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ORIGINAL RESEARCH

Preparing anaesthesiologists to safely care for patients with COVID-19: an observational study of a simulation course

Appendix 1

High fidelity simulation training for airway management in known or suspected COVID-19 patients

Summary: In response to the potential need for anaesthesia providers to care for patients with known or suspected COVID-19, a high-fidelity simulation course was developed that introduces basic elements of using personal protective equipment, anaesthesia machine preparation and cleaning, and important elements of intraoperative and out of OR airway management. The training focuses on optimising patient care and clinician safety.

Course overview:

- **Duration:** 2–2.5 hours
- **Format:** Four stations
- **Group size:** 5–7 trainees per group
- **Required personnel:** Four instructors, two simulation technicians, one administrator.
- **Recommended audience:** All hospital care providers that may called upon to provide airway management with a known or suspected COVID-19. This includes clinicians at all levels (faculty, fellows, residents of those specialties expected to provide airway management, CRNA's, anaesthesia technicians).
- **Participant advisories:** While not engaged in simulations, **participants and those waiting are encouraged to maintain a 6-foot distance and practice frequent hand hygiene**.

Definitions:

BMV:	Bag mask valve
CAPR:	Controlled air purifying respirator
CDC:	Centers for Disease Control and Prevention
COVID-19:	Coronavirus Disease 2019
DA:	Difficult airway
ETT:	Endotracheal tube
GVL:	GlideScope® videolaryngoscope
HFNC:	High flow nasal cannula O2
LMA:	Laryngeal mask airway
NIPPV:	Noninvasive positive-pressure ventilation
PAPR:	Powered air purifying respirator
PPE:	Personal protective equipment
PPV:	Positive pressure ventilation

Station #1: COVID-19 personnel protective equipment

Teaching points

1. Proper donning, doffing, and disposing of PPE.
2. Review of COVID-19 methods of virus transmission and how to prevent it.

Personnel: Instructor, infection control specialist if available

Equipment: Two sets of PPE are used in this station, one for PAPR and one for N95.

PAPR: PAPR hood and belt, shoe covers, gown, gloves, approved disposable cleaning wipes.

N95 masks: N95 masks, gowns, hats, gloves, shoe covers, eye protection.

Other equipment: Anaesthesia PPE donning and doffing infographic.pdf, laminated; PPE equipment table; hand sanitiser.

Location: Simulated or actual patient room. PPE equipment table outside the patient room. Signage on door.

Duration: 30 minutes

Opening

- Welcome
- Please use appropriate social distancing
- Although the primary method of transmission is droplet, there may be aerosolisation during intubation, extubation, non-invasive ventilation, bag-mask, ventilation, bronchoscopy, nebulisations, HFNC. Hence, we are training to airborne precautions.

Donning PPE

Invite one member of the group to complete the following steps while the rest of the group observes.

1. With the possibility of aerosolisation, don shoe covers.
2. Wash hands or hand sanitiser.
3. Put on gloves.

4. Clean PAPR (Sani-Wipe to hood and belt). Start with inside of screen. Move to outside screen and hood. Move to air tube and belt.
5. Discard gloves, perform hand hygiene.
6. Connect PAPR hose to hood and belt.
7. Turn on PAPR by pressing and holding small button.
8. Don PAPR hood and belt.
   i. Drape hood and tube over shoulder, hood at the front.
   ii. Fasten belt around waist.
   iii. Put PAPR hood on.
9. Don gown (over PAPR belt and air tube).
10. Don gloves (double glove if performing airway management).
11. PPE timeout with a colleague or infection control specialist.
12. Enter room.

Before leaving the room

1. Remove outer gloves.
2. If using airway equipment, place non disposable airway equipment in one of outside gloves. Place equipment in small garbage bag.
3. Use Sani-Wipe to wipe down outside face shield on hood and hood.
4. Remove gown and gloves.
5. Discard gown and gloves, placing below the rim of the garbage can.
6. Hand hygiene.
7. New gloves.
8. Leave room.
9. Remove hood from front to back and belt, holding contaminated PAPR away from your body.
10. Remove shoe covers.
11. Remove gloves.
12. Wash hands.
13. Done!

Key points to review

- PAPRs are reusable. N95s are single-use.
- Powered air purifying respirator (PAPR)/Controlled Air purifying respirator (CAPR) preferred over N95 as N95 are disposable and will need to be preserved for time-sensitive situations, such as responding to a code.
- CAPRs are available at the MICUs
- Do it with a partner – to check donning PPE correctly.
- Exercise safety.
- Talk through the steps of PPE (modified PPE sheet).
- PPE for care of all patients with known or suspected COVID-19.
- Discard outer gloves if torn or contaminated, may use hand sanitiser on gloves up to 20 times and re-glove.

Images of PAPR, CAPR, and N95

Powered, air purifying respirator	Controlled air purifying respirator	N95 face mask

Review types of PDI Sani-Cloth® (source: https://pdihc.com/products/environment-of-care/sani-cloth-bleach-germicidal-disposable-wipe/. Accessed 22 Mar 2020).

Any of them kills the virus.

Orange

Name: Sani-Cloth® Bleach

Requires four minutes to work.

Notes: Can cloud face mask.

Active ingredient: 1:10 dilution of 6300 PPM sodium hypochlorite (Bleach).

Grey

Name: Sani-Cloth® AF3

Requires three minutes to work.

Active ingredient: Alcohol-free quaternary ammonium.

Purple

Name: Super Sani-Cloth®

Requires two minutes to work.

Active ingredient: Quaternary ammonium and isopropyl alcohol (IPA).

Station #2: COVID-19 machine turnover

Teaching points

1. Review of proper technique in cleaning and preparing an anaesthesia machine once it has been exposed to a COVID-19 patient. Not necessary for otherwise healthy patients.
2. Review proper airway filters to be used in this patient group.

Personnel: Instructor

Equipment: Anaesthesia machine, circuit, suction canister & tubing, Sani-Cloths

Location: Space to engage group with an anaesthesia machine.

Duration: 30 minutes

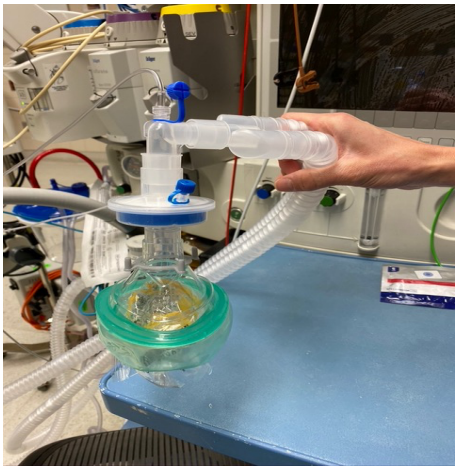
Opening

The station is set up to start after you have been assigned an OR case for a COVID-19 patient.

Anaesthesia machine set-up and operating room personnel management when caring for a patient with known or suspected COVID-19:

1. Anaesthesia machine preparation steps

I. Place the circuit filter on the PATIENT side of the circuit elbow.



II. Consider a second filter on the expiratory connector as a backup if the patient side filter becomes disconnected with it being noticed.

III. Preferably HEPA, but HME ok too (machine protection).

IV. Perform leak test.

V. Have second filter immediately attached to ETT tube/mask.

VI. Ensure suction (yankauer), tubing to canister, tubing from canister to wall suction source, and canister are clean.

VII. Confirm suction uses a closed system (vents to outside of the hospital, not to the internal environment as portable suction systems do, AND no need to disconnect ventilator circuit to suction).

2. Patient transport to the operating room

I. Conduct all possible elements of the preoperative evaluation before seeing the patient (review EMR, talk to other providers, write note, etc.).

II. Don appropriate PPE with airway buddy.

III. Phone, keys, etc. should NOT be on you when you are in PPE

IV. PPE timeout.

V. Enter patient room (you are now contaminated and will stay with patient).

VI. Examine patient, consent, etc.

VIII. Pt transport:

a. Two anaesthesia care providers will transport the patient in full PPE gear.

b. A "clean person" will accompany transport to touch buttons (elevator) open doors, etc.

c. Patient will be transported wearing a simple surgical mask.

3. Operating room personnel management during airway management

I. The anaesthesia cart is to remain outside the operating room.

II. Minimalist approach: only bring items into the room that are known to be necessary (e.g. no difficult airway carts in the room).

III. Prepare only that equipment needed for airway management to take into the room. Once in room it will be considered contaminated.

IV. Use disposable equipment wherever possible (like the portable GVLs).

V. Airway management should be performed by the most experienced provider with one designated assistant. All other providers (resident, scrub, circulator, surgeon) should leave the room. One provider is assigned to watch the intubation through the window and respond if the intubating team needs equipment or assistance.

VI. Aerosolisation is most likely to occur with airway procedures, PPV, coughing, and suctioning (if not inline suction).

VII. NO PPV unless an ETT is in place with the cuff inflated. The exception is in an unanticipated difficult airway: LMA and BMV may be used to try to avoid cricothyrotomy.

VIII. One/two anaesthesia providers, also in PPE, will remain outside the operating room door with the anaesthesia cart to provide additional items as needed.

4. Extubation

I. All OR personnel other than the airway management team should leave room prior to extubation.

II. Turn off the ventilator prior to disconnecting the circuit.

III. Use caution with suctioning as it can cause aerosolisation.

IV. Adjust anaesthetic technique to minimise coughing/bucking of the patient.

V. Extubate the patient with the HME or HEPA filter in place on the end of the ETT.

VI. Consider second filter in place on anaesthesia mask for immediate placement over patient's nose and mouth after extubation.

VII. Remain in the room until the patient is absolutely stable for transport – not requiring any airway intervention.

VIII. Consider safe way to administer supplemental oxygen – best technique is a nasal cannula with surgical face mask over the mouth and nose. Simple oxygen mask is not as effective at minimising exposure unless a surgical mask is placed underneath.

IX. While patient is in immediate recovery phase in the OR, dispose of all equipment off anaesthesia machine.

a. Circuit, gas sample line, water trap, suction with ALL disposable tubing & suction canister.

b. Turn down all gas flows.

5. Transfer patient

I. As above – two contaminated anaesthesia providers in PPE with one clean person to manage doors and elevators.

II. Give report.

III. Doff PPE .

6. Cleaning the anaesthesia machine

I. Before cleaning the anaesthesia machine, the operating room air will undergo one hour of HEPA filtration followed by regular room cleaning.

II. Anaesthesia machine cleaning and set it up.

a. Those cleaning and setting up the anaesthesia machine must be in droplet precautions (surgical mask, gown, gloves, glasses).

b. PAPR/N95 not required.

c. Wipe down machine – make sure to wipe everything – knobs, vaporisers, drawers.

d. Anything that was in the room with the prior patient is considered contaminated and must be cleaned or thrown away.

e. Wipe down patient monitor cables, computer, etc.

f. After cleaned – doff PPE, hand sanitise.

Important considerations

- If patient is already intubated – best thing is to take the patient attached to the ICU vent, and keep them on that throughout the surgery. Use TIVA.
- If the patient requires higher level O2 delivery (high flow nasal cannula, CPAP, bipap) likely safest to intubate in ICU and bring to OR intubated.
- We are also to inform everyone to avoid placing COVID-19 patients on CPAP or BIPAP, we are to consider early intubation or delayed extubation instead. If you are concerned a patient will not be able to be extubated to low flow O2, keep intubated.
- In-line suction devices are on order and should be used over Yankauer or flexible suction catheters. An example of an in-line suction catheter is presented below.

Station #3: COVID-19 airway simulation

Teaching points

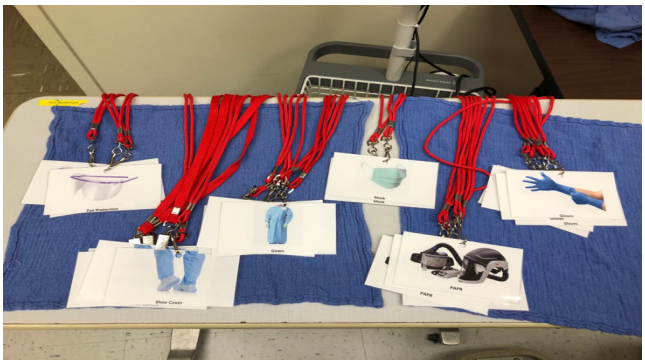
- Time out prior to procedure, use checklists.
- N95 or PAPR for aerosolising procedures (intubation, NIPPV, bronchoscopy, open tracheal suctioning, OR cases).
- Participants should select appropriate PPE in the correct donning order from the selection of lanyards; participants should doff PPE in the correct order and with hand hygiene at appropriate points at the end of the simulation.
- Avoid NIPPV, BMV, and LMA unless faced with an unanticipated difficult airway.
- Elevate HOB during preoxygenation.
- Most experienced provider (anaesthesia attending) & one assistant in room; designate another provider to watch through doorway to respond to call for help.
- Use disposable difficult airway equipment.
- Avoid bringing routine equipment or the DA cart into proximity of patients with known or suspected COVID-19.
- When to involve other providers (all personnel will be asked to leave the room during airway management except the anaesthesia attending).
- Placement of filter on end of ETT, expiratory limb of circuit.
- Review special airway precautions when managing patients with a known or suspected difficult airway in COVID-19 patients.
- Consider avoiding use of aerosol-generating procedures, including high-flow nasal oxygen, non-invasive ventilation, bronchoscopy and tracheal suction unless an in-line suction system is in place.

Location: Location that accommodates space for a high-fidelity manikin based simulation and debriefing room.

Personnel: Instructor, simulation technician engineer, simulation education specialist

Duration: 30 minutes (10 minute pre-briefing, 10 minute simulation, 10 minute debriefing)

Equipment:
Anaesthesia machine
Miller & Mac blades
7.0, 7.5 ETTs
Oropharyngeal airways, 90 mm and 100 mm
Tongue depressors
Fentanyl
Lidocaine
Propofol
Succhinylcholine
Rocuronium
Ephedrine
Phenylephrine
Sugammadex
LMA #4 and #5
Videolaryngoscope (King?)
Cricothyrotomy kit
Hand sanitiser
Laminated labels on lanyards: gloves, mask, eye protection, gown, PAPR, N95, shoe protection. See example below.



Scenario overview

Patient: 40-year-old female with an open tibia-fibula fracture and 3 day history of cough and shortness of breath.

Setting: Operating room

Critical events:

Scenario #1: OR preparation and airway management of suspected COVID-19 patient requiring urgent surgery.

Scenario #2: OR preparation and airway management of suspected COVID-19 patient requiring urgent surgery; patient found to have an unanticipated difficult airway.

Scenario 1: 40-year-old female with a 3-day history of nonproductive cough and fever presenting to the OR with an open tibia-fibula fracture.

Pre-briefing scenario 1:

- Room orientation
  - Anaesthesia machine (not yet prepped for COVID-19 patient)
  - Anaesthesia cart, outside the room
  - Disposable Mac and Miller blades
  - Oropharyngeal airways, tongue depressor
  - Videolaryngoscope, LMA, bougie, surgical airway kit
  - Simulated medication syringes
  - Suction
  - Mannequin pulses, breath sounds
  - Blue mouth with hypoxia
- Role assignments
  - Airway lead (in room)
  - Airway assistant (in room)
  - Cart assistant (at the door, available to supply needed equipment from anaesthesia cart)
- PPE lanyards
  - Don lanyards representing PPE choices in the order in which you would apply PPE
- COVID-19 POAM U of Utah Mar 2020.pdf **airway** infographic
  - Patient safety is a higher priority than prevention of aerosolisation if wearing airborne PPE
  - Personnel in room for aerosolising procedures
  - Limit equipment in room for aerosolising procedures
  - Limit BMV
  - Elevate HOB during preoxygenation
  - Ensure neuromuscular paralysis prior to intubation
  - Most experienced provider performs airway management
  - Disposable videolaryngoscope for initial attempt
  - HEPA filter on anaesthesia mask or end of ETT when applied to patient
  - Anaesthesia - **OR precautions.pdf** infographic

Stem: 40-year-old female with a 3-day history of nonproductive cough and fever presenting to the OR with an open tibia-fibula fracture. Unremarkable PMH otherwise. NKDA. Negative HCG. Mall 2, full neck flexion/extension, mouth opening and thyromental distance > 6 cm. Please set up the OR as though the patient was not yet in the OR; after you have set up your OR, organised your airway team, and donned PPE, the patient will arrive in the OR.

Time	Simulator state	Trigger to move to next state
T0	Oriented, talking. 130/80, 110, RR 20, SpO2 98% on RA (100% with preoxygenation)	Induction of anaesthesia

T1: After induction	Eyes closed, unresponsive. 110/60, 100, RR 0, SpO2 100 Easy to intubate or BMV	None

Debriefing scenario #1:

- Review OR preparation
  - HEPA filter on expiratory limb of circuit AND distal to Y-piece and EtCO2 sampling line
  - Only needed equipment brought into OR
- Airway management
  - Airborne PPE
  - Most experienced provider
  - Only two providers in room
  - Clean assistant outside room with additional supplies
  - RSI, ensure paralysis
  - Disposable videolaryngoscope as first look
  - Extubation procedures
    - Airborne PPE
    - Only two providers in room
    - Anaesthetic technique to minimise coughing
    - Extubate with filter on ETT
    - Anaesthesia mask with seal & filter in place immediately
    - Recover patient in OR through Phase 1
- Doffing procedures

Scenario 2: 40-year-old female with a 3-day history of nonproductive cough and fever presenting to the OR with an open tibia-fibula fracture. After induction, patient is found to have an unanticipated difficult airway. No airway interventions will be successful and the patient will require a cricothyrotomy.

Prebriefing scenario #2:

- Change role assignments
- Same patient

Stem: 40-year-old female with a 3-day history of nonproductive cough and fever presenting to the OR with an open tibia-fibula fracture. Unremarkable PMH otherwise. NKDA. Negative HCG. Mall 2, full neck flexion/extension, mouth opening and thyromental distance > 6 cm. Please set up the OR as though the patient was not yet in the OR; after you have set up your OR, organised your airway team, and donned PPE, the patient will arrive in the OR.

Time	Simulator state	Trigger to move to next state
T0	Oriented, talking. 130/80, 110, RR 20, SpO2 98% on RA (100% with preoxygenation)	Induction of anaesthesia
T1: After induction	Eyes closed, unresponsive. 110/60, 100, RR 0, SpO2 100 Unable to intubate; able to BMV with difficulty	3 minutes
T1 + 3 minutes	SpO2 decreases to 90%, then falls to 60% over 1 minute	Surgical airway
T2: After surgical airway	SpO2 increases to 98% with establishment of surgical airway; normal PIP	

Before ending the scenario, ask participants to "doff" their lanyards, simulating the doffing steps.

Debriefing scenario #2:

- Patient safety is a higher priority than prevention of aerosolisation if wearing airborne PPE.
  - Follow Difficult Airway Algorithm 2013: BMV, LMA, cricothyrotomy
- Review surgical airway technique

Station #4: COVID-19 out of OR airway management

Teaching points

1. Review of proper technique for preparing for emergent airway management outside the operating room for a patient with known or suspected COVID-19.
2. Review changes in ACLS in patients with known or suspect COVID-19: Hold chest compression until airway is sealed either with tight-fitting facemask with two hand technique and HEPA filter or placement of an ETT with the cuff inflated and HEPA filter attached to the end of the ETT.

Personnel: Instructor

Equipment: Emergency airway box

Drugs appropriate to emergency airway box

Videolaryngoscope with disposable blades

Laminated labels on lanyards: gloves, mask, eye protection, gown, PAPR, N95 masks, shoe protection

Defibrillator

Crash cart

Location: Location that accommodates space for a high-fidelity manikin based simulation and debriefing room.

Duration: 30 minutes

Scenario overview

Patient: 52-year-old male who requires emergent intubation on the floor

Setting: Hospital floor bed. Patient is wearing a nasal cannula. On arrival, the patient was complaining of shortness of breath and anxiety.

Critical events:

Scenario #1: Lower respiratory compromise with hypoxia, treated with endotracheal intubation

Scenario #2: Lower respiratory compromise with hypoxia followed by unstable ventricular tachycardia

Pt name: George Crown

Detailed scenario overview (For sim team eyes only):

1. *Patient description:* A 52-year-old male admitted to the medicine floor yesterday from the ED for dyspnea, fever, and borderline low oxygen haemoglobin levels. Recently tested positive for COVID-19. He has a history of hypertension, type II diabetes, and COPD. Upon admission to the floor, he was treated with supplemental oxygen (nasal cannula), antipyretics, and bronchodilators. It is 2 AM and the on-call anaesthesiologist is called to the patient's bedside for emergent airway management.
2. *Course of events:*

a. ED presentation:

I. The patient is a faculty member in the Department of Bioinformatics at the University of Utah. He recently attended a family funeral in San Francisco, California. Five days ago, he returned to Utah.

II. Yesterday, the patient presented to the ED with a 2-day history of dyspnea and a recent fever. The patient has a history of exertional and cold weather asthma and thought that it was an asthma exacerbation and self-treated with albuterol. Despite breathing treatments, his symptoms worsened.

III. In the ED, his haemoglobin oxygen saturation is 89% on room air, his temperature is 38.2 °C, and his other vital signs (including respiratory rate) were unremarkable. He complained of feeling short of breath. Given his presenting symptoms and travel history, he was suspected to have been exposed to COVID-19. He is admitted to the medicine floor for observation and COVID-19 testing.

IV. His COVID-19 blood test returned positive .

V. His medications include supplemental oxygen via nasal cannula (3 L/min), metformin, and albuterol.

b. Background:

I. His hospital course has been uneventful until now.

II. CXR on admission (earlier the day before) revealed perihilar infiltrates (see film).

III. Blood sugars have been well managed (120–150s mg/dL).

c. Baseline:

I. He is awake, tachypneic (respiratory rate of 30 breaths per minute), recruiting accessory muscles, anxious, and cyanotic appearing.

II. He is wearing a nasal cannula.

III. Vital signs: SpO2 = 73%, BP = 165/90, HR = 110, ECG: sinus tachycardia.

IV. The proctor will explain that the patient is using accessory muscles to breaths. The patient is struggling to breath.

V. The patient (manikin) should say, I feel nervous. I am not getting enough air.

VI. Lung compliance is low and airway resistance is mildly elevated.

PREBRIEFING – Location: North debriefing room (5 minutes)

Pre-briefing scenario #1:

- Room orientation
  - Monitor
  - Cables
  - Emergency airway box
  - Oxygen source
  - Room suction
  - Pulses
  - Blue mouth with hypoxia
- Role assignments
  - Lead (in room)
  - Designated assistant (in room)
  - Designated doorway assistant
  - Cognitive aid support (in room)
- PPE kits (demonstrate N95 bag)
  - Please return unused N95 masks.
  - Use HEPA filter – always use.
  - Keep bag outside of patient room, only use what you need.
  - Use garbage bag for dirty gear.
- Emergency airway box available – not to be brought in the room.
- Review COVID-19 Airway Management Infographic and red text boxes.
  - When responding to airway management requests in known or suspected COVID-19 patients, wear appropriate PPE.
  - Patient safety is of higher priority than prevention of aerosolisation during airway management if wearing appropriate PPE.
  - Avoid mask ventilation if possible.
  - Consider videolaryngoscope with disposable blade.
  - Avoid NIPPV in favour of early intubation.
  - Most experienced provider to perform intubation.
  - Perform an airway timeout, assign roles and establish plan prior to securing airway.
  - Only anaesthesiology attending and one other designee in the room.
  - Designate a person to stand in the doorway to obtain additional supplies if necessary during the intubation.
  - Other care providers can enter the room once the airway has been secured.
  - Apply the portable HEPA filter to endotracheal tube.

- If disconnection from the endotracheal tube is necessary, hold ventilation and keep the HEPA filter on the endotracheal tube.

- Ask lead participant to read the stem to the rest of the group.
- Ask the airway assistant designee to review the CXR, ECG, and ABG.
- Ask the cognitive aid specialist to review the first row of the COVID-19 airway algorithm.

Stem:

1. This is a 52-year-old male who is a faculty member in the Department of Bioinformatics at the University of Utah. He recently attended a family funeral in San Francisco, California. Five days ago, he returned to Utah.
2. Yesterday, the patient presented to the ED with a 2-day history of dyspnea and a recent fever. The patient has a history of exertional and cold weather asthma and thought that it was an asthma exacerbation and self-treated with albuterol. Despite breathing treatments, his symptoms worsened.
3. Yesterday, in the ED, his haemoglobin oxygen saturation was 89% on room air, his temperature was 38.2 °C, and his other vital signs (including respiratory rate) were unremarkable. He complained of feeling short of breath. Given his presenting symptoms and travel history, he was suspected to have been exposed to COVID-19. He was admitted to the medicine floor for observation and COVID-19 testing.
4. Yesterday evening, his COVID-19 blood test returned positive.
5. His current medications on the floor include supplemental oxygen via nasal cannula (3 L/min), metformin, and albuterol.
6. You have been called to his room for possible airway management.

Handouts

1. Scenario stem (as above)
2. Px CXR, ABG, and ECG
   a. Admission CXR shows extensive bilateral infiltrates.
   b. ABG shows respiratory acidosis with a pH of 7.05, PCO2 of 69, and a pO2 of 48.
   c. ECG shows sinus tachycardia.
3. COVID-19 airway handout

SCENARIO – Location: Pt floor (study room)

Proctor reminders:

- Stand near foot of bed and provide commentary should events occur that are not well simulated (for example: I suctioned the ETT. Describe what was found when suctioning).
- Confirm or correct breath sound findings if participants auscultate.
- Confirm or correct pulse palpation findings if participants assess pulses.
- Consider consulting with the sim tech if the scenario is stalled.

Scenario #1

Sim states (as described above)

- Baseline:
  - He is awake, tachypneic (respiratory rate of 30 breaths per minute), anxious, and weak. He is wearing a nasal cannula.
  - Vital signs: SpO2 = 73%, BP = 165/90, HR = 110, ECG: sinus tachycardia.
  - The patient (manikin) should say, I feel nervous. I am not getting enough air.
  - Lung compliance is low and airway resistance is mildly elevated.
- Start, Stage 1:
  - Anaesthesiologist is called to the floor for low oxygen haemoglobin saturation (SpO2 = 73%).
  - The proctor will explain that the patient is using accessory muscles to breaths.
  - The patient is struggling to breath.
  - Patient is awake, anxious, and tachypneic.
  - After 5 minutes, the scenario proctor will prompt to intubate.
- Stage 2 (Trigger – treatment of hypoxia):
  - If nasal cannula remains, SpO2 = 73%, RR = 30, awake anxious, patient is blue.
  - If the nasal cannula is replaced with face mask oxygen, SpO2 will improve to 78%, RR = 30, awake anxious, patient is blue.
  - If tracheal intubation, SpO2 will improve to 95%, RR = as ventilated. Asleep (if induction drugs used – etomidate and sux).
  - If <u>NOT,</u> intubated, the patient (manikin) should continue to say "I feel nervous" & "I am not getting enough air".
- End (Trigger – treatment of hypoxia with endotracheal intubation)
- Px Disposition:
  - Pharmacy representative available: Need sedation? Need NMB? Need analgesics? Need vasoactive drugs? How to optimise for transport.
  - Guidance for respiratory therapy (circuit filter placement as filter on the end of the ETT is not compatible with ventilatory circuit because of suction catheter).
  - Travel guidelines for PPE.
  - Proper PPE doff.

Debriefing scenario #1

1. Review preparation for out of OR airway management.
   a. Prepare needed airway equipment outside the patient room.
   b. Leave all unused equipment outside the patient room.
   c. Don PPE, perform PPE checklist.
   d. Assign airway lead, assistant, and door designee. All to be in PPE.
   e. Enter room, interview and examine patient.
   f. Prepare for airway management. Consider using SOAPMM note (Suction, oxygen source, airway equipment, positive pressure capability, medication, monitors).
   g. Administer paralytic before instrumenting airway (OPA, NPA, ETT) to minimise cough.
   h. Formulate plan for sedation after intubation.
   i. Proper doff.

Pre-briefing scenario #2:

1. Equipment orientation
   a. Crash cart, defibrillator, cable, and pads
   b. Where to attach defibrillator on manikin
2. Review changes to ACLS with cardiac arrest
   a. Airway managed before chest compression with either tight-fitting mask or ETT.
   b. Administer paralytic before instrumenting airway (OPA, NPA, ETT) to minimise cough.

Scenario #2

Sim states (as described above).

- Baseline:
  - He is awake, tachypneic (respiratory rate of 30 breaths per minute), anxious, and weak. He is wearing a nasal cannula.
  - Vital signs: SpO2 = 73%, BP = 165/90, HR = 110, ECG: sinus tachycardia.
  - The patient (manikin) should say, I feel nervous. I am not getting enough air.
  - Lung compliance is low and airway resistance is mildly elevated.
- Start, Stage 1:
  - Anaesthesiologist is called to the floor for low oxygen haemoglobin saturation (SpO2 = 73%).
  - The proctor will explain that the patient is using accessory muscles to breaths.
  - The patient is struggling to breath.
  - Patient is awake, anxious, and tachypneic.
  - After 5 minutes, the scenario proctor will prompt to intubate.
- Stage 2 (Trigger – treatment of hypoxia):
  - If nasal cannula remains, SpO2 = 73%, RR = 30, awake anxious, patient is blue.
  - If the nasal cannula is replaced with face mask oxygen, SpO2 will improve to 78%, RR = 30, awake anxious, patient is blue.
  - If BIPAP or effective BMV, SpO2 will improve to 85%. RR = 30, awake anxious, patient is blue.
  - If tracheal intubation, SpO2 will improve to 95%, RR = as ventilated. Asleep (if induction drugs used – etomidate and sux).
  - If NOT, intubated, the patient (manikin) should continue to say "I feel nervous" & "I am not getting enough air".
- Stage 3 (Trigger – call for induction drugs):
  - Tachycardia increases 2 minutes – unresponsive to any therapy:
    - RR = 30.
    - HR will change to 140 beats per minute and blood pressure will decrease to 50/30 over 1 min.
  - Unstable V-Tach phase:
    - HR 155
    - Weak pulses
    - Blood pressure as above
    - No oxygen saturation
    - Treatment
      - Manage airway with BMV (two hand tight fit) or ETT before chest compressions
      - Chest compressions
      - Blood pressure and heart rate will change to 170/100 and 110 after cardioversion times 2 and 2 pharmacologic interventions (any of the following will count: epinephrine 1 mg, amiodarone)
    - After 5 minutes, the scenario proctor will prompt to perform ACLS with cardioversion and administer two vasoactive medications
- End (Trigger – treatment of unstable ventricular tachycardia with cardioversion and two vasoactive medications)
- Px disposition:
  - Pharmacy representative available: Need sedation? Need NMB? Need analgesics? Need vasoactive drugs? How to optimise for transport.
  - Travel guidelines for PPE.
  - Proper PPE doff.

Debriefing scenario #2

3. Review key changes in ACLS –
   a. NO chest compressions until a two-handed mask seal is in place.
   b. Chest compressions should pause for intubation by an anaesthesia attending.
   c. Consider early intubation to protect staff.

Documents:

Anaesthesia PPE donning and doffing infographic.pdf – modified from CDC donning/doffing infographic at https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirator-use-faq.html. Accessed 30 Mar 2020.

COVID-19 POAM U of Utah Mar 2020.pdf – modified from https://www.aic.cuhk.edu.hk/covid19/. Accessed 30 Mar 2020.

Anaesthesia – OR Precautions infographic.pdf

Appendix 2

COVID-19 simulation evaluation

Thank you for participating in this anonymous evaluation of the Department of Anesthesiology COVID-19 simulation sessions. This short survey will help use evaluate the efficacy of our education efforts. Direct questions or concerns to Elizabeth. thackeray@hsc.utah.edu.

1. Prior to the COVID-19 simulation sessions, I knew the type of personal protective equipment needed for caring for COVID-19 patients.
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
2. After the simulation sessions, I know the type of personal protective equipment needed for intubating and extubating COVID-19 patients.
   a. Droplet precautions: head covering, eye protection, surgical face mask, gown, gloves, shoe covers
   b. Droplet precautions: head covering, eye protection, surgical face mask, gown, double glove, shoe covers
   c. Airborne precautions: head covering, N95 or PAPR, gown, gloves, shoe covers
   d. Airborne precautions: head covering, eye protection, N95 or PAPR, gown, double glove, shoe covers
3. **Prior** to the simulations, I was confident in my ability to correctly DON the personal protective equipment (PAPR, gown, gloves).
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
4. **After** the simulations, I am confident in my ability to correctly DON the personal protective equipment (PAPR, gown, gloves).
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
5. **Prior** to the simulations, I was confident in my ability to correctly DOFF the personal protective equipment (PAPR, gown, gloves).
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
6. **After** the simulations, I am confident in my ability to correctly DOFF the personal protective equipment (PAPR, gown, gloves).
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
7. **Prior** to the simulations, I knew where HME or HEPA filters should be placed to protect the anaesthesia machine and the OR personnel from contamination with COVID-19.
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
8. **After** the simulations, I know where HME or HEPA filters should be placed to protect the anesthesia machine and the OR personnel from contamination with COVID-19.
   a. On the inspiratory limb and distal to the Y piece & EtCO2 sampling line (patient side)
   b. On the expiratory limb and distal to the Y piece & EtCO2 sampling line (patient side)
   c. On the inspiratory limb and proximal to the Y piece & EtCO2 sampling line (machine side)
   d. On the expiratory limb and proximal to the Y piece & EtCO2 sampling line (machine side)
9. Prior to the simulations, I understood the principles of airway management relevant to COVID-19 patients.
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
10. After the simulations, I understand the principles of airway management relevant to COVID-19 patients.
   a. Airborne PPE, two providers in room, avoid PPV, RSI using disposable videolaryngoscope
   b. Droplet PPE, two providers in room, avoid PPV, RSI using disposable videolaryngoscope

c. Airborne PPE, two providers in room, modified RSI with PPV and laryngoscopy using disposable videolarygoscope

d. Droplet PPE, two providers in room, modified RSI with PPV and laryngoscopy using disposable videolaryngoscope

11. Prior to the simulations, I understood the principles of responding to a rapid response or code blue in COVID-19 patients.

a. Strongly disagree

b. Somewhat disagree

c. Neither agree nor disagree

d. Somewhat agree

e. Strongly agree

12. After the simulations, I understand the principles of responding to a rapid response or code blue in COVID-19 patients.

a. Airborne PPE for all responders, hold chest compressions until BMV with a tight seal is over the patient's nose and mouth, delay intubation

b. Droplet PPE for all responders, hold chest compressions until BMV with a tight seal is over the patient's nose and mouth, delay intubation

c. Airborne PPE for all responders, hold chest compressions until BMV with a tight seal is over the patient's nose and mouth, consider early intubation to protect staff

d. Droplet PPE for all responders, hold chest compressions until BMV with a tight seal is over the patient's nose and mouth, consider early intubation to protect staff

13. Comments on the Department of Anesthesiology COVID-19 simulations?