receiving quality training to practice independently. Patient care and procedural skills competencies were significantly affected during the early pandemic period due to the reduction in certain categories and numbers of patients presenting to the ED as well as the restrictions posed by the pandemic. Due to this residents' and students' exposure to the most common diagnoses decreased. Simulation-based education helped to make up for the decreased utilization within EDs and increase mastery with bread and butter pediatric diagnosis.

Simulation Centers and Simulation-Based Education

Simulation-based education has become adopted on a widespread basis across the world. This is especially true with health-care organizations, universities, and medical schools. The spectrum of simulation-based education has also expanded; from simple part-task trainers, low fidelity to high fidelity simulation, hybrid simulation, use of standardized patients, surgical laparoscopic simulators, simulated operating theaters and rehabilitation suites, to even applications involving virtual, augmented, and mixed reality modalities. All these can be used to hone skills and capabilities as well as help enhance health-care quality and patient safety. Simulation-based education involves repetitive training to attain mastery of skills and performance, in a nurturing and supportive immersive environment. It has been used for training medical and health-care students, residents, practitioners from various specialties, and for faculty development programs.[8-10] Simulation modules can be tailored to help train health-care teams to handle rare and challenging situations and emergencies. These modules can help to fill the void created by the decreased utilization of EDs that resulted from the COVID 19 pandemics.

Simulation centers are facilities where the replication of real-world clinical or other events takes place in an environment that is safe and conducive for teaching. This helps bridge the gap between classroom learning and real-world practice. Simulation centers can be viewed as educational centers in the clinical setting. Some are stand-alone centers, while others are integrated with medical schools, institutions, or academic medical centers. Today simulation centers may be centralized, decentralized, may function as a mobile unit or may utilize a hybrid model of operations. For simulation centers that are integrated, it is easier for staff in the medical schools or hospitals to access them for purposes of training[8-11] [Table 1].

For nations that had been affected by the Severe Acute Respiratory Syndrome (SARS) in 2003, the impact on clinical work, education, and research may have been anticipated when COVID 19 struck. For others, the challenges posed by this pandemic may be unique. Gradually, everyone had to learn to adjust and adapt in the new working environment, innovate to educate and train efficiently and safely, work in smaller communities asynchronously and strengthen collaborative relationships, even if these had to be virtual. One observation that deserved consideration is that simulation had previously been demonstrated to have great potential in contributing both toward preparation for pandemic management as well as continuing education of healthcare personnel.[12,13] For the former, practicing through the use of simulation can help staff familiarize themselves with the new workflow and work processes within a short period. Moreover, such simulation practices can help enhance understanding (e.g., why certain steps have to be taken in the new pandemic workflow) and can reduce cognitive burden once the staff are back in the busy clinical environment. This is because they would be assumed to have asked questions and clarified all their doubts

Table 1: Types of simulation centers

Types of simulation center by location
Centralized
Decentralized
Mobile unit
Hybrid model of operations
Types of simulation center by function
Stand-alone simulation center
Hospital or academic medical center-based
Medical school-based
In situ simulation

during the simulation exercise and practices. Simulation-based practices can be incorporated into orientation modules for staff from inpatient departments who are sent to boost workforce in EDs during the COVID 19 pandemic. This kind of training helps to enhance their understanding and execution of the frontline practice. This also contributes to their cross-training experience. Health-care simulation training enhances health-care workers' personal strengths, critical to operational and clinical outcomes during COVID 19.[14-16] In fact, during the COVID 19 pandemic, simulation can be helpful to help prepare for staffing issues or rostering, supply chain management, bed management, assessing new workflow, and new equipment for latent threats and even transportation routes to take for infected patients. These are examples of activities which need to be learnt and executed at very short notice when the pandemic struck. For institutions that have been doing regular emergency preparedness exercises, these serve as reinforcements to assist staff to recall the steps involved[17,18] [Table 2].

The COVID 19 pandemic affected simulation centers operations in multiple ways. The immediate impact on simulation centers thus would include some of the following:[19-26]

1. Stopping or tailing down all face-to-face simulation-based training and courses until further review (this may be based on individual state or country policies)
2. The staff may have to:
    a. Work from home
    b. Be involved in other duties especially with the increased burden of patient care during the pandemic
    c. Assist in planning and coordinating "ramped up" training to get health-care staff up to date with their N-95 mask fitting, donning, and doffing of PPE
    d. Work in partnership with clinical staff in execution of the hospital pandemic and preparedness response
    e. Form a working task force to review the steps to be undertaken for the gradual and safe reopening and re-introduction of the programs and training within the simulation center.

Over and above these, staff are not allowed to cross institutions and have inter-mixing during this period. Gatherings of all sizes were not approved, especially in the initial stages. Later on, gradual relaxation was embarked upon and small classes and groups of not more than 5 persons were allowed. International travels were banned and thus, no foreigners and international participants would be able to attend simulation courses. This also means all conferences were put on hold.[21,22,25]

Oversight and Coordination in Managing COVID 19

With COVID 19, most healthcare institutions and medical centers formed inter-professional, multidisciplinary taskforce to oversee, provide advice, coordinate operations, make critical decisions pertaining to clinical practice, education, and research activities.[19,22] At SingHealth Duke NUS Academic Medical Centre (AMC), the SingHealth Disease Outbreak Taskforce (SDOT) taskforce was set up for this function. Every department and division in the AMC had representatives in SDOT. SDOT worked very closely and aligned with the National Multi-Ministry COVID 19 Taskforce in terms of providing instructions and advisories. In the area of training and education, for proper governance and resumption of training, approval must be given by SDOT. The submissions must include why certain types of training are deemed critical and necessary. In individual departments with their own simulation equipment, these continued to be used for training learners, using ISS model[11,21] [Table 2].

At the Robert and Dorothy Rector Clinical Skills and Simulation Centre (CSSC), the leadership met with the Thomas Jefferson University stakeholders, including the institution's COVID 19 Taskforce, to develop plans for the center's activities. In the interim period, the center developed a "grab and go" model whereby simulation equipment could be provided to faculty who wanted to utilize them for teaching students and residents in their own clinical areas. These faculty would have to complete a detailed template on their requirements and discuss

Table 2: Types of activities where simulation can be utilized to educate, prepare and enhance the knowledge, skills and attitude of staff

Use of Simulation during COVID 19
Introduce concepts related to epidemiological history taking in greater detail
Familiarize with new workflows and processes eg., admission workflow for ARI patients versus non-ARI patients
Understand when to consult senior doctors and seek advice or approval in the new workflow
Communicate with suspected COVID 19 positive patients
Create and follow reporting processes for COVID 19 positive patients
Hand hygiene proficiency
Donning and doffing PPE appropriately
Referral and transportation of the COVID 19 positive patient, including which route to take to get to the intensive care unit or isolation wards
High risk airway management and proper handling of aerosol generating medical procedures
Help scale up capabilities of new staff seconded to the frontline such as the emergency departments
Debriefing after management of appropriate cases and patients
Need for change (eg., change in ergonomic placement or change in equipment) or latent threats with the new processes and newly acquired equipment

ARI: Acute respiratory illness, PPE: Personal protective equipment

them with the center's simulation program coordinator. The requested equipment and task trainers will then be prepared and packaged, either to be picked up by the faculty or arranged to be sent to a designated location. Post-training the package will be returned to the center and will be inspected and disinfected by the staff accordingly. For integrated simulation centers, the coordination with the hospital or academic medical center is more readily facilitated. At CSSC, there was a bulk purchase of additional task trainers, with the help of the University. This was deemed necessary to replace many of the procedure skills processes which were previously done using Standardized Patients.

In New Zealand, at the Wellington Regional Simulation Centre (WRSSC) the capital and Coast District Health Board the COVID 19 Steering committees tasked the Center with training in procedures relating to the pandemic, hospital systems review, and COVID 19-specific service simulations. As paralleled our national plan of "bubble groups,"[27] hospital teams were allowed to continue simulation in their perspective work bubbles. The Center was able to support essential COVID 19 related simulation as decided by individual service requirements. WRSSC was also tasked with providing numerous training videos, serious gaming, and online content. The amount of face-to-face simulation increased as the national alert levels decreased. Standardized patients were not allowed in the hospital, however, they were used for 3rd and 4th-year medical students interview training through videoconferencing.

Timing and Preparation for Re-Opening: Resumption of Simulation-Based Programs

The opening of the simulation center for "business" should only take place when the COVID 19 situation has achieved some degree of stabilization or reach a steady-state in terms of numbers of cases in the community or presenting to the AMC or hospital. At SIMS (SingHealth Duke NUS Institute of Medical Simulation), we aligned this with the national statistics, number of cases in the community and with the government's "circuit breaker" (versus a lockdown) period and national guidelines. Once Singapore came out of the "circuit breaker" period, we commenced with some of our simulation programs and training. The opening was aligned with the work of the simulation centers' taskforce proposed framework and all the staff must be familiar with the guidelines and practical aspects of execution and implementation. This refers to the issues such as entry/exit control, contact tracing, hygiene, and health monitoring as well as distancing measures. The safety of learners, staff, and faculty is of utmost importance. Members of the task force came up with innovative ideas and initiatives to maintain safe distancing and ensure low risk of exposure. As they planned, they must bear in mind the "new norm" post-COVID 19. This means simulation centers must be able to adapt to the new paradigm and continue to thrive and grow.[1,4,14]

The following discussions will address the multiple elements for consideration as simulation centers gradually open up and relax to accept more and more learners and make available training programs, moving as much as possible toward "business as usual." However, we have to be realistic that achieving the latter may not be feasible. There will be new practices and requirements to maintain safety for staff and users of simulation centers.[28,29]

"Safe Entry" and contact tracing

COVID 19 set the stage for safe distancing, which was not even seen during the 2003 SARS outbreak.[12,20] This was the period where we saw new and innovative ways to connect remotely as well as safe distancing measures, with restrictions on numbers of people allowed in gatherings and groups for various purposes. For entry and exit from areas and premises, the "Safe Entry" application is utilized. This is the national digital check in system used in Singapore and the "whole of government." Businesses and organizations register for its use at no cost. SIMS came on board and learners as well as staff coming in and out of the simulation center must use the application, by simply scanning the QR Code placed at strategic locations. This is also very useful for contact tracing. "Safe Entry" has reduced the manual effort for the simulation center to keep logs of people passing through the premises [Figure 1]. This way, there will be an efficient "monitor" of the staff and learners at any location in the simulation center, at any particular point in time. A spin-off from the "Safe Entry" application is a "Trace Together" token, which comes in the form of a wrist band. This can be used by people who have them and they will be automatically tracked as they enter and exit premises [Figures 1 and 2]. The technological application certainly makes contact tracing easier, faster and more efficient.[30,31] All staff of the AMC will use one of these applications. Non-AMC staff will also need to have their temperature taken and complete the health and travel declaration upon entry. Any persons serving Stay Home Notice and/or are on medical leave will be denied entry into the premises.

Health monitoring, personal hygiene, and infection control

In the state of Philadelphia, needed to attest to not having any symptoms. If they had, they were assessed via the telehealth program, JeffConnect and were given the appropriate advice

Figure 1: Declaration form and safe entry signage

and/or placed on quarantine. At SIMS, all staff as well as learners are required to log in their temperatures twice a day. Anyone with respiratory tract symptoms (fever, cough, sore throat, loss of taste, or smell), feeling unwell in any way must seek medical consultation at the staff clinic on campus. People on "stay home notice" must not come to the simulation center. Anyone with COVID positive swab results too will be denied entry. It requires discipline on the part of staff and learners to ensure compliance and thus, safety for all. E-mails are to be sent to participants to inform them to contact the course coordinator if they are unwell and not to turn up for workshops. During the training, the participants who appear to be unwell will be asked to leave and to seek medical treatment for further assessment.[1,32]

All persons are mandated to wear their masks at all times except during meal times. If any person requires a new mask, spare masks will be made available when requested. All persons are to practice proper hand hygiene either at washing points or with the readily available hand sanitizers placed strategically in each training room and along walkways or corridors. It is essential for all instructors and participants to wash/sanitize their hands before the course commences, as well as before and after any hands-on session and after breaks. Everyone was advised to avoid touching their faces at all times.[4,11,32-36] Manikin and training aids must be thoroughly disinfected before and after every participant.[33] This is done using the appropriate wipes or disinfectant for COVID 19 [Figure 3]. Gloves should be worn when changing, cleaning, moving, and disinfecting the manikin and training aids.[37-42]

A wipe down of surfaces, common spaces and frequently-touched areas (i.e., registration counter, training area, doorknobs, chairs/tables, etc.) using disinfectant wipes is conducted after each training session. The training laboratories are cleaned with a thorough wipe-down after every session.[36-39]

Safe distancing and facility utilization

Everyone was encouraged to promote virtual learning and e-learning where possible to align with the "whole of government or state approach." Where possible, small groups of not >5 persons were allowed to group together for training but had to maintain safe distancing measures and be at least 1 meter apart from each other and the appropriate masks had to be used at all times. There must be at least 1-m spacing between participants during registration and in-classroom seating. There should be different registration points for participants from different training groups that are running concurrently. In the USA, the distance suggested is at least 6 feet. Bedside training was also limited to a ratio of 1 faculty to 5 participants. Where possible, physical and social interactions between groups/classes should be minimized at all times. To reduce possible congregation of staff/learners at common areas, break times should be staggered. Alternatively, participants can have their break times within their own breakout rooms. Only bento (individually packed) meals are to be provided for course participants and faculty. Buffet set-ups will encourage the congregation of people and was thus not encouraged. Each training room will have signage on the door to indicate their maximum occupancy, for everyone's understanding and compliance [Figure 4]. The manager of the facility may conduct spot checks, looking in upon all the training rooms and laboratories to ensure these guidelines are strictly adhered to.[11,14,31,32,34,35] At CSSC, the usual simulation session with 40 learners per classroom was reduced to 8 learners. This

Figure 2: Trace together application or token. Photo credit to www.tracetogether.gov.sg

Figure 3: Disinfectant wipes in each training room

Figure 4: Signage indication the room capacity

meant the recruitment of more faculty to meet the needs of the additional small classes.

Procurement of cadavers and use of cadavers for training

Besides the use of cadavers for anatomy lessons during undergraduate medical education, cadaveric dissection is used across surgical disciplines such as neurosurgery, surgical oncology, burns and plastic surgeons, head-and-neck surgeons, orthopedic surgeons and ENT surgeons to experiment with innovative surgical techniques, practice surgical skills and procedures to explore the human body in a realistic manner, before embarking on major or complex surgery on living patients.[43-45] For simulation centers that have wet laboratories or cadaveric laboratories and storage facilities, it is important to ensure proper guidelines are in place during an outbreak such as COVID 19. Guidelines for the management of dead bodies must be adhered to and often this is a local or national guideline. For SIMS, as procurement of dead bodies and body parts for training is from overseas, there is a need to ensure these cadavers have been screened and tested for COVID 19. These will come with a valid certificate of clearance from the appointed vendors. The appointed vendor uses nasopharyngeal swab-based polymerase chain reaction testing and they adhere strictly to the guidelines issued by The American Association of issue Banks.[46] Besides these, local advisories from the Ministry of Health, Singapore, and the National Environment Agency must also be complied with.[39] The local guidelines will issue step by step instructions on precautions, infection prevention, control measures, handling of the body, environmental controls as well as the disposition of the body after use[39] [Table 3]. All personnel handling these bodies and body parts must have their full PPE on at all times. Before disposal and cremation of the bodies, all tubes drains, or catheters must be removed and all puncture wounds created should be properly cleaned, and sutured. Any other wounds would be covered with absorbent dressing followed by an outer layer of impermeable material or plastic.[44,45]

Alternatives to Training in the Simulation Centre

Computer-based simulation

During the COVID 19 pandemic when face-to-face interactions have to be curbed, computer-based simulation (CBS) offered an alternative as teaching must continue. It is with the hope that this can help improve confidence and deepen understanding in the interim period. CBS is the use of a computer for the imitation of a real-world process, situation, or system. This is where technology is used to enhance, augment or even at times, replace real-life simulation. It can certainly acquaint learners and students with the prelude to their real-life experiences. It can also provide the students with the opportunity to realize the areas for potential improvement. CBS can also be integrated with the use of 2-or 3-dimensional objects and the environment to create an immersive and engaging learning experience. It can also be a bridge towards manikin-based simulation or the actual clinical exposure and

Table 3: Cadaver handling and cleaning during pandemic

SIMS had to abide by the following instructions as the first line of safety measures for the cadaveric handling and cleaning during a pandemic
National infection prevention and control guidelines for acute healthcare facilities (https://www.moh.gov.sg/resources-statistics/guidelines/infection-control-guidelines/national-infection-prevention-and-control-guidelines-for-acute-healthcare-facilities) [Last accessed on 2021 Jan 05]

Item	Guidelines/work processes for implementation
Cadaver receiving	PPE (surgical cap, mask, gown, gloves, shoe covers) to be worn at all times during the handling of cadavers
	Upon receiving cadavers, dispose all of the packaging that can be removed into biohazard bin
	Store the cadavers into its proper storage
Cadaver handling before workshop	PPE (surgical cap, mask, gown, gloves, shoe covers) to be worn at all times during the handling of cadavers. N95 mask and safety googles are to be worn during procedures that produce aerosols
	Each layer of the packaging that comes from USA to be wiped down with surgical surface disinfectant and dispose immediately after it is removed from the cadavers to biohazard bin
	Wash cadavers with detergent before use
Cadaver handling during and after workshop	PPE (surgical cap, mask, gown, gloves, shoe covers) to be worn at all times during the handling of cadavers. N95 mask and safety googles are to be worn during procedures that produce aerosols
	Cadavers are tracked on each station
	Cremate on the next available slot after training is completed
	The procedure of cremation will be done according to SIMS SOP on the Management of Disposal of Cadaver or Cadaveric Parts
Cleaning protocol	After each workshop, lab and the instruments have to be cleaned thoroughly
	All work areas, stands, tables, countertops, sinks and equipment surfaces shall be cleaned between each workshop
	Surface will be cleaned with Mikrozid AF disinfectants OR other equal disinfectants
	Whenever possible, instrument shall be cleaned using washer (Some of the instruments are fragile that are not recommended to use washer. Additionally, washer only cleans the surface. Instruments with tubings or odd shape won't be cleaned)
	Any manual brushing required should be done under water
	All autoclaveable instrument shall be autoclaved after being washed including instruments from external parties
	Each waste should be treated accordingly as per SIMS policy on the Management of different waste

SIMS: SingHealth Duke NUS Institute of Medical Simulation, PPE: Personal protective equipment, SOP: Standard Operational Procedures

practice, which would likely be introduced once the COVID 19 pandemic stabilizes.[47,48]

CBS offers a lot of flexibility, convenience and can even be scheduled outside curriculum time. This was extremely helpful as many of the frontline faculty were busy working long hours at the hospital. It can be slotted in relatively easily, even with team members at different locations. The cost of using CBS is very reasonable and there can be unlimited repetitions at the learners' request. The teams can be evaluated in real-time, just like in the other forms of simulations. The range of cases can be from simple to more complex ones, planned to meet the strategic objectives. Creativity and innovativeness can also be applied as relevant. Some learners preferred CBS as it helps to reduce their performance anxiety.[47-49] CBS scenarios can cover a wide spectrum of clinical cases, including both adult and pediatric emergency scenarios.

"At home" Adjuncts to supplement computer-based training modules

As discussed above, the pandemic has created a need for different ways to train/re-train or cross-train residents and ancillary staff outside of the traditional lecture, simulation centers and large group settings. The team at Oak Hill Hospital in Brooksville, FL has utilized three-dimensional (3D) printers to facilitate the training of residents on a number of procedural competencies. The price of the 3D printers have dramatically decreased in the past several years and their functionality has markedly improved. There are many at-home versions currently available. A basic set up costs between $150-500 USD. Various websites exist with free anatomic and other teaching models such as the NIH 3D print exchange. There are also several options for free software such as Blender and Meshlab.

These models can be used at home or for guided virtual simulation training. Most 3D printers use plastic polymers, which can easily be sanitized and re-used between residents. At the time of this publication, the average cost of a 1Kg spool of polymer is between $20-30 USD. An advantage to this low-cost solution is the ability to create individual models for each resident. Depending on the size and complexity of the model many copies can be created from the same spool. Figure 5 shows a sample cricothyroidotomy 3D model. After the initial capital expenditure to purchase the 3D printer for our residency program, each model costs only $0.78 (USD) to produce. From one spool (1 kg filament), educators can make approximately 38 models. This means a model can be provided for each resident for their use at home along with video instruction for a total of $14.04 (USD). This technology can be adapted to make ultrasound models as well as anatomic and surgical teaching aids.

Incorporation of newer modules: Social determinants of health

In addition to teaching traditional procedural competencies and diagnostic scenarios, ACGME now requires residency programs to educate learners on the ways in which healthcare

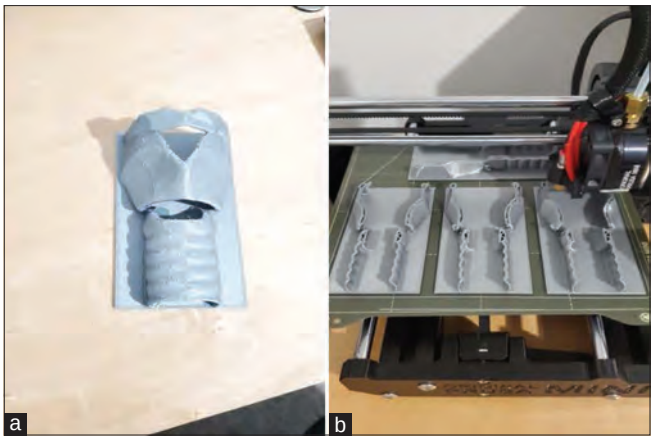

Figure 5: CICO rescue cricothyroidotomy trainer.https://www.thingiverse.com/thing:2530474. (a) Example of free training model from Thingiverse. This was made from a flexible polmer which mimics the elasticity of the trachea. It was printed on a prusa mini 3D printer (USD$350). (b) Depending on the size of the , model and print bed, multiple copies can be created at once decreasing production time

disparities impact patients and the delivery of healthcare.[50] In 2018, ACGME developed a Quality Improvement: Health Care Disparities Collaborative, whose directive was:[50]

1. To enhance learner engagement in systems-based quality improvement activities,
2. To better understand and address health-care disparities within their own organizations;
3. To engage early learners within their respective Clinical Learning Environments on developing quality improvement projects and initiatives to address disparities,
4. To enable learners to have an interactive experience, sharing their findings with peers all across the graduate medical education, and
5. To subject their findings to facilitated review and guidance from faculty members with national and international expertise in health care disparities to ascertain the sustainability of any projects.

COVID has further demonstrated the importance of social determinants of health. Specifically, it has spurred educational efforts to recognize the grave impact of discrimination, the patient's occupation, educational level, income/wealth, housing situation as well as the limitations inherent in the patient's access to healthcare on his/her overall health and risk.

As educators, we have the capability to use simulation (scenarios for learning) to highlight the importance of these social determinants of health. The social history, which is often minimized or neglected in many disciplines, is a key part of simulation in determining patient risk for many medical conditions/disease processes.

Virtual Reality

WRSSC used a virtual reality platform to demonstrate practice differences in managing patients with suspected COVID

infection in core critical care procedures in different areas of the hospital. These included the ED, ICU, and the operating theater. It was felt that using an interactive virtual reality platform to demonstrate how to safely intubate, deal with a patient in respiratory distress, and run a cardiac arrest were high-value activities. These online modules could be accessed anywhere and were able to reduce the amount of face-to-face time this training would have normally taken [Figure 6].

In situ simulation

When preparing and responding to the first wave of COVID 19 infections, simulation modeling and training can be used to assess and strengthen the following aspects of organizational functioning and preparedness. Besides staff training, it can also be sued for residents and students teaching:[9,50]

a. Department and Institution readiness
b. Health-care staff readiness
c. Systems-based practice and referral system readiness
d. Establishing and refining standards of care.

ISS modeling enables testing systems dynamics, care protocols, and pathways during the current pandemic. This simulation modeling can be especially useful because:

a. It allows flexibly with the rapidly changing demands, workflow and processes as new evidence were generated, at strategic intervals
b. It provides an avenue for real-time testing of various control measures.

ISS department-based goals and objectives can be planned collaboratively between the different departments involved. Engagement with other departments and staff within the institution is also crucial and highly encouraged to strengthen inter-professional practice. Uploading of the regularly updated documents, policies, and procedures onto a shared institutional platform can help raise awareness and make this critical knowledge readily accessible by all stakeholders for practice using ISS.[9,10,51,52]

The following represents the list of activities and scenarios whereby ISS can be utilized under the simulation paradigm outlined above:

1. Donning and doffing of PPE: This was useful as refresher as well as for new trainees. At any point in time, any staff member could request to have the training if they felt unsure regarding any aspect of the established procedure or standard-issue equipment.
2. Donning and doffing of powered air-purifying respirator (PAPR)
3. Procedural training while donning PPE ± PAPR:
    a. Endotracheal intubation, inclusive of suctioning
    b. Toilet and suture
    c. Chest tube insertion
    d. Central line insertion (ultrasound guided)
    e. Practice of physical examination on potentially infected patients (note that with PAPR it was not possible to auscultate or use a stethoscope on a patient)
4. Workflow and work process training:
    a. Full-scale resuscitation exercise
    b. Trauma team activation exercise
    c. Stroke team activation exercise
    d. ST-elevation acute myocardial infarction management, inclusive of cardiac catheterization laboratory team activation
    e. Other common resuscitation scenarios included:
        i. Pregnant COVID 19 positive patient with cardiac arrest or in labor,
        ii. Respiratory distress,
        iii. Septic shock,
        iv. Ventilator connection and disconnection,
        v. Use of noninvasive ventilation and metered dose inhalation,
        vi. Ventilator dys-synchrony.

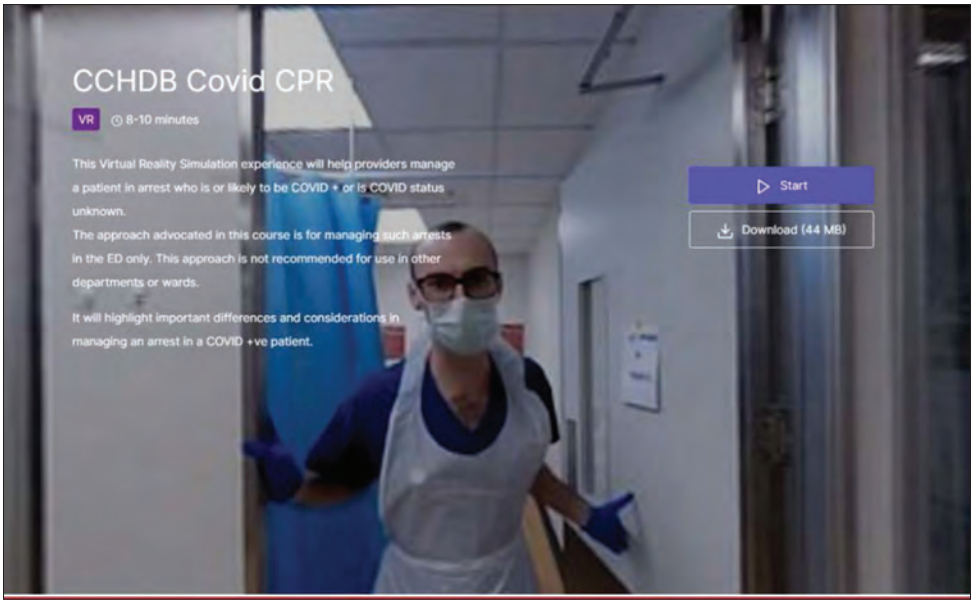

Figure 6: The WRSSC's virtual reality platform

6. Transport and transfers, with the following common examples:
    i. Which route should be taken to send COVID 19 patient to the isolation ward
    ii. What PPE is required for the staff accompanying the patient.

Challenges embedded within the scenarios, such as unexpected equipment failure or lack of its availability, intentional errors, lack of information, as well as the arrival of a second or third critical patient. Moreover, incorporating various cultural and communications challenges into the simulated scenarios can be very useful. This is especially in the context that many institutions provide care to foreign patients, and expatriates working in their countries. Finally, we also had to bear in mind our pandemic workflow. One such example would be the use of PAPR with high-risk infectious patients:

1. Challenges with using the PAPR:
    a. Inability to auscultate and listen to lung sounds
    b. Communications challenges
    c. Patient's apprehension and anxiety
    d. Proper training required: To don, to doff, and to care for.

Psychological Safety in Users of Simulation Facilities

Psychological safety during simulation-based learning can be an even more critical consideration during the COVID 19 outbreak. Psychological safety is important in all learning platforms and this is more so in SBL as there is "performance" involved and learners can be more self-conscious among themselves. With all the added restrictions and precautions during the pandemic, learners may feel unsettled and concerned. Thus facilitators of these sessions need to have an "eagle eye" to observe even the slightest nuances from the learners perspectives. They must be aware of these and also assist to nurture and urge participation in a neutral and nonthreatening way. Facilitators must add in an additional component on infection control, personal hygiene, and safety when addressing the learners during the pre-brief session. Throughout the simulation session, proper hand hygiene and distancing must be maintained. During the debriefing, once again, this can be commented on as well.[11,21,52-56]

Once learners feel comfortable, they may then start to share and talk more openly Being nonjudgmental is critical. Just one statement which is offensive to one learner can throw us back many steps. Thus preparedness from the faculty and facilitators is important. Psychological wellness affects performance during simulation-based learning in a similar way stress does. Thus, the impact of making learners feel at ease must never be under-estimated.

In Asia, culture plays an essential role as well. In general, Asian learners may tend to be less vocal, less confrontational and may thus appear to be less participatory and quiet. Hierarchy plays a critical role as well, whereby respect for teachers and faculty is still something still held very strongly. Thus for faculty working in cross-cultural settings, there is a need to be aware of this.[57,58]

Simulation Programs in the "New Norm"

Besides the introduction of relevant, new programs, many of the ones started during the COVID 19 pandemic will continue post-COVID 19. There will be "blending and braiding" of existing programs with new ones to improve safety and care delivery. These would include telemedicine and telehealth courses, virtual teaching platforms, the use of VR (virtual reality), AR (augmented reality), and MR (mixed reality) to supplement teaching and training programs. E-learning and online platforms will continue to be enhanced further. Even in organizing local and international conferences, virtual platforms will be added, besides the usual face-to-face sessions. For many of the conferences which are organized by both institutions, hybrid models will be offered, where some components will be offered face to face while others will be delivered virtually. Keeping in touch with the community of practice, both locally as well as globally is also important. Currently, virtual connections and teleconferencing keep us connected to share information and best practices across the globe.

Programs such as bulk purchasing training and courses will have value across healthcare clusters and regional health-care organizations. It will help the procurement of shared inventories and preparation for stock-piling of certain products and equipment for simulation-based training and courses (e.g., masks, PPE). This can be more cost-efficient. The simulation will continue to be helpful in planning the management of uncertainties, balancing needs against resources. Simulation-based training will continue in smaller groups and is useful in the testing workflow, latent threats and can also be applied as *in situ* simulation. Coupling *in situ* simulation with failure mode effect analysis can also have value.

During the pandemic, staff were seconded to the frontline and busier departments to assist with the work. These staff may not be very familiar with the workflow and would need a quick briefing and introduction. Cross-training would be a very useful initiative that can help prepare staff for such secondment. Cross-training can be a strategy to help the staff acquire skills and capabilities of working in areas other than their own discipline. This way they can diversify their skill sets, be more versatile and help to serve where they are needed in crises. Cross-training can "energize and strengthen" staff, improve teamwork and inter-professionalism, as they learn and understand more of what their colleagues do in the various departments. The level of respect across disciplines can also be enhanced.

Our institutions and simulation centers have always been very supportive of staff's innovation and research projects. During the pandemic, one of the grant calls for the AMC was termed "COVID 19 Innovation Grant Call". The objectives clearly specify the focus on innovative ideas in the "new norm:"

1. To increase operational efficiency and productivity for work processes affected by COVID 19
2. To improve quality of care and patient safety among the "new norm"
3. To ensure the safety of health-care professionals during the resumption of health-care services for non-COVID 19 patients and
4. To encompass longer-term innovations to support strategic goals and operations in the "new norm"

The AMC organizers will also assist to match interested parties with internal or external partners as appropriate, for example, technological experts, engineers. This really demonstrates the emphasis and inclusivity of all staff in contributing their ideas towards making patient care and work processes as well as system flow better.

Another springboard for strategic change innovation and implementation is scenario planning, which can generate new initiatives. The staff will put forth their ideas and suggestions, colored by their life experiences, including those derived during the COVID 19 pandemic. Many of these will commence with brainstorming, which starts with critical questions that can help generate insights into the shared future and what we collectively want, post-COVID 19. To be able to continue with these newer modalities, some unlearning and relearning will be required. Training will help bridge the gaps. The acquisition of new knowledge and skills will continue to be robust. To face the disruption and digital transformation, we must all be prepared, both psychologically and physically.

Conclusion

To date, there is no tried and tested method for simulation centers and simulation-based programs to look toward for advice in handling a pandemic such as COVID 19. The rapid changes called for adaptability, resilience, and agility on the part of the staff and learners. The educational needs had to be reviewed and adapted quickly to cater to the needs of the wide spectrum of learners using simulation centers and while applying simulation-based education principles in their programs. The active participation of everyone concerned, their willingness to buy-in, collaborative culture, and contribution of creative ideas in terms of programming were prerequisites to the milestones created, which will take us into the new norm.

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Conflicts of interest

There are no conflicts of interest.

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