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# MANAGING THE PEDIATRIC AIRWAY

## [AND IN COVID]

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# OBJECTIVES

- Review differences between children and adults
- Discuss devices available for pediatric airway
- Illustrate useful techniques to maximize success
- Airway safety in the era of COVID-19

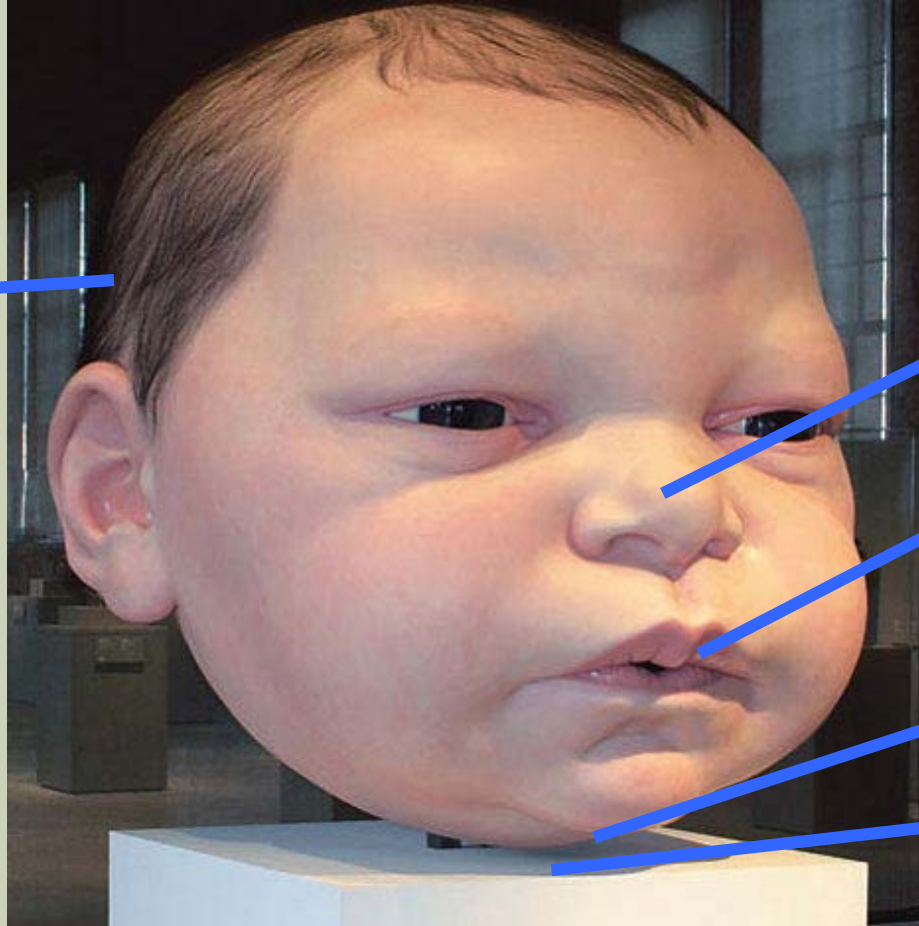


# COVID IN PEDS

- Usually isn't severe in kids, some do get sick enough to require hospital treatment.
- Fever, cough and shortness of breath were the most common symptoms in kids, but they occurred less often than in adults.
- U.S. through Apr 2, 2,572 of cases were among people under the age of 18 -less than 2% of total cases, even though that age group makes up 22% of the U.S. population.

# ANATOMICAL DIFFERENCES

Large occiput



Narrow nares

Large tongue

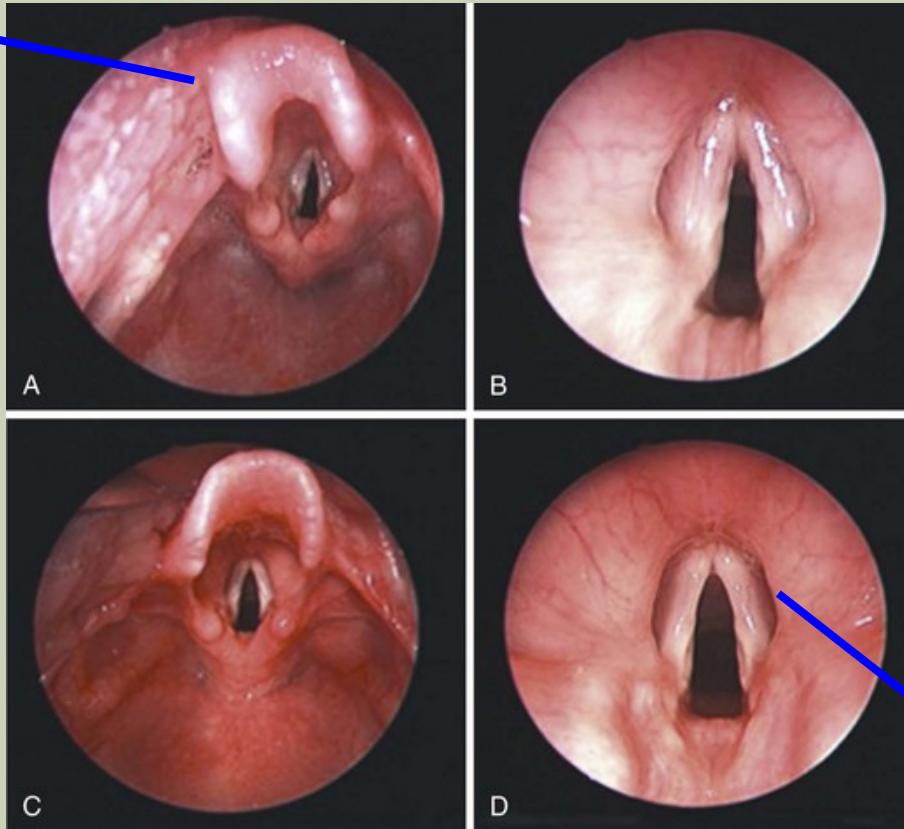
High glottis

Narrow cricoid

# PATIENT POSITIONING IS IMPORTANT



# Omega shaped epiglottis



Anteriorly slanted  
vocal cords



# AIRWAY OPTIONS

## PRE-INTUBATION

## Oxygen

### Blow-by:

- Set flow meter:
  - Newborns: 5 L/minute; other patients: 12 L/minute.
- Have parent or other helper hold mask near airway.
- No mask? Put oxygen tubing through hold in bottom of paper cup.

### Non-rebreather:

- Run Oxygen at 10 to 15 L/minute.
- Fit mask to patient. Adjust elastic strap so mask is snug.
  - Watch bag to be sure it moves a little each time patient breathes.

### Nasal cannula:

- Run Oxygen at 2 to 6 L/minute.
- Put prong in each nostril, with curve of prongs pointed down.
- Adjust to fit using the round slider under chin.

### High-flow nasal cannula:

- Choose nasal cannula with prongs that do not occlude >50% nares
- FiO<sub>2</sub> 50%, 37deg C
- Titrate flow to 0.5-2 LPM/kg
  - Titrate flow by 1 LPM increments over first 3 mins until improvement in WOB.

ADAPTED  
FROM:  
E-CHAM  
&  
YKHC  
CLINICAL  
GUIDELINES

[HTTPS://YKHEALTH.ORG/WIKI/HIGH-FLOW\\_NASAL\\_CANNULA\\_\(HFNC\)\\_%E2%80%94\\_PEDIATRIC](https://ykhealth.org/wiki/high-flow_nasal_cannula_(hfnc)_%E2%80%94_pediatric)





## **Suction**

**Turn on suction machine or use bulb suction.**

**Insert tonsil-tip or catheter into back of mouth, keeping it in sight.**

**Always suction only on the way out.**

- **Cover hole to start suction as you move catheter out of the mouth.**
- **Suction for no more than 15 seconds.**

**Try to ventilate patient or allow several breaths in between suctioning.**

**ADAPTED  
FROM:  
E-CHAM**

## Bag-Valve-Mask (BVM)

Note: Works best when used by 2 people.

**First person:** at top of patient's head.

- Open airway (jaw thrust/head-tilt/chin-lift).
- Put mask over nose and mouth.
- Place hands (C-E position):
  - Thumbs over top half of mask.
  - Pointer (index) fingers over bottom half of mask.
  - Other fingers under chin and jaw.
  - “Pull” face up toward mask, rather than pushing mask down on face.

**Second person:** Squeeze bag with both hands until patient's chest rises.

- Child/infant: If using adult-size bag, stop squeezing as soon as chest begins to rise, **1 breath / 3 seconds**.

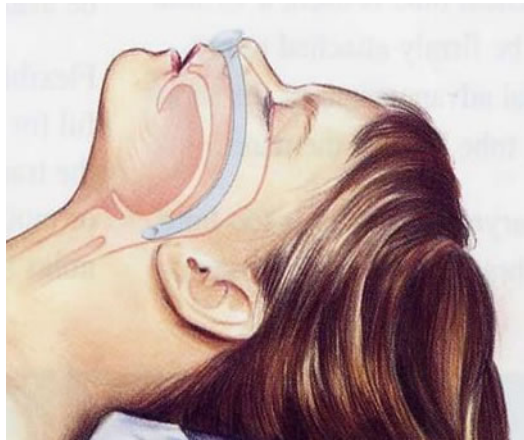
If feel resistance (bag is hard to squeeze) airway is **NOT** open.

- Reposition head and try again.
- If still a problem, remove mask and check for vomiting or obstructed airway.

If you have trouble keeping the airway open, consider inserting an oral or nasal airway.



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## Nasal Airway (Nasopharyngeal Airway)

Use on responsive OR unresponsive patient.

- Do NOT use if patient has injury to face, above lower jaw.

Measure airway:

- Size of patient's little finger or nostril.
- Length: From nostril to tip of ear lobe or angle of jaw.

Lubricate nasal airway with K-Y Jelly or other.

Insert airway:

- Bevel (opening) should be toward septum (middle) of nose.
- Gently twist airway as you push in.
- Flange (wide part at top) should rest on nostril.



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E-CHAM

## Oral Airway

Use only in unresponsive patient with NO gag reflex.

Measure airway: From corner of mouth to tip of ear lobe or angle of jaw.

Open patient's mouth.

Insert Airway:

- Push tongue down (flatten) with tongue blade or your thumb.
- Slide airway straight in over tongue.
- Flange should rest on lips or teeth.



# AIRWAY OPTIONS

## INTUBATION



# QUICK TIME OUT FOR SAFETY



**Right Patient**

**Right Plan**

**Right Prep**

**Right Equipment**

**Right Monitoring**

**Right Rescue Plan**

**Right Attitude**

## Preparation: Equipment

### “S – O – A – P – I – M”

#### Suction

#### Oxygen

#### Airway equipment

- Check manual ventilation device for leaks
- Appropriately sized mask
- Verify laryngoscope light function
- Planned ETT size and one size smaller
  - Verify pilot balloon / valve function
  - Fully deflate cuff
- Oral airway
- Closest location of Laryngeal Mask (in case needed)

#### Pharmaceuticals

- Which drugs?
  - Premedication(s)
  - Sedative /Induction medication(s)
  - Neuromuscular blocking agents
  - Emergency medications
- What order?
- Labeled and read?

#### Intravenous Access

- Confirm function

#### Monitors

- Electrocardiography
- Non-invasive blood pressure (q3-5mins)
- Pulse oximetry
- Capnography (ideal) or colorimetric carbon dioxide detector

Physical Signs	Less Difficult Airway	More Difficult Airway
<b>L</b> Look Externally	<ul style="list-style-type: none"> <li>• Normal face and neck</li> <li>• No face or neck pathology</li> </ul>	<ul style="list-style-type: none"> <li>• Abnormal face shape</li> <li>• Sunken cheeks</li> <li>• Edentulous or “Buck” teeth</li> <li>• Receding mandible</li> <li>• “Bull-neck”</li> <li>• Narrow mouth</li> <li>• Obesity</li> <li>• Face or neck pathology</li> </ul>
<b>E</b> Evaluate the 3-3-2 rule	<ul style="list-style-type: none"> <li>• Mouth opens <math>\geq 3</math> fingers</li> <li>• Hyoid-chin distance <math>\geq 3</math> fingers</li> <li>• Thyroid cartilage-mouth floor distance <math>\geq 2</math> fingers</li> </ul>	<ul style="list-style-type: none"> <li>• Mouth opens <math>&lt; 3</math> fingers</li> <li>• Hyoid-chin distance <math>&lt; 3</math> fingers</li> <li>• Thyroid cartilage-mouth floor distance <math>&lt; 2</math> fingers</li> </ul>
<b>M</b> Mallampati	<ul style="list-style-type: none"> <li>• Class I and II</li> <li>• Can see the soft palate, uvula, fauce, +/- faucial pillars</li> </ul>	<ul style="list-style-type: none"> <li>• Class III and IV</li> <li>• Can only see the hard palate +/- soft palate +/- base of uvula</li> </ul>
<b>O</b> Obstruction	<ul style="list-style-type: none"> <li>• None</li> </ul>	<ul style="list-style-type: none"> <li>• Pathology within or surrounding the upper airway (e.g. peritonsillar abscess, epiglottitis)</li> <li>• Retropharyngeal abscess</li> </ul>
<b>N</b> Neck Mobility	<ul style="list-style-type: none"> <li>• Can flex and extend the neck normally</li> </ul>	<ul style="list-style-type: none"> <li>• Limited range of motion of the neck</li> </ul>

## L.E.M.O.N. METHOD



# MALLAMPATI CLASSIFICATION

Classification	Attributes	Level of Intubation Difficulty
<b>Class I</b>	Soft palate, uvula, fauces, pillars visible	Easiest
<b>Class II</b>	Soft palate, uvula, fauces visible	Easy
<b>Class III</b>	Soft palate, base of uvula visible	Difficult
<b>Class IV</b>	Only hard palate visible	Most difficult



## Timeline

**- 5 min**

Assess risk, apply monitors, check equipment: “S-O-A-P-I-M”

Sniffing position

Preoxygenate/apneic oxygenation

Time Out for Safety

**- 2 min**

Premedicate

**0-1 min**

Sedate

Paralyze

**+ 1 min**

Direct Laryngoscopy.

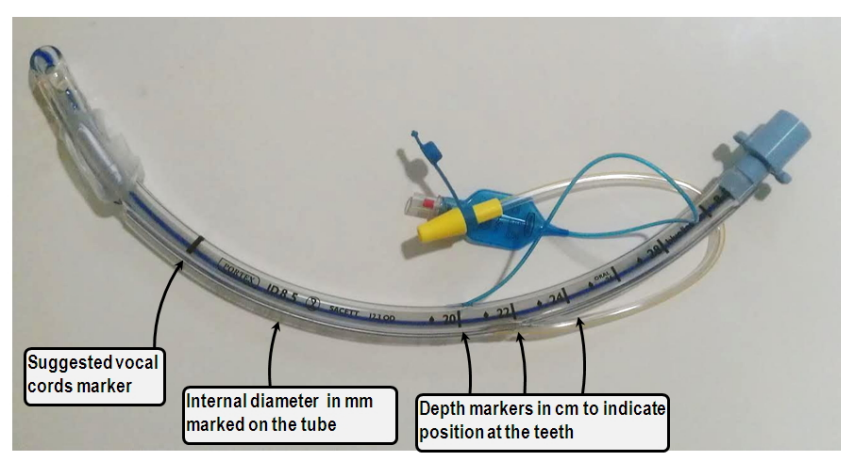
Intubate. Verify. Secure.

NG tube to decompress stomach.

# INTUBATION EQUIPMENT

Equipment	GRAY* 3-5 kg	PINK Small Infant 6-7 kg	RED Infant 8-9 kg	PURPLE Toddler 10-11 kg	YELLOW Small Child 12-14 kg	WHITE Child 15-18 kg	BLUE Child 19-23 kg	ORANGE Large Child 24-29 kg	GREEN Adult 30-36 kg
Resuscitation bag		Infant/child	Infant/child	Child	Child	Child	Child	Child	Adult
Oxygen mask (NRB)		Pediatric	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric/ adult
Oral airway (mm)		50	50	60	60	60	70	80	80
Laryngoscope blade (size)		1 Straight	1 Straight	1 Straight	2 Straight	2 Straight	2 Straight or curved	2 Straight or curved	3 Straight or curved
ET tube (mm) <sup>†</sup>		3.5 Uncuffed 3.0 Cuffed	3.5 Uncuffed 3.0 Cuffed	4.0 Uncuffed 3.5 Cuffed	4.5 Uncuffed 4.0 Cuffed	5.0 Uncuffed 4.5 Cuffed	5.5 Uncuffed 5.0 Cuffed	6.0 Cuffed	6.5 Cuffed
ET tube insertion length (cm)	3 kg 9-9.5 4 kg 9.5-10 5 kg 10-10.5	10.5-11	10.5-11	11-12	13.5	14-15	16.5	17-18	18.5-19.5
Suction catheter (F)		8	8	10	10	10	10	10	10-12
BP cuff	Neonatal #5/infant	Infant/child	Infant/child	Child	Child	Child	Child	Child	Small adult
IV catheter (ga)		22-24	22-24	20-24	18-22	18-22	18-20	18-20	16-20
IO (ga)		18/15	18/15	15	15	15	15	15	15
NG tube (F)		5-8	5-8	8-10	10	10	12-14	14-18	16-18
Urinary catheter (F)	5	8	8	8-10	10	10-12	10-12	12	12
Chest tube (F)		10-12	10-12	16-20	20-24	20-24	24-32	28-32	32-38

# TRADITIONAL DIRECT LARYNGOSCOPY (DL) ENDOTRACHEAL TUBES (ETT)



# APNEIC OXYGENATION



# GLIDESCOPE



# STORZ C-MAC VIDEO LARYNGOSCOPE



# MEDICATIONS (RSI)

## ■ Pre-treatment

- Atropine: prevents reflex bradycardia and secretions

## ■ Sedatives

- Midazolam: rapid acting; respiratory depression (use in normotensive)
- Etomidate: rapid acting; rapid acting; cerebroprotective; adrenal insufficiency (use in hypotensive)
- Ketamine: rapid acting; bronchodilator; increased ICP (use in hypotensive, status asthmaticus, sepsis)
- Fentanyl: rapid acting; analgesic; risk of chest-wall rigidity (use in sepsis)

## ■ Paralytics

- Depolarizing: Succinylcholine (ultra rapid onset and short duration; multiple contraindications)
- Non-depolarizing: Rocuronium (1-2mg/kg) (rapid onset; few side effects), Vecuronium, Pancuronium



# WHAT I TYPICALLY USE

- Neonate:
  - Atropine 0.02 mg/kg
  - Fentanyl 1-2 mcg/kg
  - Vecuronium 0.1 mg/kg
  
- Non-neonate:
  - Ketamine (2 mg/kg)
  - Rocuronium (1.2 mg/kg)



# KEY STEPS FOR ENDOTRACHEAL INTUBATION

- 1.** Using **RIGHT** fingers, open the mouth
- 2.** With blade in **LEFT** hand, insert gently to right of tongue and advance until visualization of tonsillar pillars
- 3.** Move blade to midline (sweep tongue to left side) and find epiglottis
- 4.** Lift **UP** and **AWAY** (No Rocking) to visualize the vocal cords
- 5.** Pass the endotracheal tube through the vocal cords

# TROUBLESHOOTING DIFFICULT VENTILATION

## MR. SOPA

**Mask adjustment (consider 2-handed technique)**

**Reposition airway (neutral or slightly extended)**

**Suction mouth and nose (bulb or catheter)**

**Open mouth (lift jaw forward)**

**Pressure increase (in 5-10 cm H<sub>2</sub>O increments to max 40 cm H<sub>2</sub>O)**

**Another alternative airway (ETT, LMA)**

## Know who to ask for help early!

- Local/regional Pediatricians
- ANMC Intensivists
- CRNAs
- Lifemed Crew

## DOPE

**Dislodged or Displaced tube**

**Obstruction of tube**

**Pneumothorax**

**Equipment malfunction/failure (ventilator, tubing, cords)**

# CONFIRMATION OF TUBE PLACEMENT

- Gold standard: End tidal CO<sub>2</sub>, but what if inadequate perfusion?
- Physical exam (chest rise, bilateral breath sounds) not reliable
- Chest x-ray not reliable as sole technique, may take time
- \*Quick: Reinsert blade and confirm ETT is thru vocal cords

# COVID CONSIDERATIONS

# ARDS

- Acute, diffuse inflammatory lung injury that leads to increased pulmonary vascular permeability, increased alveolar/interstitial edema and loss of aerated tissue
- Clinical hallmarks are hypoxia and bilateral infiltrates on CXR
- Pathologic hallmark is diffuse alveolar damage
- Evidence of oxygen impairment on PEEP  $\geq 5$  cmH<sub>2</sub>O
  - PaO<sub>2</sub>:FiO<sub>2</sub>@ ratio
    - Mild: P/F = 201 to  $\leq 300$
    - Moderate: P/F = 101 - 200
    - Severe P/F =  $\leq 100$

# AEROSOL GENERATING PROCEDURES

- Examples:
  - Intubation/Extubation
  - Non-invasive ventilation
  - Nasotracheal suction
  - Nebulizers/humidification via Tracheostomy
  - CPR
- **Society for Critical Care Medicine and European critical care societies all agree after review of literature that HFNC is NOT aerosol generating.**

# REDUCE RISK





# GOALS

- **Minimize risk to staff in the room**
  - Full PPE
  - Minimum amount of people necessary
- **Minimize contamination of equipment/supplies for future patients without COVID-19**
  - Have what you need in the room
  - Take everything else out of the room or cover it up
  - Have a clean “runner” to get extra equipment if needed
  - Precautions to prevent contamination of inside of ventilators, ETCO2 monitors

## PPE CHECKLIST

Eye Shield

Goggles

Level 3 gown/Bunny suit

Shoe Covers

Hair cover

2 Pairs of Gloves

EXTRA 2 Pairs of Gloves

N95 in your size

PAPR Hood, Charged Battery, Filters

Hand Sanitizer in and out of room



Adapted from ANMC Intubation Procedure COVID19

<https://anthcstaff.org/covid-19-updates/>

# DONNING/DOFFING - PRACTICE

## Donning

- Hand hygiene
- Shoe covers
- Gloves (first pair)
- Gown
- Respirator N95
- Head cover
- Eye protection (mask with splash guard)
- Gloves (second pair)

## Doffing

- Gown with top gloves
- Shoe covers
- Hand hygiene
- Eye protection (without touching the front of the mask)
- Head cover
- Gloves
- Hand hygiene
- Leave the room
- Respirator N95 (without touching the front of the mask)
- Hand hygiene

## PHYSICIAN CHECKLIST

INTUBATION EQUIPMENT	DIFFICULT AIRWAY
DL Laryngoscope Handles	(ready outside the room, avoid bringing into room and contaminating unless high suspicion they'll be needed)
DL Blades	Laryngeal Mask Airway
Glidescope, Power Cable	Cric set
Plastic Glidescope Blades	
Endotracheal Tubes	
Stylet	
5-10 cc syringe	
Lube	
Mayo Stand	

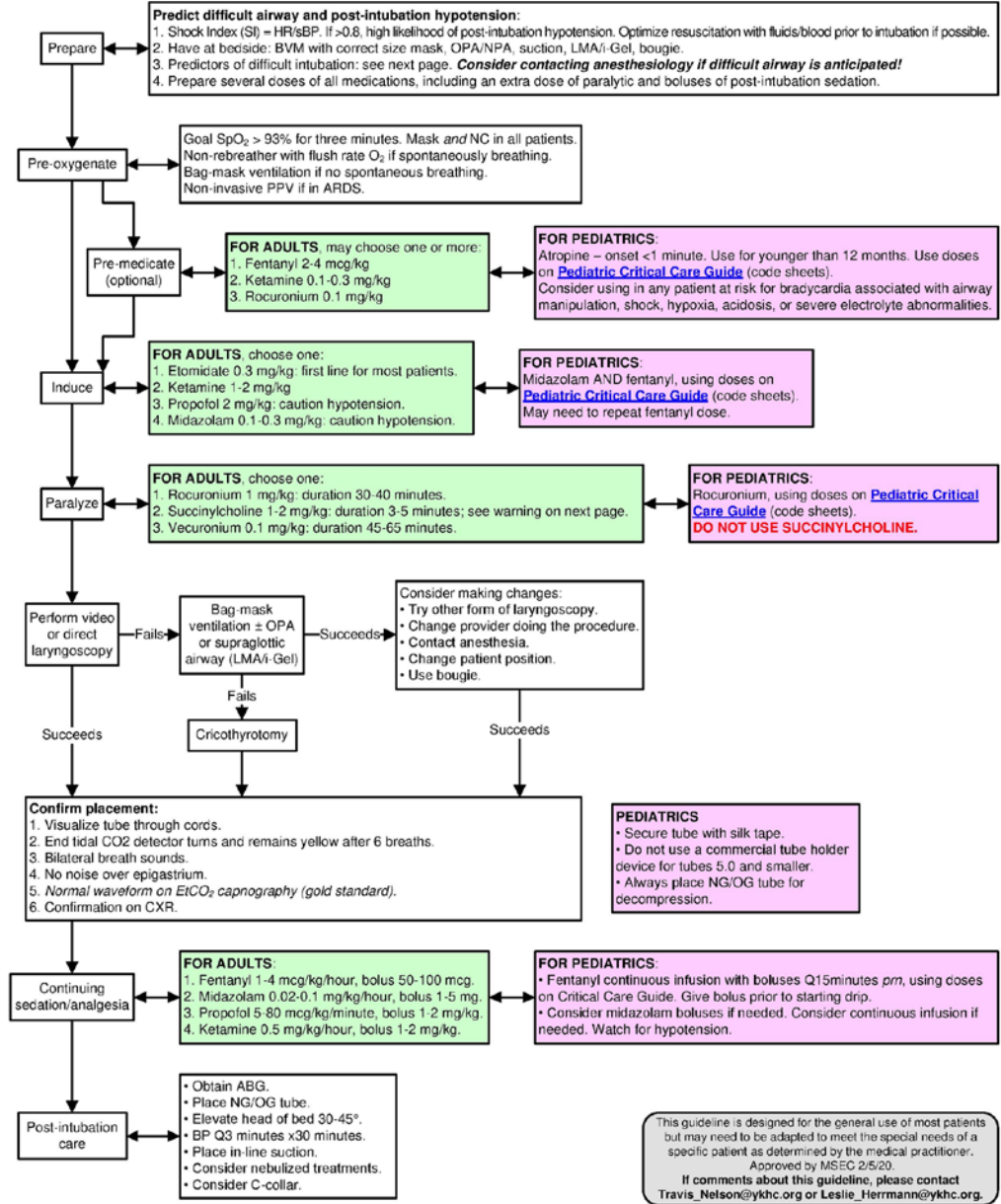
Adapted from ANMC Intubation Procedure COVID19

<https://anthcstaff.org/covid-19-updates/>

# INTUBATION TIPS FOR COVID

- Neg pressure room (if possible)
- Most experienced provider
- Full PPE
- Paralyze with hefty dose to minimize coughing (1.2 mg/kg of rocuronium)
- Keep tight mask seal until end of expiratory phase and ready to intubate
- Stand as far away from the face as possible (use video laryngoscope)
- Do not ventilate until cuff is fully inflated
- In-line suction
- Viral filter on endotracheal tube
- If need to disconnect endotracheal tube from ventilator circuit or mapleson, clamp the endotracheal tube

# APPENDICES



[https://ykhc.org/wiki/Intubation\\_%E2%80%93\\_Adult\\_and\\_Peds](https://ykhc.org/wiki/Intubation_%E2%80%93_Adult_and_Peds)

# Clinical Pathways Program



Our Clinical Pathways Program within the Center for Healthcare Quality & Analytics aims to incorporate evidence, best practice, and local expert consensus into easily accessible, shared mental models for use by clinical teams at the point of care to facilitate the delivery of high quality medical care.

[Learn more about the Clinical Pathways Program at CHOP](#)

## FIND A CLINICAL PATHWAY

Search

1 - 3 of 3

### [2019 Novel Coronavirus \(COVID-19\) Clinical Pathway — Ambulatory](#)

The Ambulatory Coronavirus Pathway provides guidance for the evaluation and care of patients with laboratory-confirmed 2019-nCoV or who is under investigation for 2019-nCoV while that patient was ill.

### [2019 Novel Coronavirus \(COVID-19\) Clinical Pathway — Emergency](#)

The ED Coronavirus Pathway provides guidance for the evaluation and care of patients with laboratory-confirmed 2019-nCoV or who is under investigation for 2019-nCoV while that patient was ill.

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Patients and families are at the center of

<https://www.chop.edu/clinical-pathway/airway-difficult-critical-clinical-pathway>



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# RESOURCES ON VENT MANAGMENT

Society of Critical Care Medicine : Critical Care for the Non-ICU Clinician

<https://covid19.sccm.org/nonicu.htm>

Hamilton E-learning on ventilation:

[https://www.hamilton-medical.com/en\\_US/E-Learning-and-Education/College.html](https://www.hamilton-medical.com/en_US/E-Learning-and-Education/College.html)

ARDSnet protocol:

[http://www.ardsnet.org/files/ventilator\\_protocol\\_2008-07.pdf](http://www.ardsnet.org/files/ventilator_protocol_2008-07.pdf)

WHO technical guidance for COVID:

<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance>

*Many excellent Youtube videos on basics of mechanical ventilation and PPE donning and doffing!!*