

Supplementary Material 1. Anesthesiology intensive care unit (ICU) document

Process of establishing an anesthesia led critical care unit

Goal: rapidly deploy anesthesiology personnel and equipment to create a critical care unit in medical/surgery units with support from ICCM.

1. Environment

a. Requirements:

- i. Oxygen, air, vacuum wall line setup with splitters if needed
- ii. Network jack access
- iii. Uninterrupted power supply (red outlets)
- iv. Central monitoring station preferred- anesthesia machine vital monitors can be interfaced with telemetry units

b. Recommendations

- i. Options to ameliorate partial or no view rooms
 1. Punch a window into all of the doors
 2. Reverse the direction of the bed so the head of the bed can be seen from the door
 3. Position anesthesia machine so the articulating arm with the vital sign monitor can either face the door/window or AV system
 4. Whiteboard installed on door to record personnel names as well as current ventilator settings
 5. AV hookup
 - a. Centrally monitored AV system- preferred- 9 AV tower units per monitoring booth with someone stationed who can monitor all 9 patients and report immediately.
 - b. Tablet/zoom setup- secure camera/tablet to wall facing both patient and monitors. Can only be dialed in to from a second tablet allowing only for spot checks and not continuous monitoring.
 6. Communication system- Vocera.
 - a. Critical to supply units to all staff members including physicians
 - b. Must develop unique call signs with hierarchy and emergency broadcast function (see appendix)
 - c. Allows communication through closed doors while wearing PPE to communicate and record vital signs, ventilator settings, supply needs or broadcast for emergency assistance when no one can see or hear you.

2. Staffing

- a. In house attending physician support recommended given unique environment and machinery with need for rapid problem solving.
- b. Consider dynamic staffing model to spread resources between many new units in order to maintain flexibility and reduce number of staff needed to cover each unit
 - i. Surge system: a backup process to call in order to have more staff immediately available if unit gets very busy with concurrent admission or emergencies.
 1. Surge pager: 3,908 or 3,910 – daytime covered by cardiac anesthesiology attending. Evening weekends covered by CT anesthesia fellow in house
 2. NICS ICU faculty (Amion): nights
 3. CTICU critical care anesthesiologist or surgeon (in house)
 4. Backup call attending (24/7 backup coverage scheduled in case of emergency or illness that would not interfere with other clinical duties)- last resort as home call
 - ii. Secondary resources
 1. Prone team
 2. Line service

3. Palliative care team
4. SW or case manager for identifying NOK and placement if needed
5. Walking rounds with ICCM and or anesthesiology leadership

3. Supplies

a. Anesthesia machine- deployed and interfaced by anesthesiology department

i. Equipment:

1. Circuits
2. HEPA or B/V filters- one placed in expiratory limb, 2nd placed at circuit Y
3. HME humidifying filter with gas analyzer sampling line
4. D-fend cartridges
5. CO₂ absorbers
6. Spirometry tubing (allows for plateau pressure measurement)
7. ECG, NIBP, SP2 and invasive monitoring cables
8. 25ft network cables for each room. One waterproof/washable keyboard for machine/network interface management

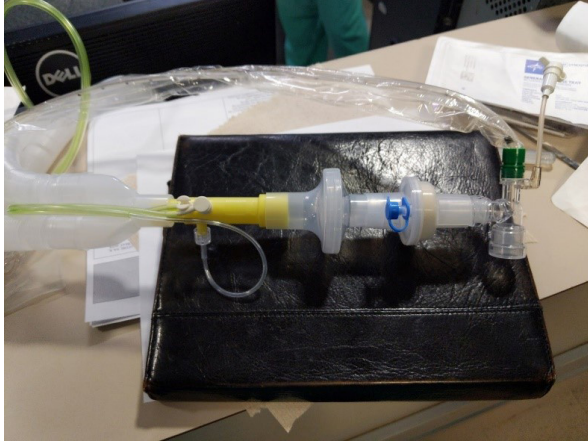
b. Workroom:

- i. Med/surg floors do not have critical care equipment. Goal is to utilize equipment familiar to anesthesiologists to improve workflow.
- ii. Create a supply area with stock assessment and refill workflow. Anesthesiology equipment managers and techs may help with this process.
- iii. Create packs or “go bags” with supplies for specific tasks (e.g., airway pack, central line pack, arterial line pack.) Goal of “go bags” are to provide critical equipment rapidly without creating waste by bringing too much equipment into a room even during an emergency (see appendix for content)
- iv. Stockroom area should be outside of COVID care area to reduce contamination and protect those who take inventory and stock.
 1. Stocked and locked anesthesia cart is quickest simplest solution as familiar to anesthesia team and techs who restock.
 2. 2 ultrasound machines, 1 video laryngoscope
 3. Airway packs with intubation equipment (see airway section)
 4. Invasive monitoring and central access packs and extra supplies
 5. Sterile gloves
 6. Airway supply cart with equipment needed to maintain anesthesia machines and circuits (list above)



4. Setup

- a. Circuit order
 - i. Circuit -> BV filter -> HME filter -> in line suction elbow -> ETT or mask
 - ii. Must have BV filter proximal to HME in order to prevent moisture buildup in BV filter. Sampling line for ETCO₂ goes to waste gas line and does not contaminate environment
- b. Self-inflating resuscitation bag on machine
- c. Rubberized perfusion clamp for ETT clamping for disconnects



5. Workflow:

- a. Different from other units given:
 - i. poor visibility of patients
 - ii. No respiratory therapy support as they are not familiar with anesthesia machines
 - iii. RN colleagues may not have critical care training
- b. Add ventilator rounds twice daily as well as extra scheduled patient evaluations
 - i. Team works in pairs with one person entering room to assess status of circuit, filters, CO₂ absorber, change ventilator settings as well as examine patient and environment. 2nd person outside room to pass supplies and record data.
 - ii. Coordinated with nurses so nursing tasks can be accomplished by anesthesiology team when they enter the room saving PPE and reducing RN exposure.
- c. Ventilator Management (adapted from on American society of Anesthesiology and Anesthesia Patient Safety Foundation recommendations)
 - i. Power cycle and complete check out prior to connecting. Machine automatically power cycles off after 49 days (GE). Therefore, leave off until connection imminent as to not start the timer.
 - ii. Initial mode: Pressure control volume guaranteed
 - iii. May need to increase Pmax to attain TVs.
 - iv. May need to add air to ETT cuff if Pmax is increased.
 - v. Flows at 10 L/min- goal is to match Flows to MV. Flows > MV leads to poor humidification which can damage lungs. Flow < MV leads to rapid buildup of moisture in the circuit and even the machine that can cause poor filter or machine performance.
 - vi. Set FiCO₂ alarm to 5 mm and replace CO₂ absorber whenever it rises >3 mm or majority color changes
 - vii. Check sampling line D-fend for fluid and replace if needed. Not frequent if setup with spirometry tubing with sampling line proximal to filters.
 - viii. Measuring plateau pressures: On the ventilator screen- select spirometry, then source and then select patient (instead of machine). Pplat will appear in spirometry section on left side of ventilator monitor.

6. Miscellaneous

- a. Creating a team based approach is the most important element in rapidly creating a fully functional intensive care unit in a space not designed for one and with staff who may not be familiar or trained in critical care. This requires constant communication and coordination between physician and nursing leaders as well as establishing an environment where tasks that are often performed by one type of provider can be done by any person entering a COVID room. Anesthesiologists know how to manage critical care pumps, lines/tubing, patient turning,
- b. Education: Daily discussions focusing on teaching non-anesthesiology team members how identify and interpret alarms and setting on anesthesia ventilator.
- c. Rapid escalation pathways: what is learned today is implemented tomorrow. All team members must be able to voice ideas or concerns in order to adapt and improve care for patients in a new patient care area.

Appendix:

APSF/ASA Guidance on Purposing Anesthesia Machines as ICU Ventilators:

<https://www.asahq.org/in-the-spotlight/coronavirus-covid-19-information/purposing-anesthesia-machines-for-ventilators>

(Please attach included PDF in appendix)

Airway "go bag" contents:

1. 8.0 and 7.5 endotracheal tube
2. soft stylet
3. 10 ml syringe.
4. Medium sized oral airway
5. 3 × 10 ml syringe, labeled Rocuronium, Etomidate and Succinylcholine
6. 1 × 20 ml syringe labeled propofol
7. 1 HME filter
8. 1 orogastric tube
9. 3 lube packets
10. 1 pair of eye protector sticker
11. 1 McGrath size 3 blade

Central line "go bag" contents:

1. 7fr triple lumen kit
2. 1 surgical gown
3. 1 sterile ultrasound probe cover with lubricant
4. 1 Biopatch (if CHG Tegaderm not available)
5. 1 CHG Tegaderm or standard Tegaderm dressing
6. 3 Luer-lock adapters
7. 1 sterile 24 inch arterial line tube (for manometry)

Arterial line "go bag" contents:

1. 20 g 12 cm arterial line kit
2. 1 sterile ultrasound probe cover with lubricant
3. 1 Biopatch (if CHG Tegaderm not available)
4. 1 CHG Tegaderm or standard Tegaderm dressing
5. 1 armboard
6. 2 rolls of 1 inch tape
7. 1 heparinized ABG syringe

Example Vocera call infrastructure:

Designations (nickname)

1. 7 east anesthesia resident 1-4 (7E residents 1-4)
2. 7 east anesthesia attending 1-2 (7E attending 1-2)
3. 7 east nurse anesthetist (7E CRNA)

Broadcast designations: may be called by any staff member in case help is needed

1. Broadcast to 7 east anesthesia team – calls all physician team members
2. Broadcast to 7 east emergency - calls all physician team members as well as charge nurse
3. NO PUSH TO TALK given its use as primary communication tool between other staff members