Simulation role in preparing for COVID-19
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Abstract:
During the current COVID-19 global pandemic, the major efforts are channeled toward containing and minimizing the spread and maintaining the healthcare providers' safety. One of the major aspects of effective infection control and prevention is healthcare team training and system troubleshooting. Simulation-based education appears to be a practical and flexible instructional design to achieve variable levels of knowledge, skills, and attitude training. In this paper, we aim to provide a brief scheme on how simulation-based training can be employed in COVID-19 pandemic preparedness efforts. In addition, we will be sharing our multidisciplinary simulation experience in critical care at the National Guard Health Affairs, Saudi Arabia.

Keywords:
COVID-19, National Guard Health Affairs, preparedness, simulation-based training

Since COVID-19 was declared as a global pandemic, the major focus of healthcare organizations shifted toward preparing healthcare systems to handle the inevitable COVID-19 burden at different phases and levels. According to the CDC guidelines, one of the major aspects of infection control and prevention is training and educating the healthcare team members. Several instructional modalities are currently being utilized such as protocol dissemination, presentations, and online modules. Over the past decade, simulation has emerged as a practical and timely tool to achieve predetermined levels competencies at either level of knowledge, skills, and/or attitudes in a highly authentic setting. In addition, it is a modality that can be easily tailored to improve the healthcare system; from individual capacity building to process and system testing while identifying system latent safety threats and improving team behaviors.

During the past epidemics, simulation was successfully utilized for healthcare systems and professionals preparation. For example, simulation-based training (SBT) identified serious gaps in safety protocols at hospitals deemed ready for Ebola management. Following the era of SARS, simulation-based airway management and cardiac arrest training programs were widely adopted to improve hard and soft skills of healthcare providers involved in care of patients with highly contagious diseases.

Currently, national and international healthcare institutions are sharing and regularly updating their simulation-based experiences. In addition, variable simulation governing bodies are providing frequently updated lists of simulation resources. The most popular and heavily utilized example is the Toronto simulation-based multidisciplinary scenario created by the emergency department for the management of suspected COVID-19 case presenting with respiratory distress. The Prince of Wales Hospital (affiliated with Chinese University of Hong Kong) conducted an in situ simulation at the intensive care units and operating theaters to familiarize their employees with the principles of airway management in suspected or confirmed COVID-19 infections.
A Case Study for Simulation Preparedness Plan

The MNGHA has an established infection control program in place “Right Care, Right Now,” in addition to a series of updated guidelines and pathways for managing patients with suspected or confirmed communicable disease. COVID-19-specific protocols and guidelines are regularly being updated and disseminated to all employees.

In addition to a large simulation laboratory in the university, the Intensive Care Department at MNGHA has a three-room simulation laboratory with a control room, which is fully equipped by high fidelity mannequins and audio-visual equipment. The “point-of-care” laboratory enables early access to train residents, nurses, and respiratory therapist without significant impact of daily workflow.

Our simulation team identified some of the potential applications of SBT in the setting of COVID-19 preparation plan. These areas include infection control precautions, bed-side skills modification, team and resource management, and system latent safety threat identification. An example of each domain is provided in Table 1.

We designed two simulation-based scenarios, based on our assessment of the biggest performance gap. The objectives of each covered two or more of the domains mentioned above. In our first multidisciplinary session, we focused on proper handling and management of newly presenting suspected COVID-19 case. This session basically addressed the entire patient flow experience, from the minute of emergency room presentation to the moment of securing a compromised airway in a negative pressure room. The second project was a series of multidisciplinary sessions tackling the appropriate use of specialized portable negative pressure chamber for transporting suspected/confirmed COVID-19 patients within and between healthcare institutions [Figure 1]. The trainees were allowed to deliberately practice until a minimum level of competency was achieved, resulting in high degree of satisfaction and improved confidence. Worth mentioning, these sessions received an encouraging feedback nationally and internationally upon social media dissemination through the hospital’s formal accounts. Multiple requests were received to deliver these sessions at different departments and institutes. We are currently working on building SBT scenario

| Application | Examples |
|-------------|----------|
| Infection control precautions | Screening and triage.  
Downing and doffing.  
Proper use of Personal Protective Equipment (PPE) e.g., N95 mask, PAPR etc.  
Safe patient transportation within or between health care institutions. |
| COVID-19 patients safe management skills | Airway management: Deliberate practice of airway management skills in order to minimise number of intubation attempts, avoidance of aerosol generating procedures, use of paralytics to prevent cough; use of filters, close circuits and disposable instruments.  
Cardiopulmonary resuscitation: Early chemical and mechanical cardioversion to minimise the progression to chest compressions.  
Invasive procedures: Performed at single session if possible, under ultrasound guidance.  
Point of care ultrasound: To reduce the need for alternative radiological testing (confirming ET tube placement, assess cardiac function and screen for lung pathologies such as effusion and pneumothorax)  
Sever ARDS salvage treatment: prone positioning and ECMO (As an increased need is anticipated) |
| Crisis resource management | Clear communication of the patient COVID-19 status  
Minimizing number of respondents during codes  
Most experienced personnel to perfume the required procedure to minimise aerosolization and time of contact. |
| Protocols piloting and system latent threat identification | Patients allocation  
Patients in hospital flow |

Figure 1: Isopod transportation simulation-based training session
### Table 2: Multidisciplinary Simulation-Based Scenario

| Title | Suspected COVID-19 in Respiratory and Cardiac Arrest |
|-------|------------------------------------------------------|
| **Target Audience** | ICU/ER medical, nursing and respiratory care staff. Code Blue Team |
| **Learning Objectives** | Appropriate PPE use  
Correct choice of N95 mask  
Correct sequence of donning PPE  
Correct use of non-permeable gown  
Appropriate airway management and precautions of COVIS-19 patient  
RSI maneuver  
Avoid bagging as possible  
Use of video assisted devices  
Use Muscle relaxant  
Minimize air leaks (inflate balloon before bagging, tube extension use, tube clamp)  
CPR management of COVID-19 patient  
ACLS  
Two hand technique during Ambu-bagging  
Early ETT intubation  
No chest compression during intubation  
Avoid open suction |
| **Environment** | Simulation lab set up as an ICU room.  
Mannequin setup: Sim Man 3G.  
Medications: labeled syringes Epinephrine, Succinylcholine, Cisatracurium, Midazolam, Fentanyl, and Propofol; various IV fluids for boluses.  
Instruments: Oxygen therapy (simple face mask, non-rebreather mask, Ambu-bag with appropriate mask). Basic airway management (OPA, adult laryngoscope handle, size 3and 4 curved blades, LMA size 3 and 4, ETT cuffed size 7 and 7.5, suction) |
| **Case Narrative** | HPI: a 65-year-old COVID-19 suspected male. Your called because the patient in PEA arrest. Initial vital signs: HR 115, BP undetectable, RR 5, Sat 60%.  
Past medical history: DM, HTN.  
Allergies and medications: NKDA; Amlodipine 10 mg QD, Metformin daily 500 mg BID  
Family/social history: never smoked, no drugs.  
Scenario conditions initially  
History from primary nurse: patient with travel history to Europe, admitted with CAP pending results of COVID-19. He was stable hemodynamiclly on 2l/min nasal cannula. Few minutes ago, he started complaining of worsening SOB and became unconscious.  
Patient initial exam:  
Ill looking, cyanosed, unconscious with agonal breathing. Absent peripheral and carotid pulse.  
Patient’s physiology: initial vitals as above. Patient is in PEA arrest  
Scenario map  
After proper PPE use, ACLS protocol applied with focus on two hand face mask technique with other person doing the bagging. Epinephrine and chest compression as usual. After completion of 1 cycle, ROSC is achieved.  
Patient BP and Saturation is 86%, HR 105, BP 112/58, RR 10, GCS 5.  
Intubation decision should be made.  
RSI is ideal to minimize apnea time and bagging, Glidescope should be done for intubation. If no muscle relaxant used then the patient will cough.  
Corrugated tube extension with HEPA filter and Co2 detector ready to be connected.  
Once intubated, the Ambu-bag connected to the extension tubing and to the ETT. |
| **Debriefing Plan** | A. Method of debriefing: group debriefing of all participants/spectators.  
B. Debriefing handout: will be emailed after the session for attendees.  
C. Questions to facilitate the debriefing  
What was done right? What actions were done decisively and in a timely manner?  
What errors were made? Were any critical actions missed?  
What suggestions are there for improvement?  
Where are the risks of infection during CPR?  
What are the important points to consider during intubation?  
Any particular technical changes needed for the circuit preparations? |
bank to address additional aspects and areas with perceived gap. As an example, Table 2 shows a simulated scenario for managing a suspected/confirmed COVID-19 case with respiratory and cardiac arrest.

**Our Recommendations**

“Once you’re in the midst of a severe pandemic, your options are very limited. The greatest good can happen with pre-planning.”

– Eric Toner, Senior Scholar, Johns Hopkins Center for Health Security.

Up to the moment this document was written, our region remains relatively less affected by the global pandemic compared to other countries, which leaves us with a great opportunity to educate our healthcare teams and identify the gaps in our protocols and algorithms to bridge them in a timely matter. SBT is an educational design that is feasible and adaptable to the dynamic policy changes at institutional or national levels. For example, personal protective equipment utilization during training sessions was modified to respect the current global shortage. The number of participants was kept to minimal each session in compliance with the crowd management policy. Moreover, multiple simulation modalities and techniques can be utilized to design a simulation experience that is tailored according to time available, resources, educational objectives, and targeted stakeholders.

SBT does not necessarily require investments of money and technology to succeed. Basic training can be accomplished with the resources already present. When utilized and applied properly, even these basic training sessions can have a significant impact on the learners and the institution in which they are applied.

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There are no conflicts of interest.