Pediatric Anesthesiology Guide to COVID-19

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Objective: To provide the most current and vital information to prepare and protect staff, trainees, patients and their families, as well as to provide the highest level of medical care for our patients infected by the COVID-19 coronavirus.

Basics:

- To skip to Perioperative Management go to page 4.
- To skip to PPE go to page 6.
- **Hand hygiene to key**: Handwashing for 20 secs (preferred) OR alcohol-based hand sanitizer rubbed thoroughly over palms, back of hands, between fingers, and into palms until fully evaporated.

About the Virus:

- SARS-COV-2 is a strain of coronavirus that seems to have originated from Wuhan, China- initial reports of the clinical illness dubbed “COVID-19” emerged 12/31/2019.
- It binds via the angiotensin-converting enzyme 2 (ACE2) receptor located on type II alveolar cells and intestinal epithelia
- This is the same receptor as used by SARS (hence the technical name for the COVID-19, “SARS-CoV-2”). When considering possible therapies, SARS (a.k.a. “SARS-CoV-1”) is the most closely related virus to COVID-19

Transmission:

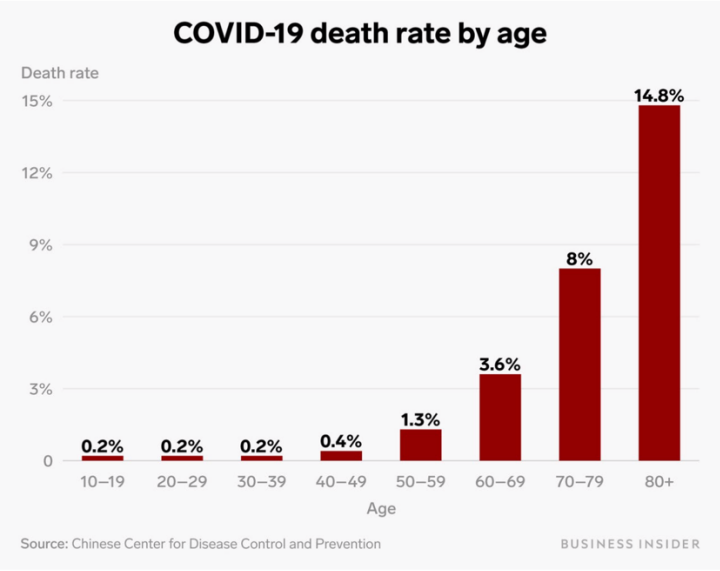
- Large respiratory droplets: this means that if you are closer than 6 feet from an infected person you need at least a surgical facemask, if it is aerosolized (PPV, intubation, NIPPV, high-flow NC O2) you need a N95/PAPR mask (more on this on *PPE guidelines page 6*)
- Oral/Fecal spread (Vomit, diarrhea)
- Fomites: Can survive on surfaces from 3-7 days
- Infected patients should wear a facemask to reduce droplet emission while around others
- Clearance for confirmed cases (per WHO-China Report 2.2020) is afebrile x 72hr and 2 negative swabs at least 24 hours apart. It is thought that pts can shed RNA for up to 4 days after being asymptomatic but correlation between RNA and infection is unknown.

Pathophysiology:

- Incubation is thought to take anywhere from 4-14 days.
- Presentation typically is with cough, shortness of breath, and fever. Fever is variable between cases. Bilateral pneumonia is common, In older individuals,

presentation can be “silent hypoxemia” which is respiratory failure in the absence of symptoms. There is about a 10% incidence of GI symptoms like nausea/vomiting and diarrhea.

- Low infection and mortality rate in 0-10 yo and 10-20yo- children tend to display milder symptoms: runny nose, cough, fever, mild GI symptoms (diarrhea, vomiting). Pediatric deaths have been few and only in children who were immunocompromised or multiple comorbidities.
- In the WHO-China Joint Mission Report China reported a 2.4% infection rate amongst children<19yo and of those 2.5% developed severe disease and 0.2% critical disease.
- Risk factors noted in the WHO-China report: Hypertension, diabetes, cardiovascular disease, cancer, chronic respiratory disease.



- Labs: lymphopenia (low-normal WBC), thrombocytopenia, elevated LFTs, negative flu and viral swab (though can have concurrent infection)

Diagnostics:

- Positive SARS-CoV-2RT-PCR test
- Patchy infiltrates on Chest CT (more subtle on CXR), severely ill patients can develop cardiomyopathy (TTE)
- ARDS and cardiomyopathy are later presentations and have poor prognosis

Typical features according to current publications Age Mean (SD) 55,5 (13·1), Male (68%) Exposure to Huanan seafood market in Wuhan, China (49%) Chronic medical underlying illness (51%) Admission to Intensive Care Unit (23%)	FIRST WEEK				SECOND WEEK			
SETTING	WARD Illness day 4	WARD Illness day 5	WARD Illness day 6	WARD Illness day 7	WARD/ICU Illness day 8	ICU Illness day 9	ICU Illness day 10	ICU Illness day 11
REPEATED SAMPLING OF THE NASOPHARYNX AND TRACHEAL ASPIRATES (IF INTUBATED) BY rRT-PCR FOR THE COVID-19	Initial important viral shedding		Decrease of the viral shedding sometimes associated with transient respiratory deterioration		Respiratory failure, increase of the viral shedding and viremia or Decrease of the viral shedding, and superinfections			Duration of viral excretion unknown
OXYGEN THERAPY AND MECHANICAL VENTILATION	NO		Consider oxygen support	FNC	FNC followed by MV	MV		MV
ORGAN FAILURE	**Typical signs according to current publications** Fever, cough, and shortness of breath (15%) bilateral pneumonia (75%), lymphopenia (35%), thrombocytopenia (12%), prothrombin time decreased (30%), elevated liver enzyme levels (about 30%)		Deterioration of respiratory status with most often spontaneous recovery		ARDS If shock beware of superinfections ⚠ Possible renal failure Neurological failure unlikely Hemostasis disorders			YES
CO-INFECTION/SUPERINFECTION	NOT LIKELY				Consider a possible HAP/VAP and other nosocomial infections (see text for diagnostic procedures)			Profound immune paralysis and late onset infections
ANTIBIOTICS	NO				Consider antibiotic therapy			YES
ANTIVIRAL AGENTS	NO				Consider antiviral agents if deterioration[a]			

INCUBATION PERIOD and ONSET OF SYMPTOMS 3 DAYS AGO

LONG TERM INFO PENDING

FNC = flow nasal cannula; HFNC = high flow nasal cannula; HAP = healthcare-associated pneumonia; VAP = ventilator-associated pneumonia; MV = Mechanical ventilation;
[a] The use of immunomodulation including corticosteroids is unlikely but debated

Fig. 1 Global picture of severe cases

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Clinical Pearls for COVID-19 Patients: (Note: these are compiled from the experience of frontline doctors in Italy, France, and China- not from published data.)**

1. Observation from France is noting that patients are doing worse with NSAIDs. Consider Tylenol or other adjuncts.
2. Steroids not proving to be beneficial in patients with ARDS
3. Proning and inhaled Epoprostenol seems to be very helpful in severely hypoxemic patients.
4. Hemodynamic management: low dose NorEpinephrine, minimize IVFs use pressors early
5. Trial Drugs:
    a. Remdesivir: antiviral from Gilead, blocks RNA polymerase, Hard to get and patients would have to enroll in either Gilead's RCT (5 vs 10 days of Remdesivir) or the NIH's "Adaptive" RCT (Remdesivir vs. Placebo).
    b. Chloroquine: antimalarial, in vitro endosomal acidification fusion inhibitor blocked infection of a clinical isolate of SARS-CoV-2. Side effects: N/V, vision changes, diarrhea (worse in kids).
    c. Lopinavir (Kaletra): HIV antiretroviral, Not a lot of benefit seen yet.

Screening for Providers:

- Per the CDC: Clinicians should use their judgment to determine if a patient has signs and symptoms compatible with COVID-19 and whether the patient should be tested. Most patients with confirmed COVID-19 have developed fever[1] and/or symptoms of acute respiratory illness (e.g., cough, difficulty breathing). Priorities for testing may include:

  - Hospitalized patients who have signs and symptoms compatible with COVID-19 (respiratory illness: cough, fever)
  - Other symptomatic individuals such as, older adults and individuals with chronic medical conditions and/or an immunocompromised state that may put them at higher risk for poor outcomes (e.g., diabetes, heart disease, receiving immunosuppressive medications, chronic lung disease, chronic kidney disease).
  - Any persons including healthcare personnel[2], who within 14 days of symptom onset had close contact[3] with a suspect or laboratory-confirmed[4] COVID-19 patient, or who have a history of travel from affected geographic areas (currently S. Korea, Iran, UK, China, Japan, Europe) within 14 days of their symptom onset.
- Healthcare Providers should monitor for potential exposure, the CDC has a detailed website to evaluate your risk here: https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-risk-assesment-hcp.html

Things to plan:

- Work with your team to work out the care flow of a COVID-19 positive patient from room and back (OR, recovery, transport)
- Coordinate with your anesthesia team (techs, attendings, trainees) who will be in the room and who will be on standby
- Decide on how you will clean an OR and its contents
- Ensure that there are designated areas for donning and doffing PPE and that all team members are aware of them and the process of putting on and removing PPE

Management of perioperative care:

1. In concert with the Attending Surgeon, determine if the case is urgent/emergent. Elective cases should be postponed unless there are extenuating circumstances. Also, consider if a procedure can be safely done at the patient's bedside to reduce exposure.
2. Pre-op Considerations: Respiratory failure (large A-a gradient) or ARDS, pneumonia, cardiomyopathy (TTE), cytokine storm (sudden cardiovascular collapse)
3. Attempt to decide for intubation at the earliest time possible, emergent intubations are not ideal as PPE takes time to put on.
4. Prepare your OR team, make sure you have a HEPA filter for the ventilating bag during transport and your anesthesia machine.
5. COVID-19 Patients or PUI on contact/droplet precautions should **not** come to the holding or PACU areas.

   a. Floor status patients should be received by the OR staff and anesthesia physician/provider at the hallway entering the OR.
   b. ICU patients should be transported directly by the anesthesia team and OR staff.
6. Spontaneously breathing patients should wear a facemask while in transport. The transport team should wear PAPRs.
7. Intubated patients require use of a hydrophobic HEPA filter between the ETT and the reservoir bag. HEPA filters and N95 masks can be found at the main OR front desk under the care of the charge nurse. Keep the HEPA filter with the patient, put a patient label on it so that it can be used again for that patient.
8. Negative pressure OR should be used for these patients. It requires about 30 minutes to establish a negative pressure room
9. If the patient is on NIPPV (BiPAP or CPAP) or high flow-O2 and requires intubation for their surgery, consider intubation at the bedside prior to transport to reduce aerosolized particle emission during transport.
10. Induction and Intubation:
   a. Put on PPE for aerosolized procedure. (see “donning and doffing PPE” section below). Consider the double glove technique.
   b. Should be the most experienced provider performing the intubation, reduce all non-essential personnel.
   c. Avoid awake fiberoptic intubation to reduce aerosolation
   d. APSF guidelines: **pre-oxygenate, paralyze** (to minimize coughing), **RSI** (to reduce mask ventilation). Consider using a video laryngoscope/ glidescope to allow for increased distance between face and patient. If manual ventilation is required, apply small tidal volumes.
   e. Once you intubate, sheath blade with outer glove and place airway equipment in a ziplock bag. Then put hand sanitizer on gloves.
   f. Consider the increased use of anti-emetics to reduce risk of PONV and viral spread via vomiting.
   g. **Our anesthesia machines (Drager Apollo and Perseus) DO need an additional HEPA filter attachment.** These are available at the Main OR front desk. Check what your machine needs.
11. Assign a core team to directly manage the patient, assign a person to be clean to assist with doors and elevators.
   a. Alert ICU of your arrival so that hallways can be cleared and ICU staff have enough time to don proper PPE.
   b. After transfer of care, remove PPE in designated antechamber (see “donning and doffing PPE” section below, page 6)
12. Non-ICU patients should recover in the OR before transport back to their room.
13. Sixty (60) minute minimum room turnover time following terminal clean.

Cardiac/Respiratory Arrest Scenario Tips:

- Devise a modified protocol beforehand with identified members of the senior care team
- Ensure all members have proper mask fit and PPE
- If child is already intubated try not to disconnect while doing CPR
- If Crash Cart used be sure to dispose of all contents in the room in a biohazard bin and clean the cart thoroughly after with sani/hyperchlorite wipes.

PPE:

1) **For asymptomatic patients all interaction:** *APSF Rec***-** Consider using elevated measures when managing the airway even of asymptomatic patients: surgical mask, eye protection, gloves; *WHO Rec*- No PPE needed for asymptomatic pts).
2) **For symptomatic patient interaction not involving airway management, also already intubated pts not being transported:** current recommendation is for surgical mask, eye protection, gown, gloves. Patient should wear mask whenever possible.
3) **For symptomatic patient care involving invasive procedures and/or airway manipulation (intubation AND extubation), intubated pts in transport, and pts on NIPPV (ie: BiPAP or CPAP):**
    a. Option A: PAPR, gown, gloves, hair cover, shoe cover. Can consider surgical hat to cover neck
    b. Option B: N95 mask, hood cover (standard hood is NOT droplet occlusive so you need an N95 mask), gown, gloves, hair cover, shoe cover- hood should cover the neck in this scenario.

Donning and Doffing:

Tips:

- Have a PPE Buddy to assist and double-check the process.
- Always put on PPE in a clean area (ante-room)
- Tie up long hair, consider shaving facial hair to ensure better fit of N95.
- Pay special attention to the junction between gloves and gowns. The gown should be tucked into the gloves. Using gloves with extended cuffs facilitates this (similar to sterile surgical gloves). Gloves with long cuffs may facilitate removal of the gown and gloves as one unit.
- Before removing PPE apply hand-sanitizer to your gloves.
- After PPE is off apply hand-sanitizer again up to the mid-forearms

Donning:

1. Remove jewelry and apply hand-sanitizer.
2. Put on shoe covers.

3. Put on gloves.
4. Put on the gown, place thumbs through the thumb holes of the gown and tie it in the back.
5. Put on the mask and then hood/eye protection OR PAPR. Double check for the proper seal, if you are fogging your eye wear, your mask does not have a good seal!
6. Put on a second layer of gloves. Consider surgical gloves so the longer cuff covers wrists.
7. Good video courtesy of NETEC here: https://youtu.be/bG6zISnenPg

Doffing:

1. Do this in the designated area by a biohazard bin.
2. Have PPE Buddy wipe down outside of hood or PAPR with a sani wipe
3. Hand sanitize your gloves and remove the outer layer of gloves only.
4. Remove hood or face shield/goggles, put them in the bin.
5. Remove gown and out in the bin.
6. Remove shoe covers put in the bin.
7. Remove PAPR hood or mask, **SAVE PAPR hoods** but disinfect with germicidal/bleach wipe after each use. (only after patient interaction is complete).
8. Remove the last layer of gloves.
9. Wash hands thoroughly.

Tips for Protecting your home:

1. Wear a separate outfit (clothes and shoes) going in and out of the hospital that is separate from your scrubs.
2. Clean your high contact objects regularly: PHONE, pager, pens, badge (glasses and watches if you wear them). Consider leaving jewelry at home.
3. Don't touch your face.
4. Consider leaving your laptop at home and downsizing your work bag to something that can be in your locker or wiped down regularly.
5. Wash your hands up to the elbows before leaving work.
6. Shower at home, keep work bags in designated area.
7. Keep separate drinking cups and cutlery.
8. Wipe down areas of heavy traffic or contact frequently: door knobs, car interior (steering wheel), remote controls, light switches.

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- World Health Organization Daily Situation Reports. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/
- Dr. Gina Hottle “Peds Anesthesiology Plan” (Big shout out to this lady.)
- Wong, B., Shastry, S., Mihm, F. 2020 Taskforce on COVID-19, Stanford Medical Center
- Paediatric Intensive Care Society (PICS) Guidelines for COVID-19 https://picsociety.uk/covid19/

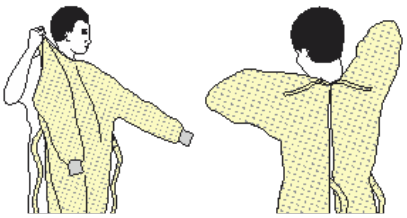
Appendix:

SEQUENCE FOR PUTTING ON PERSONAL PROTECTIVE EQUIPMENT (PPE)

The type of PPE used will vary based on the level of precautions required, such as standard and contact, droplet or airborne infection isolation precautions. The procedure for putting on and removing PPE should be tailored to the specific type of PPE.

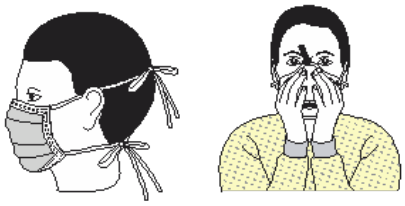
1. GOWN

- Fully cover torso from neck to knees, arms to end of wrists, and wrap around the back
- Fasten in back of neck and waist



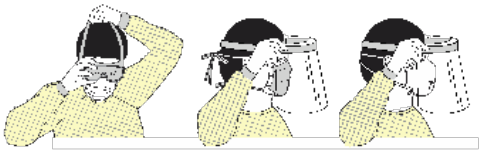
2. MASK OR RESPIRATOR

- Secure ties or elastic bands at middle of head and neck
- Fit flexible band to nose bridge
- Fit snug to face and below chin
- Fit-check respirator



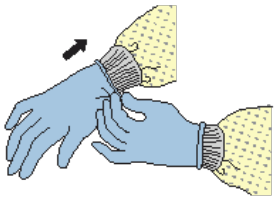
3. GOGGLES OR FACE SHIELD

- Place over face and eyes and adjust to fit



4. GLOVES

- Extend to cover wrist of isolation gown



USE SAFE WORK PRACTICES TO PROTECT YOURSELF AND LIMIT THE SPREAD OF CONTAMINATION

- Keep hands away from face
- Limit surfaces touched
- Change gloves when torn or heavily contaminated
- Perform hand hygiene

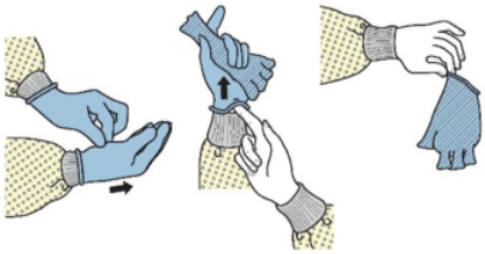
CDC

HOW TO SAFELY REMOVE PERSONAL PROTECTIVE EQUIPMENT (PPE) EXAMPLE 1

There are a variety of ways to safely remove PPE without contaminating your clothing, skin, or mucous membranes with potentially infectious materials. Here is one example. **Remove all PPE before exiting the patient room** except a respirator, if worn. Remove the respirator **after** leaving the patient room and closing the door. Remove PPE in the following sequence:

1. GLOVES

- Outside of gloves are contaminated!
- If your hands get contaminated during glove removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Using a gloved hand, grasp the palm area of the other gloved hand and peel off first glove
- Hold removed glove in gloved hand
- Slide fingers of ungloved hand under remaining glove at wrist and peel off second glove over first glove
- Discard gloves in a waste container



2. GOGGLES OR FACE SHIELD

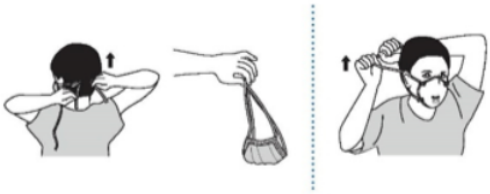
- Outside of goggles or face shield are contaminated!
- If your hands get contaminated during goggle or face shield removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Remove goggles or face shield from the back by lifting head band or ear pieces
- If the item is reusable, place in designated receptacle for reprocessing. Otherwise, discard in a waste container

3. GOWN

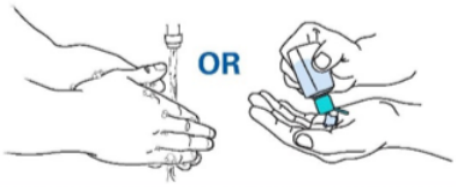
- Gown front and sleeves are contaminated!
- If your hands get contaminated during gown removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Unfasten gown ties, taking care that sleeves don't contact your body when reaching for ties
- Pull gown away from neck and shoulders, touching inside of gown only
- Turn gown inside out
- Fold or roll into a bundle and discard in a waste container

4. MASK OR RESPIRATOR

- Front of mask/respirator is contaminated — DO NOT TOUCH!
- If your hands get contaminated during mask/respirator removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Grasp bottom ties or elastics of the mask/respirator, then the ones at the top, and remove without touching the front
- Discard in a waste container



5. WASH HANDS OR USE AN ALCOHOL-BASED HAND SANITIZER IMMEDIATELY AFTER REMOVING ALL PPE



PERFORM HAND HYGIENE BETWEEN STEPS IF HANDS BECOME CONTAMINATED AND IMMEDIATELY AFTER REMOVING ALL PPE

CS250672-E

Source: CDC