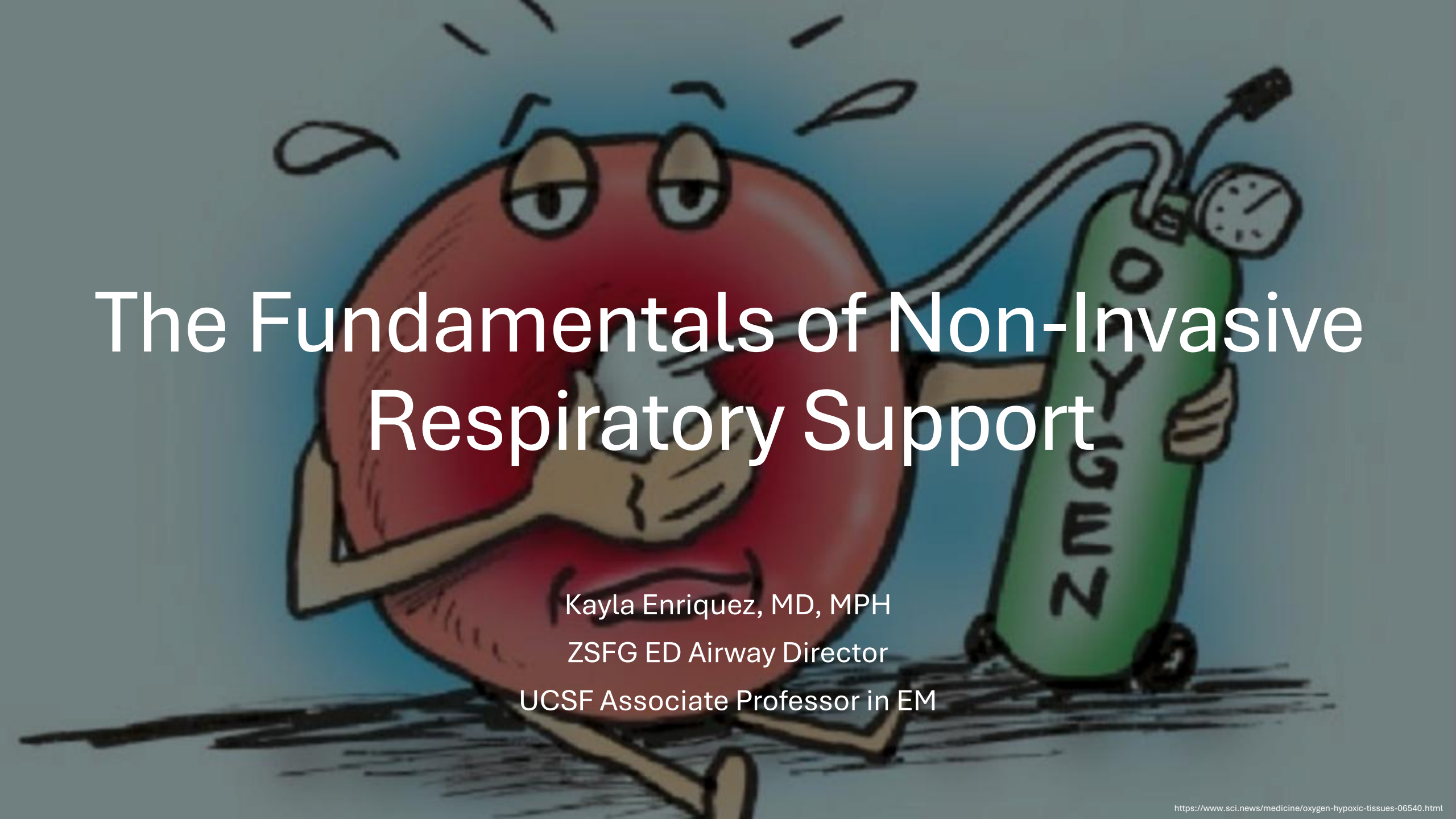

The Fundamentals of Non-Invasive Respiratory Support

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https://www.sci.news/medicine/oxygen-hypoxic-tissues-06540.html

Financial Disclosures

- None

Objectives

- Familiarity with your ED Oxygen Toolkit
- When to use non-invasive respiratory support
- Understand the ins and out of high flow nasal canula (HFNC)
- Understand when, why and how to use non-invasive positive pressure ventilation
- Become comfortable with delayed sequence intubation

https://www.alibaba.com/product-detail/1-5L-Medical-Oxygen-Regulators-Oxygen_1601159156290.html

https://onlinelibrary.wiley.com/doi/10.1155/2020/8873156

https://www.physio-pedia.com/Cyanosis

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ED oxygen toolkit

- Nasal Canula
- Simple Facemask
- Non-rebreather
- High Flow Nasal Cannula
- BiPAP/CPAP
- BVM
- LMA
- Definitive airway

Non-invasive Respiratory Support

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Non-Invasive Respiratory Support

- Safe and effective in mild to moderate hypoxemia
- Best when respiratory failure has a reversible cause
  - Serves as a bridge while treatments work on underlying issues
- Preserves physiological pathways for airway protection
- Helps maintain adequate oxygenation and ventilatory support
- Addresses pathology that can result in intubation
  - Hypercapneic encephalopathy
  - Hypoxemia
  - Respiratory muscle exhaustion

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Goals of NIV Respiratory Support

- Maintain adequate oxygenation
- Provide adequate ventilatory support
  - Comfort
  - Decreased respiratory muscle fatigue
- Allow for secretion clearance
- Protect airway
- Maintain stable or improving condition

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Case # 1: Multifocal PNA

- 32 yo, PMH HIV, anxiety, presenting with cough and fever x 1 week with worsening over the past 2 days.

- BP: 90/50
- HR: 120
- RR: 30
- O_2 Sat: 90% on ra
- Temp: 39.5 ^{oC}

https://journals.sagepub.com/doi/10.1177/0885066614538753

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Problem List

- Sepsis
- Respiratory distress
- Immunocompromised?
- Time

What next?

a) The patient is oxygenating and ventilating OK, keep on NC and admit.
b) Secure a definitive airway now- we all know where this is going
c) Escalate oxygen amount delivered via simple facemask then NRB if facemask does not help
d) Place the patient on CPAP/BiPAP
e) Place the patient on HFNC

High Flow Nasal Canula

- Unique mode of noninvasive respiratory support:
  - Warmed, humidified oxygen
  - FiO_2 of 0.21 to 1.0
  - Flow rate as high as 60 L/min
- Improved patient comfort
- Many physiological advantages
  - Reduces WOB/RR
  - Anatomical dead space washout
  - PEEP
  - Fraction of Inspired Oxygen

https://www.draeger.com/en-us_us/Products/HI-Flow-Star-System

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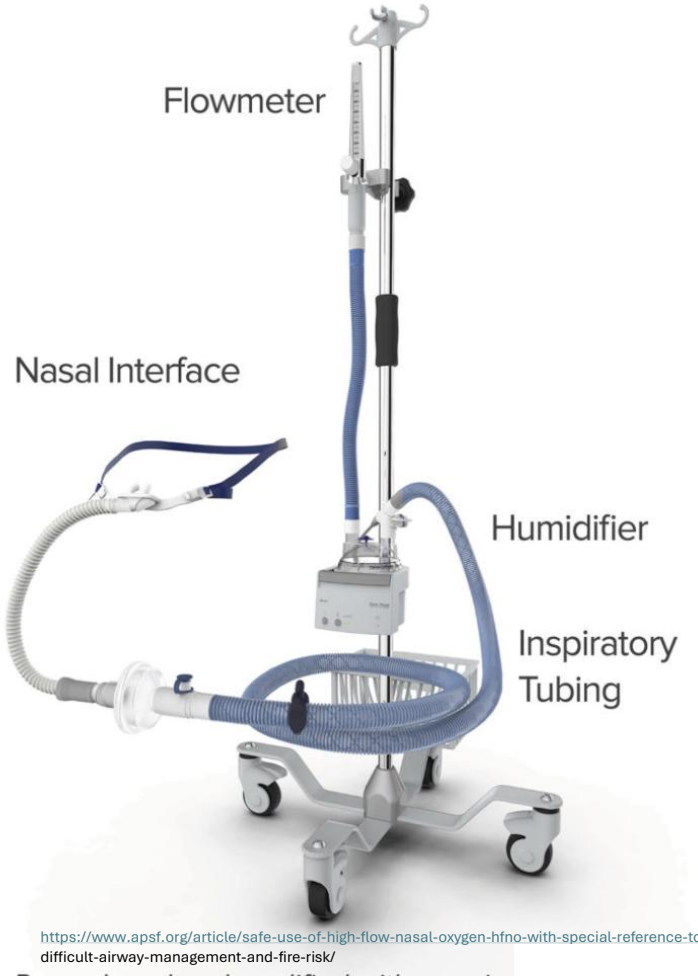
When and How to use HFNC

- High-flow demands
  - Parenchymal disease with low pressure needs
  - Acute respiratory failure with minimal hypercarbia
  - Pre-oxygenation/post extubation oxygenation
- Inability to tolerate NIPPV

- Set flow rate
  - Start at 20-35 L/min (range is 5-60 L/min)
- Set FiO_2
  - Start around 60% (range 21%-100%)
- Hypoxemia severity (PaO_2/FiO_2)



https://www.apsf.org/article/safe-use-of-high-flow-nasal-oxygen-hfno-with-special-reference-to-difficult-airway-management-and-fire-risk/

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High-Flow Oxygen through Nasal Cannula in Acute Hypoxemic Respiratory Failure

Authors: Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D., Christophe Girault, M.D., Ph.D., Stéphanie Ragot, Pharm.D., Ph.D., Sébastien Perbet, M.D., Gwénael Prat, M.D., +23, for the FLORALI Study Group and the REVA Network* Author Info & Affiliations

Published June 4, 2015 | N Engl J Med 2015;372:2185-2196 | DOI: 10.1056/NEJMoa1503326 | VOL. 372 NO. 23

- Acute hypoxemic respiratory failure WITHOUT hypercapnia
- Compared HFNC vs FM vs NIPPV

- Results: Intubation rate same, 90-day mortality & Vent free days better with HFNC

Randomized Controlled Trial of Humidified High-Flow Nasal Oxygen for Acute Respiratory Distress in the Emergency Department: The HOT-ER Study

Peter G Jones [1], Sinan Kamona [2], Owen Doran [2], Frann Sawtell [2], Margaret Wilsher [3]

Affiliations + expand

PMID: 26577199 DOI: 10.4187/respcare.04252

- Patients with various underlying pulmonary disease showing sign of respiratory distress
- Compared HFNC vs traditional O2 delivery

- Results: Trends of lower intubation rates after 24 hrs but higher 90-day mortality however not statistically significant

High-Flow Nasal Oxygen vs Noninvasive Ventilation in Patients With Acute Respiratory Failure

The RENOVATE Randomized Clinical Trial

RENOVATE Investigators and the BRICNet Authors

JAMA. Published online December 10, 2024. doi:10.1001/jama.2024.26244

- 5 groups with respiratory failure
- Compared HFNC vs NIPPV

- Results: HFNC non inferior to NIPPV at preventing intubation and mortality at 7 days

Back to our Case

- Patient was started on HFNC at 30 L/min, 60% FiO_2
- Work of breathing improved
- Was able to go to the floor instead of ICU
- No decompensation resulting in intubation

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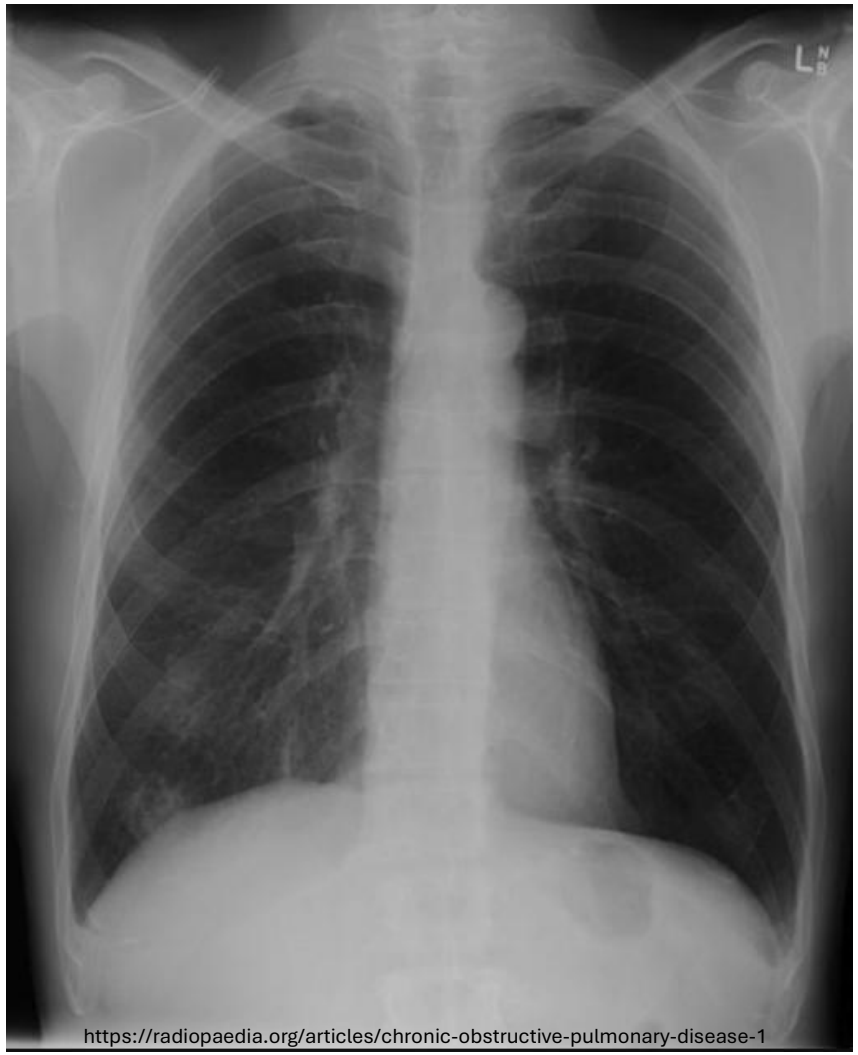
Case # 2: Pink Puffer

- 73 yo, PMH COPD/asthma, ILD, presenting with progressively worsening SOB, productive cough and wheezing.

- BP: 160/95
- HR: 100
- RR: 28
- O_2 Sat: 88% on ra
- Temp: 37 ^{oC}



https://radiopaedia.org/articles/chronic-obstructive-pulmonary-disease-1

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Problem list

- COPD (lung disease, complicates oxy/vent, airway management)
- Work of breathing
- Hypoxia
- Somnolence which we have to assume is due to hypercarbia

What next?

a) Intubation is our only option, NIPPV is CI due to mental status and respiratory drive (diminished due to tiring out)
b) HFNC will offer some pressure support and increase oxygenation while being comfortable for the patient
c) BiPAP is preferred due to offering stronger ventilatory support than other interventions and being non-invasive
d) Continuation of medication management and slow increase of oxygention delivery methods to meet O2 requirements
e) Phone a friend

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Contraindications to NIVVP

- Patient is not tolerating
  - Can try sedation with close observation
- Inability to get good seal due to facial abnormalities, trauma, etc.
- No spontaneous respirations or bradypnea
- Mental status changes**
- High risk for aspiration
  - Active vomiting or pathophysiology that can result in vomiting


https://www.indiamart.com/proddetail/bipap-cpap-mask-7190883862.html

When to use NIVVP

- Hypoxia
- Increased work of breathing
- AMS with high suspicion for CO_2 retention
- Pre-oxygenation for intubation

- Strongest evidence for use in:
  - Acute pulmonary edema and Bronchospasm (asthma, COPD)
  - Reduces rate of intubation

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How to use NIVVP

- CPAP- usually pressure set at 5 cmH_2O
- BiPAP- Pressure support + PEEP
  - PEEP 5-8 cmH_2O, pressure support 8-14 cmH_2O

- Set FiO_2 based on O2 requirements
- PEEP- setting for oxygenation needs. Start at 5 and titrate up
  - ARDS, PNA, atelectasis
- PSV/inspiratory pressure- setting for ventilation needs. Start at 5 and titrate up
  - COPD, asthma

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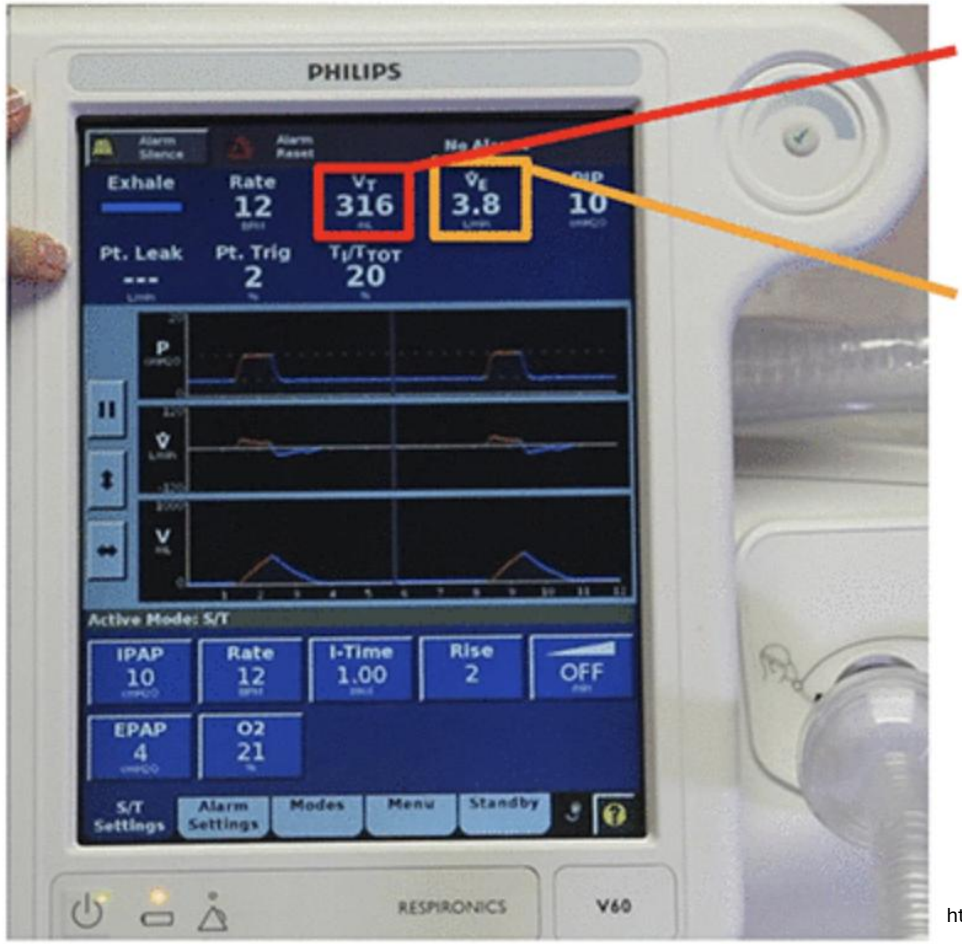
NIVVP Monitoring

- Oxygenation
- Work of breathing
- Mentation
- BiPAP Monitor
- ABG/VBG

- Frequent assessments



Tidal volume

- Normal ~ 6 cc/kg (~400 ml)
- Very low tidal volumes (<4-5 cc/kg) suggest hypoventilation.

Minute ventilation

- Normal ~6-7 liters/min.
- Very low minute ventilation (<5 liter/minute) suggests hypoventilation.

https://emcrit.org/pulmcrit/bipap-hfnc/

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Back to our Case

- VBG showed a CO_2 of 110
- Patient was put on BiPAP with close monitoring (nurse did not leave the room)
- Serial VBG's and frequent patient assessments showed improvement over time
- Pt admitted to the ICU on BiPAP

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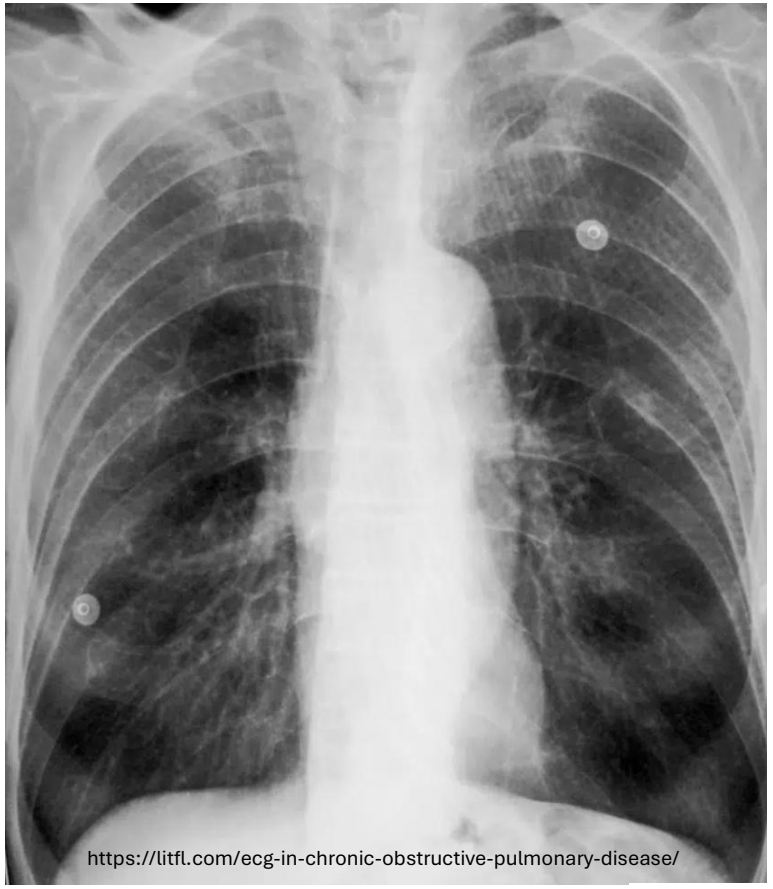
Case # 3: COPD with Respiratory Failure

- 65 yo, PMH COPD, pulmonary fibrosis, presenting in respiratory distress. Unable to give further history. H/o many intubations.

- BP: 160/100
- HR: 100
- RR: 34
- O_2 Sat: 89% on NC
- Temp: 37 ^{oC}


https://litfl.com/ecg-in-chronic-obstructive-pulmonary-disease/

Airway Issues

- Distress
- Oxygenation and Ventilation issues
- Altered Mental Status
- Time

WHAT NEXT???

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MEDICATION
PREPARATION
AREA
KEEP CLEAR

Delayed Sequence Intubation

- Procedural sedation to help facilitate pre-oxygenation
- Breaks up RSI sequence:
  - 1st induce- keep patient breathing
  - 2nd paralyze- only push paralytics when ready
- Helps to:
  - Denitrogenate the lungs
  - Pre-oxygenation
  - Gastric emptying- GI bleeder, vomiter, etc
  - Control of the room

https://depositphotos.com/stock-photos/hospital-ventilator-patient.html?qview=86079224

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Delayed Sequence Intubation

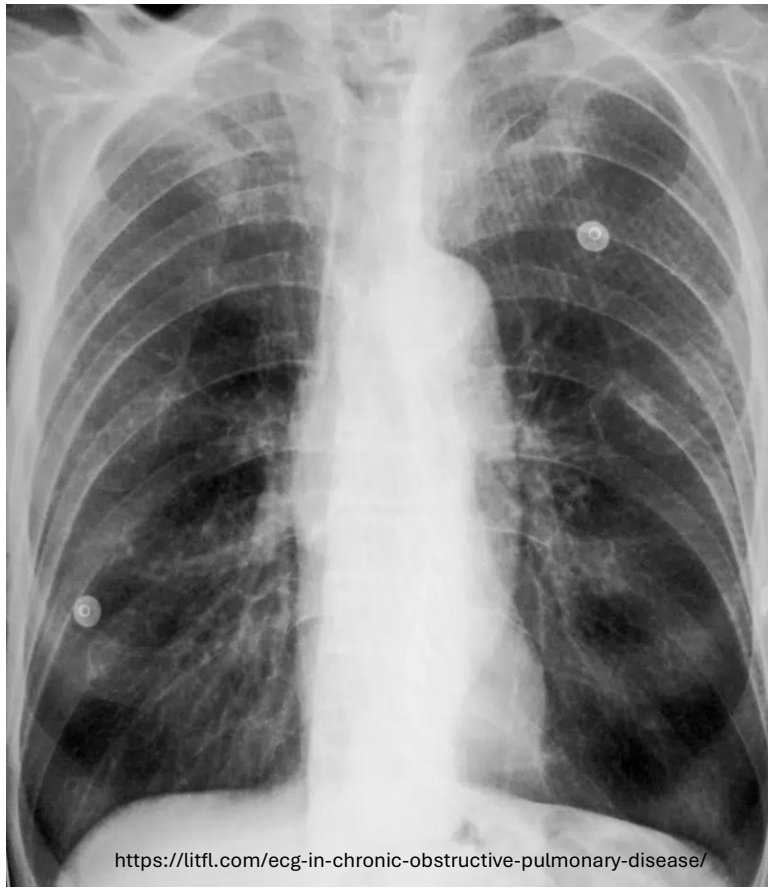
- Ketamine (1mg/kg) then 0.5mg/kg as needed
- 3 minutes to allow for pre-oxygenation and denitrogenation
  - NC
  - NRB
  - BiPAP
- Paralyze and intubate

DSI gone wrong

- Peri-procedural emesis
- Affects on intracranial pressure and cardiovascular stability
- What happens if the patient goes apneic?
  - Has not been reported unless push ketamine fast and only lasts 15-30 seconds
  - If happens and get into a bind, push paralytic and RSI- same position you were in previously

Back to our Case

- 100mg ketamine given slowly
- 3-minute timer started
  - BiPAP applied to help better oxygenate/ventilate
  - Another IV placed
  - Equipment setup (including back-up bougie, LMA, cric kit)
- Video Larnygoscopy with apneic oxygenation



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Take Away's

- Non-invasive respiratory support is a temporary bridge
- Non-invasive respiratory support improves Oxygenation/ventilation, decreases work of breathing and can help prevent invasive airway management
- HFNC is best in patients with parenchymal disease not requiring a lot of pressure support (PNA, ARDS, ILD)
- NIVVP is best for patients that require more pressure support (CHF, bad COPD/asthma, diaphragmatic issues)
- DSI can effectively pre-oxygenate the agitated patient requiring intubation

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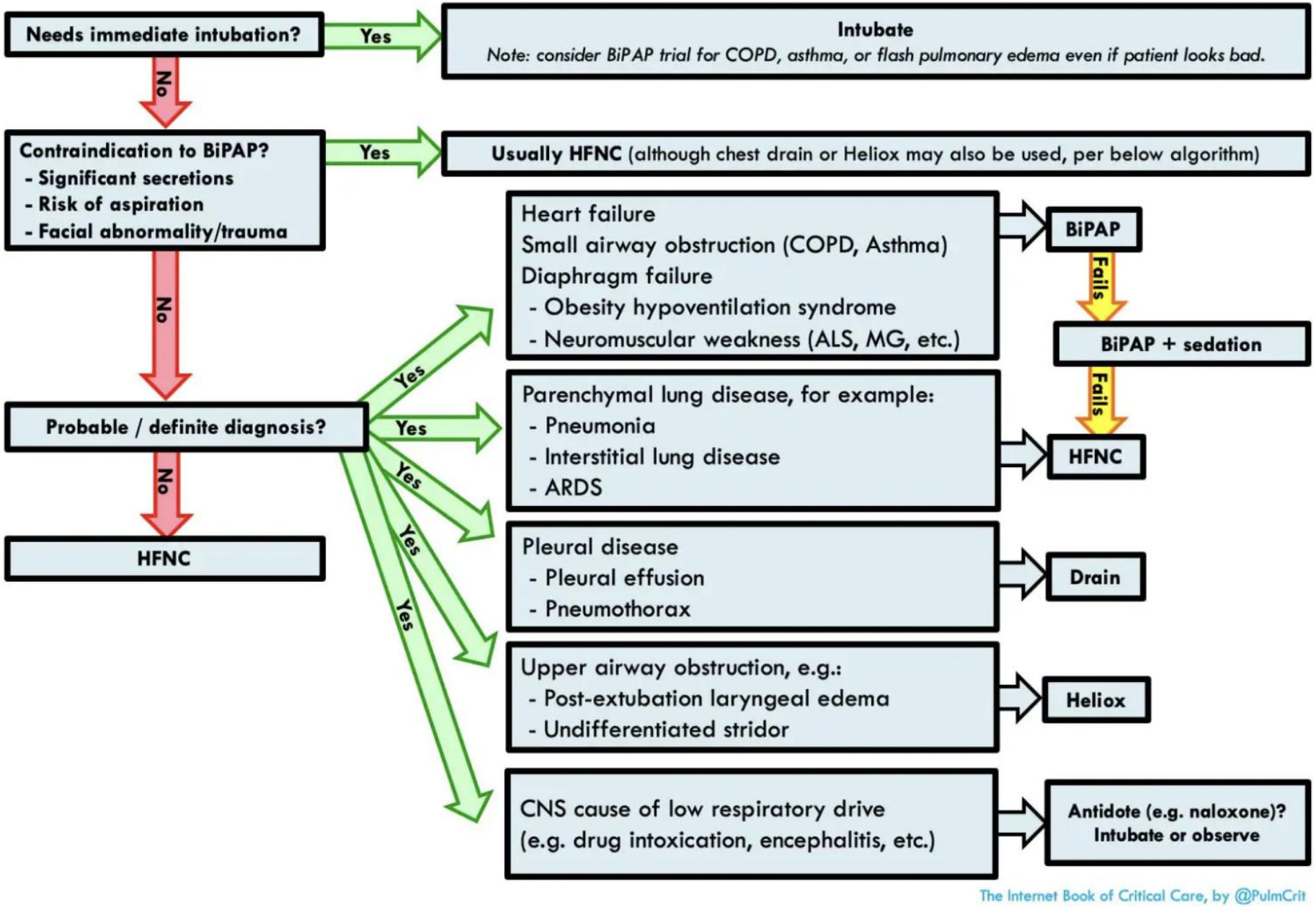
Cognitive schema for selecting a mode of respiratory support



https://emcrit.org/ibcc/support/

Questions?
Thank you!

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- https://emcrit.org/pulmcrit/bipap-hfnc/
- https://www.thebottomline.org.uk/summaries/icm/renovate-high-flow-vs-niv/

Overall, varied results for impact on intubation rate and mortality

HFNC benefit- reduced WOB and improved comfort