Current Respiratory Care for Inpatient Therapists

- Physical Therapy
- Occupational Therapy
- Speech and Language Pathology

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Objectives

- Define and describe different diseases and disorders of the respiratory system
- Identify & discuss advantages and disadvantages of different oxygen delivery devices
- Indications, patient selection, and mobility implications of HHFNC and Non-invasive ventilation strategies
- Discuss indications, modes, Arterial blood gases, and waveforms for positive pressure mechanical ventilation
- Identify and highlight important aspects of care of patients with endotracheal or tracheostomy tubes
- Examine the impacts of ABCDEF bundle on therapy teams
- Discuss opportunities for coordination of care and early mobility strategies between RT and OT/PT/SLP in the critical care setting and beyond

Pulmonary Diseases

- Chronic Obstructive Pulmonary Disease
  - COPD is characterized by airflow obstruction and an abnormal inflammation response in the lungs, typically due to long term exposure to noxious particles and gases, particularly cigarette smoke.
  - This response may result in:
    - Mucous hypersecretion - **chronic bronchitis**
    - Tissue destruction – **emphysema**
    - Small airway inflammation and fibrosis – **bronchiolitis**
  - The airway obstruction progressively traps air during expiration, resulting in hyperinflation. Hyperinflation reduces the inspiratory capacity and therefore the functional residual capacity during exercise. These features result in breathlessness and limited exercise capacity typical of COPD.
  - COPD patient's breath sounds will typically have wheezes as air moves through the much smaller inflamed airways. Depending on severity of the disease, even very little movement such as bending over or standing can cause breathlessness as it is difficult to move air through the obstructed airways.

Pulmonary Diseases

- Pursed lip breathing
  - Releases trapped air in the lungs
  - Keeps the airways open longer and decreases the work of breathing
  - Prolongs exhalation to slow the breathing rate
  - Relieves shortness of breath
  - Causes general relaxation
- How to coach pursed lip breathing

1. Relax your neck and shoulder muscles.

2. Breathe in (inhale) slowly through your nose for two counts. Don't take a deep breath; a normal breath will do. It may help to count: inhale, one, two.

3. Pucker or "purse" your lips as if you were going to whistle or gently flicker the flame of a candle.

4. Breathe out (exhale) slowly and gently through your pursed lips while counting to four. It may help to count to yourself: exhale, one, two, three, four.

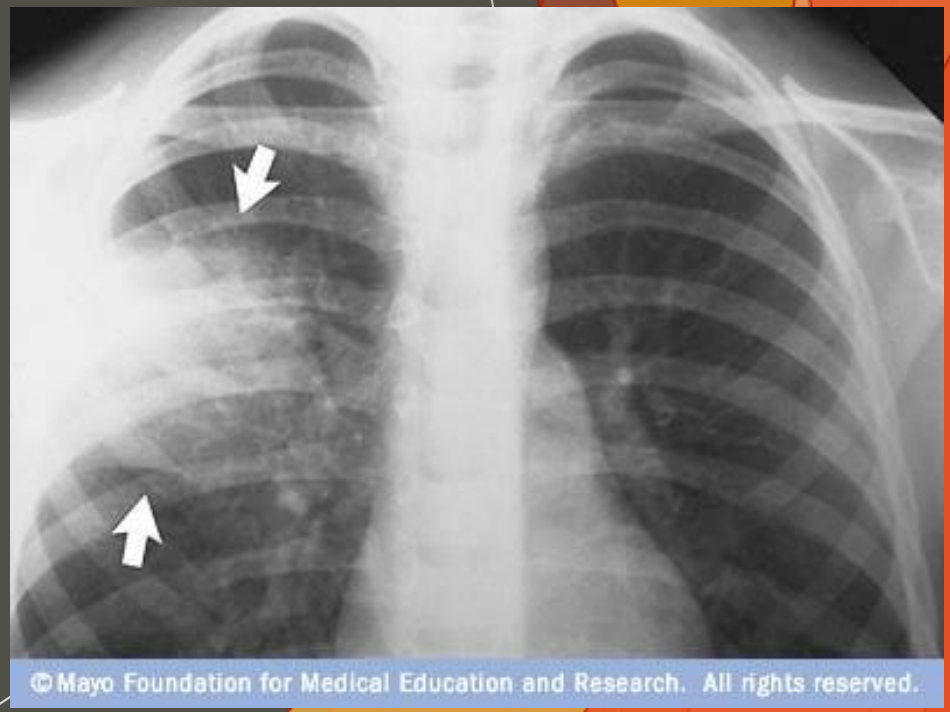
Pulmonary Diseases

Pneumonia (PNA)

- Pneumonia is an infection in the lungs which could be caused by a bacteria, virus or fungi.
- Inflammation, fluid or pus accumulates in the alveoli restricting gas exchange.
- The following can increase severity or likely hood of illness:
  - Age: infants or children under 2yrs and people over 65yrs.
  - Chronic lung diseases or chronic illness
  - Weakened immune systems or recent respiratory infections
  - Drug abuse or difficulty swallowing (Aspiration PNA)
  - Hospitalizations (Hospital acquired PNA or ventilator associated PNA)
  - Smoking or exposure to chemicals or pollutants

- Severe complications of Pneumonia include:
  - Respiratory Failure
  - Sepsis
  - ARDS
  - Lung abscesses

- Mobilizing these patients can assist them with breaking up secretions in the lungs.



Pulmonary Diseases

- Interstitial Lung Disease
  - Definition: a set of diseases leading to fibrosis and scarring of the lung tissue
  - Tend to progress quickly
  - Very difficult to oxygenate- most likely on Home oxygen. Minimal oxygen reserve.

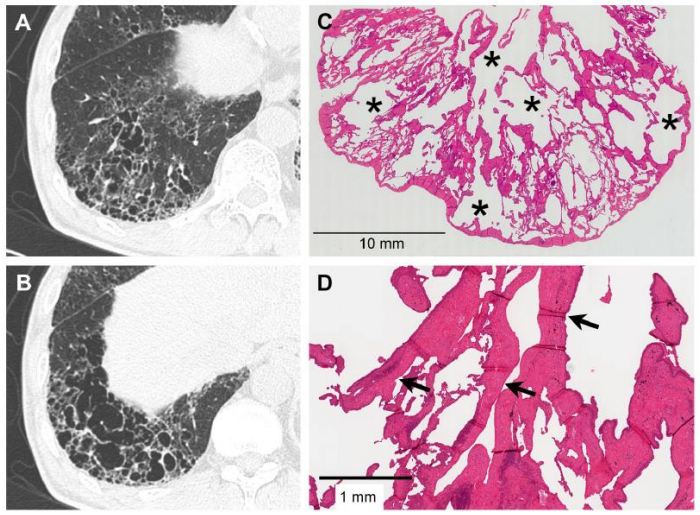
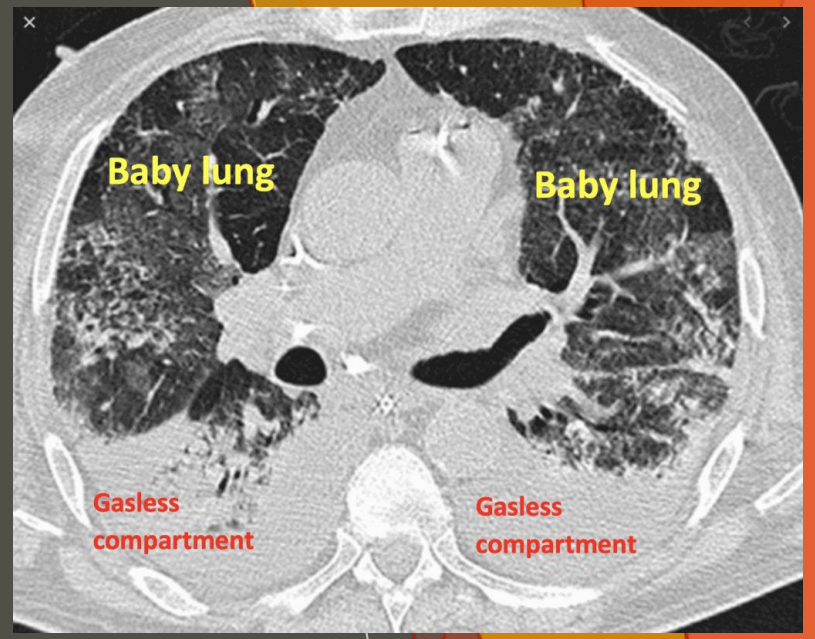


Figure 3 Severe SRIF with emphysema pattern on thin-section CT images and histological findings.
Notes: (**A** and **B**) Thin-section CT images showing clustered cysts of markedly irregular size and shape accompanied by ground-glass attenuation with reticular structures in the surrounding area. (**C**) Low-power photograph of a histological section (hematoxylin–eosin stain) reveals irregularly shaped emphysematous spaces (asterisk) with collagenous fibrotic walls. Many of the walls are truncated. Patchy fibrosis is observed in the intervening lung parenchyma and corresponds to ground-glass attenuation with reticular structures on thin-section CT. Irregular cysts with thickened walls tend to be present a little apart from the pleura with less-involved subpleural lung parenchyma. (**D**) On this high-power photograph of a histological section, fibrosis consists of hyalinized paucicellular fibrosis (arrow) corresponding to SRIF.
Abbreviations: SRIF, smoking-related interstitial fibrosis; CT, computed tomography.

Pulmonary Diseases

- ALI/ARDS
  - ALI: Acute Lung Injury
    - a syndrome of inflammation and increasing permeability that is associated with a constellation of clinical, radiologic, and physiologic abnormalities that cannot be explained by, but may coexist with, left atrial or pulmonary capillary hypertension
  - ARDS: Acute Respiratory Distress Syndrome
    - Non-compliant lungs→ Poor oxygenation and gas exchange
    - P/F ratio < 300
    - Pulmonary vasoconstriction
    - High mortality rate (27-45%)
    - Treatments: Mechanical ventilation, proning, inhaled pulmonary vasodilators
  - Considerations
    - Very unstable respiratory status, long mechanical ventilation times, prone positioning, long recovery times



Acute Care - Inpatient Care

What do we expect these patients to look like when in the hospital?

Disease	Presentation	Treatment/Therapy
aeCOPD	SOB, hypercapnia	O_2, NIV, SVN, intubation
PNA	SOB, retained secretions	O_2, pulmonary hygiene, NIV, intubation
ILD	SOB, low O_2	high FiO_2, HHFNC, intubation
ARDS/ALI	Sepsis, lung trauma	intubation, proning, NIV/HHFNC

Med-surg floor unit

Intermediate unit

Critical Care Unit

Oxygen Therapy

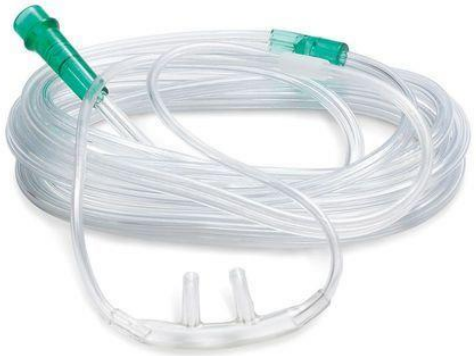
- **Indications** – treats **hypoxemia = PaO2:less than 60mmHg or SaO2:less than 90%**
  - **PaO_2 = arterial partial pressure of oxygen** measured on an arterial blood gas result
  - **SaO_2 = arterial oxygenation saturation** measured on an arterial blood gas result

- SpO_2 = Peripheral capillary oxygen saturation
  - Measured by pulse oximetry, which provides an indirect measurement of arterial oxygenation based on the differential absorption of light by oxygenated and deoxygenated blood during pulsatile blood flow.

- Definition of **FiO_2** = Fraction of inspired oxygen.
  - Ex: Ambient air is 0.21 or also known as 21% concentration

Oxygen Devices

Nasal Cannula



- Run at 1-6 LPM
- Gives 24-44% FiO_2

Venturi mask “Venti-mask”

- Runs at 5-15 LPM
- Gives 28-50% FiO_2

Oxygen Devices

Oxymizer

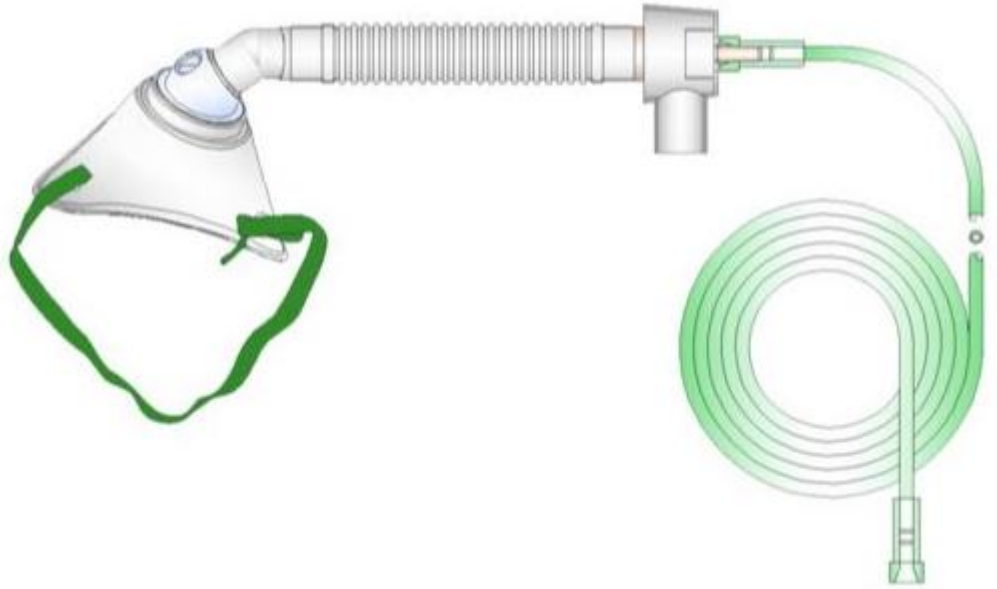
- Run at 6-12 LPM
- Gives 52-82% FiO_2

Non-rebreather mask

- Runs at 15 LPM
- Gives 100% FiO_2

Oxygen Devices

Trach – Venturi Mask



- Runs at 5-15 LPM
- Gives 28-50% FiO_2

High Flow Nasal Cannula-What is it?

- Background:
  - A heated, humidified nasal cannula, capable of providing higher flows to supplement the patient's spontaneous inspiratory flow
- HHFNC vs NIV
- HHFNC vs NC

Why use HHFNC?

- Benefits of HHFNC for the respiratory system
  - Treats hypoxemic respiratory failure
  - Assists work of breathing
    - Supplements tidal volume, decreases tachypnea & air-hunger
  - Supports ventilation with positive pressure

Hypoxemic respiratory failure:

- needing ≥ 4 L/min O2 for 4 hours, or
- ≥ 6 L/min O2 via face mask for 2 hours, and/or
- respiratory rate of ≥ 25 breaths / minute

How it helps

- HFNC
  - Delivers positive airway pressure → increases oxygenation
  - Decreases WOB → Splints airways open, decreases airway resistance
  - Provides PEEP → Recruits alveoli for better gas exchange, minimizes dead space ventilation (more on this later)
  - Supplements mucociliary clearance → minimizes secretions that block air flow and prevent gas exchange

How much PEEP does it *actually* provide?

- PEEP (positive end-expiratory pressure) stents the airways open and leads to better oxygenation
  - Studies have shown differing levels of PEEP are provided depending on how much flow is provided.
  - PEEP pressures have been shown to range anywhere from 1.5-5.3 cmH_2O
    - This requires the patient to breath with their mouth closed AND have a cannula that completely occludes the nares.

What are we concerned about with these patients?

- Decreased coordination to safely breath/swallow
- Decreased respiratory drive-inability to forcefully expectorate
- Possible decreased sensation
- Higher flows lead to resistance to expiration, such as during swallowing → increased risk of aspiration at higher flows (Arizono et. Al)

HHFNC & SLP

- It may be beneficial to evaluate swallowing ability in patients on HHFNC before allowing oral intake, especially at higher flows (Arizono et al)
  - WST and RSST are rapid, simple tests for patients on HHFNC
- "The Impact of High-Flow Nasal Cannula on Swallow Function" (Alshuwaikhat, H., Scott, B.).
  - SSF was not significantly affected by HHFNC regardless of flow
- "Effects of different high-flow nasal cannula flow rates on swallowing function" (Arizono, et al.).
  - Flow rates > 40Lpm increased aspiration risk
  - Flow rates > 20Lpm increased swallowing effort

HHFNC & Mobility

- While some patients may benefit from the higher flow, precise FiO_2 delivered by the High-Flow Cannula during mobilization, there are some important considerations to take prior to, and during therapy sessions:
  - It may be beneficial to increase the patient's FiO_2 prior to or during the session, as these patients may be at higher risk of desaturating on exertion. Doing so may allow the patient to tolerate more therapies. Discuss with your RT prior to starting with the patient to make a plan.
  - Some HHFNC modalities allow for more freedom than others
    - Airvo2 must be plugged into an outlet at all times, limiting the distance a patient can be moved from the bedside
    - Older versions using an oxygen blender can be run on an O_2 tank, but drain the tank QUICKLY
    - V60's in high-flow mode can be used for mobility, but are bulky and also drain O_2 tanks QUICKLY

Weaning

- Coordinating with Physicians, APPs, and the bedside RN, RT's work to determine the best plan of weaning patient's from HHFNC, typically working toward a low-flow NC.
  - More often than not, we will attempt to wean the flow down to 30-40 Lpm, paying close attention to the patient's WOB and respiratory pattern
  - FiO_2 is weaned separately, titrating for the goal SpO_2 ordered by the care team
    - 92-95%
    - 88-92%
    - Goal is to wean to FiO_2<45%, as this can be provided by a low-flow NC

BiPAP

- **BiPAP** stands for **Bi**level **P**ositive **A**irway **P**ressure
  - Uses two levels of pressure to help improve ventilation
    - IPAP (Inspiratory Positive airway pressure)
    - EPAP (Expiratory positive airway pressure)
  - IPAP-EPAP=PSV
    - The difference between IPAP and EPAP creates a pressure gradient called PSV (pressure support ventilation).
    - More PSV=More ventilation

CPAP

- **CPAP** stands for **C**ontinuous **P**ositive **A**irway **P**ressure
  - The constant pressure helps stent airways open and prevent areas of collapse or obstruction and push out unneeded fluid. CPAP increases the functional reserve capacity (the volume of air remaining in the lungs post exhalation)
  - Best used for CHF/pulmonary edema or Obstructive Sleep Apnea (OSA)
  - Improves Oxygenation issue.

BiPAP & CPAP

Devices

V60

Autopaps

Masks

Nasal Mask

Full Mask

Total Mask

V60 Screen

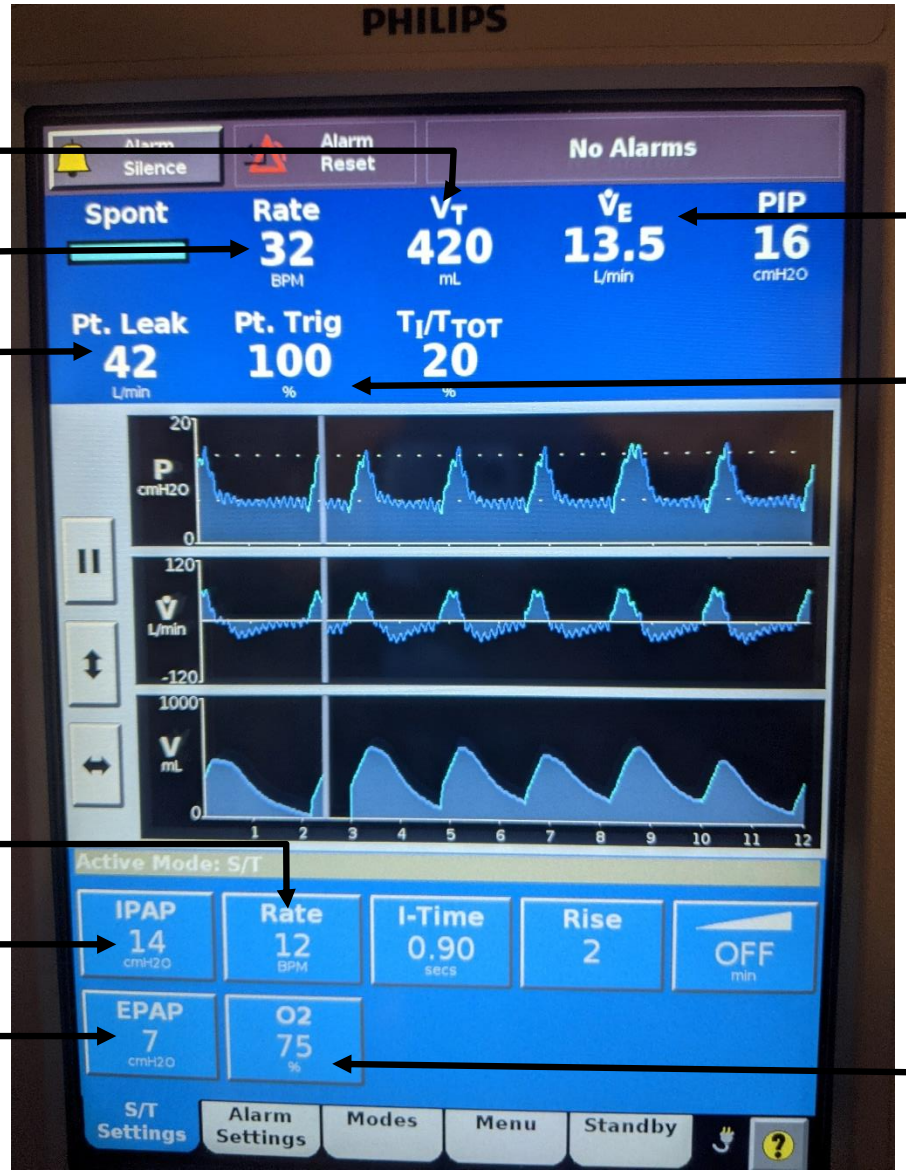
Tidal Volume achieved by Pt

Pt actual RR

Mask Leak

Minute Ventilation achieved by Pt.

Trigger (% of time Pt triggered breath vs timed back-up rate used)



- Blue waveforms spont. RR
- Orange waveforms set back-up RR

Set RR (back-up RR)

PSV (Change in Pressure

FiO_2

VENTS

Indications for Invasive Mechanical Ventilation

- Apnea
- Acute Respiratory Failure:
  - Significant hypoxemia (PaO2 < 60 on FiO2 > 60%)
  - Respiratory acidosis despite all other therapies (<7.20)
  - Anesthesia-induced hypoventilation

Assist/Control

- Set RR
- Set Vt (VC) or DP (PC)

Effects Ventilation (PaCO2)

- FiO2
- PEEP

Effects Oxygenation (PaO2)

Pressure Support (PSV/CPAP)

- PS
- PEEP
- FiO2

Modes of ventilation

- Volume Control
  - Set Vt, variable PIP
- Pressure Control
  - Set PC, variable Vt

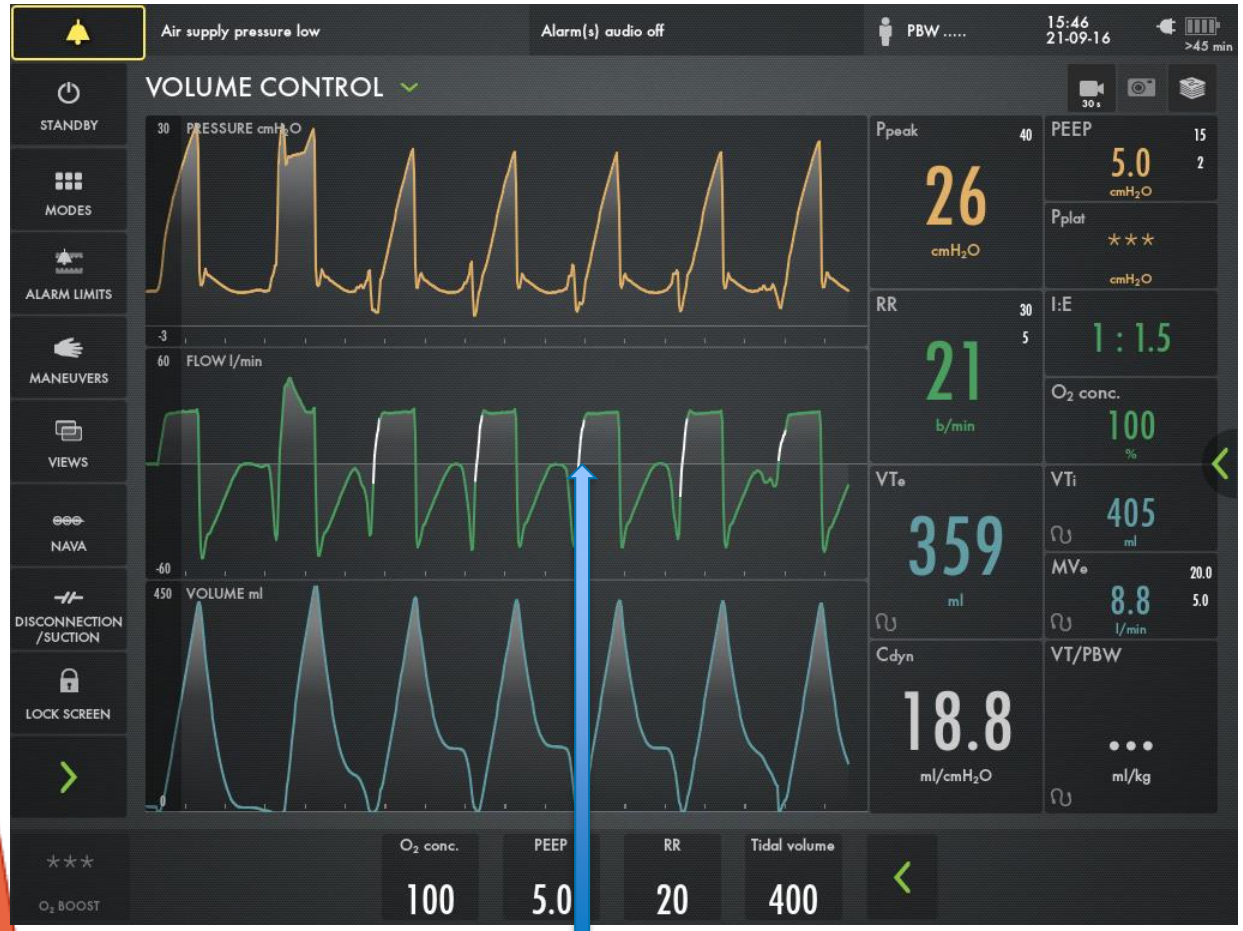
Pressure Support

Spontaneous breathing supplemented with PS

No set RR

VENTS


Air supply pressure low
Alarm messages
PBW .....
15:45
21-09-16
>45 min
VOLUME CONTROL
STANDBY
MODES
ALARM LIMITS
MANEUVERS
VIEWS
NAVA
DISCONNECTION /SUCTION
LOCK SCREEN
O2 BOOST
35 PRESSURE cmH2O
-4
60 FLOW l/min
-60
450 VOLUME ml
0
Ppeak 40
28
cmH2O
PEEP 15
4.9
cmH2O
2
Pplat
***
cmH2O
RR 30
20
b/min
5
I:E
1 : 2.0
O2 conc.
100
%
VTe
400
ml
VTi
408
ml
MVe 20.0
8.0
l/min
5.0
Cdyn
17.1
ml/cmH2O
VT/PBW
•••
ml/kg
Readings (patient controls)
O2 conc. 100
PEEP 5.0
RR 20
Tidal volume 400
Settings (we control)



Spontaneous breath

Active alarm

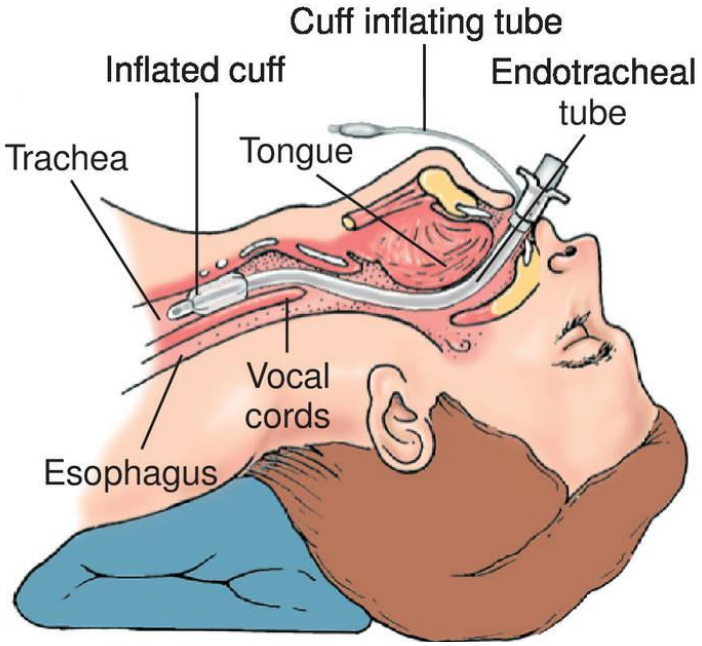
SBT/Extubation

- Spontaneous Breathing Trial
  - 30-120 min. trial on PS 5-7, PEEP 5
- Pt. is awake, alert
- Stable RR, HR, BP, mental status (follow commands)
- Effective spontaneous Vt on PSV

Extubate!!

Artificial Airways

Endotracheal Tube (ET tube)

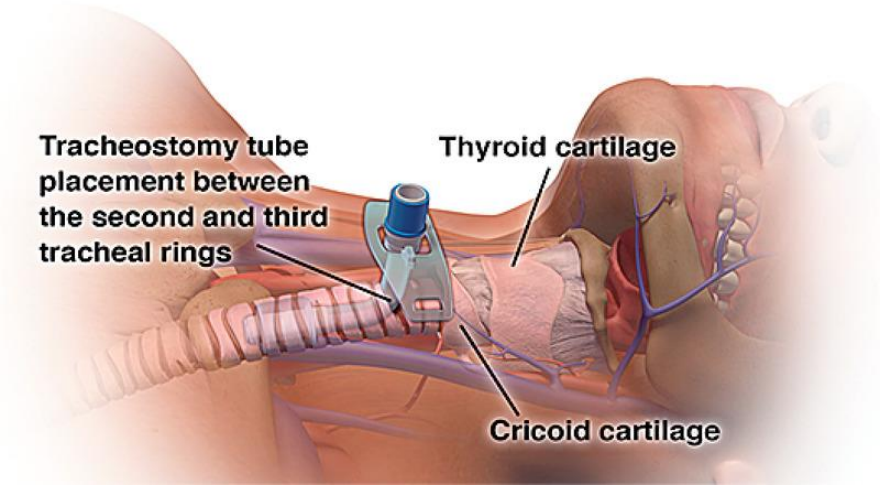


- Passes through the vocal cords
- Cuff must be inflated to ensure air from vent is delivered adequately to lungs and to prevent secretions from leaking down into airway.

Held in place with a hollister

Artificial Airways

Tracheostomy tube (Trach)



- Surgically inserted and sits below the vocal cords.
- Cuff must be inflated while on ventilator. Uninflated when using trach mask.

Types

Shiley Flex

Extended Length (XLT)

Fenestrated

Bivona

Artificial Airways

Tracheostomy tube caps

- Used for weaning to decannulation
- Patient must have strong cough and ability to mobilize secretions to upper airway

Passy Muir Valves

- Speaking valve
- MUST HAVE CUFF DEFLATED!
- Contraindicated for increased secretions or when patient has increased WOB

Mobilizing Patients with Artificial Airways

- Make sure circuit of vent or tubing of oxygen device has enough movement to not put tension on airway.
- If extra hands are needed for airway or circuit stabilization, please call respiratory therapist to assist.
- Monitor SpO_2 during activity incase O_2 or ventilation support must be adjusted by respiratory therapist.

Case Study

- 56 y.o. M presents with SOB x3 days. PMH includes CAD, HTN, COPD. Patient does not use home oxygen, is a current everyday smoker (40 pk yr), and lives at home with wife.

- Patient dx with acute COPD exacerbation, started on 4L NC, and sent to med surg.

- Hospital day 3- Patient becomes febrile and oxygen requirements begin to increase. Patient started on HHFNC 50L/60%, nocturnal BiPAP, transferred to intermediate care.

- Hospital day 4- RRT called to bedside d/t rapidly increasing oxygen requirements (SpO_2 87% on BiPAP 14/6 90%), decreasing mental status. Patient subsequently intubated and transferred to critical care.
  - Initial ventilator settings: VC 22 450 60% +8

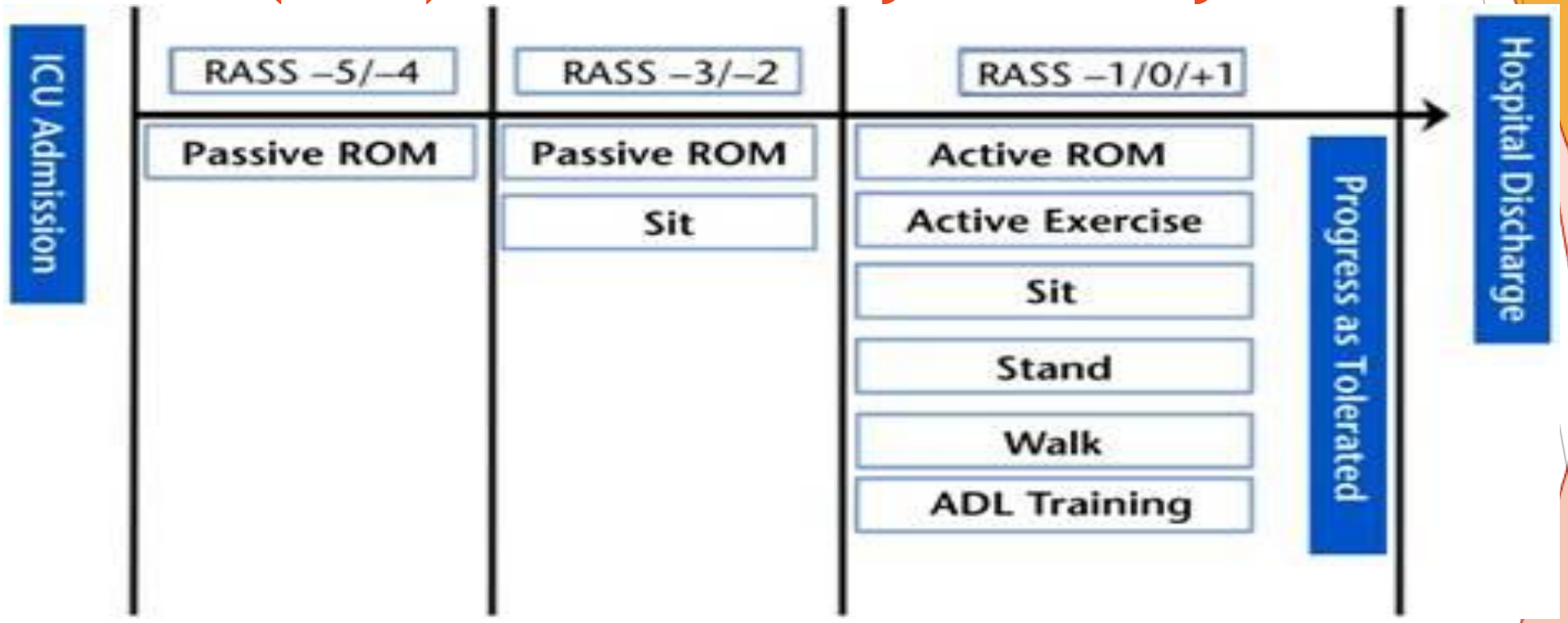
ABCDEF (A2F) Bundle

- Background: A bundle of 6 different components of care for the critically ill patient designed to align and coordinate care.
- Goal: To achieve an ICU environment that emphasizes a culture of awake, mobile patients spending time cognitively engaged and able to understand their own plan of care.
- Data supports a higher compliance to the bundle relates to higher survival, shorter MV time, shorter ICU LOS, hospital LOS, fewer ICU readmissions, less delirium, use of restraints, and D/C to SNF & LTACHs
- Components:
  - A: Assess, prevent, and manage pain
  - B: Both SAT & SBT
  - C: Choice of Analgesia and Sedation
  - D: Delirium: Assess, prevent, and manage
  - E: Early mobility and exercise
  - F: Family engagement and empowerment

ABCDEF (A2F) Bundle

- RT role
  - Coordinate and perform daily SAT & SBT with bedside RN
  - Assess for weaning and liberating from mechanical ventilation
  - Assist members of the interdisciplinary team with early mobility
- Therapy Role
  - Assess readiness for early mobility
  - Execute early mobility plan with members of interdisciplinary team
  - Engage in cognitive assessments and exercises to prevent delirium and facilitate communication
  - Assess readiness for oral intake after extubation

ABCDEF (A2F) Bundle-Early mobility



- While Passive ROM may not require much assistance from your RT, sitting at the edge of the bed, standing, and walking patients on mechanical ventilation should be coordinated with the RT to optimize from a respiratory standpoint.

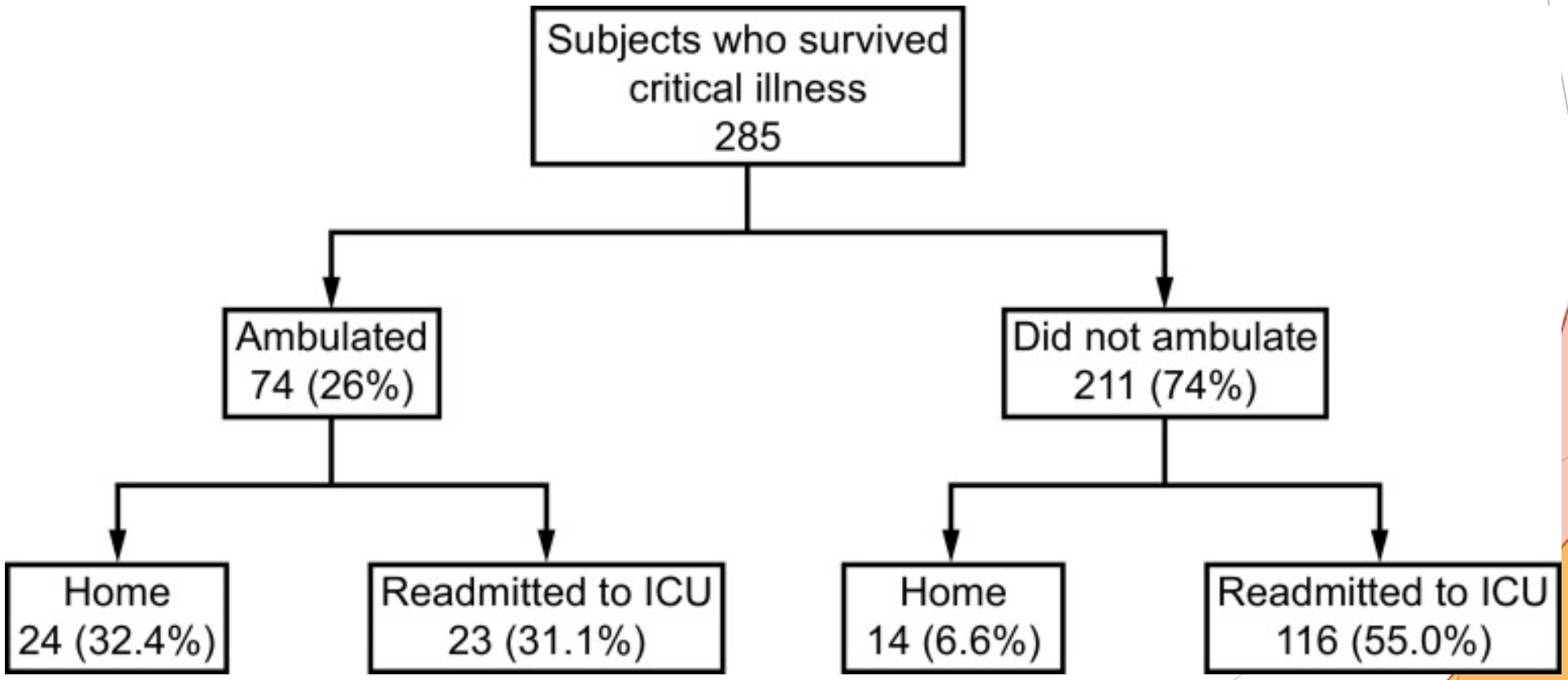
ABCDEF (A2F) Bundle

- Delirium: disturbance of consciousness with inattention accompanied by a change in cognition or perceptural disturbance that develops over a short period of time and fluctuates over time.
  - 3 motoric subtypes: hyperactive (ICU psychosis), hypoactive (quiet delirium), and mixed (fluctuates between hypo-and hyper-)
  - ICU Delirium is associated with:
    - Increased vent days
    - Increased ICU LOS
    - Increased Cost
    - Higher mortality (both in hospital and post-discharge)
    - Greater long-term cognitive dysfunction

Ambulatory Status Is Associated With Successful Discharge Home in Survivors of Critical Illness

Dena H Tran, Parth Maheshwari, Zain Nagaria, Harsh Y Patel and Avelino C Verceles

Respiratory Care August 2020



PICS

- Definition: *Post-intensive care syndrome* -health problems that remain after critical illness. Include the following components:
  - ICU-acquired weakness: Muscle weakness that develops during an ICU stay
    - 33% of all mechanically ventilated patients
    - 50% of patients with Sepsis diagnosis
    - 50% of patients with ICU LOS>7days
  - Cognitive dysfunction: deficiencies in memory, attention span, problem solving, and organizational skills
    - Seen in 30-80% of ICU patients
  - Both make ADLs incredibly difficult during and after the hospital stay
  - Impacts are felt by the patient, as well as the care-givers
  - Impact on overall health and may have long-lasting detrimental socioeconomic burdens

PICS

- Took on a new context following SARS-Cov-2 pandemic
  - More critically ill, respiratory failure patients on mechanical ventilation
  - High use of sedation and chemical paralysis to accommodate mechanical ventilation and prevent worsening respiratory status
  - Increased incidence and heavier impacts on patients and families
  - Difficult to combat due to visitation restrictions, isolation requirements, PPE and staffing shortages

Case Study

- Vent day 2- Patient becomes febrile, oxygen requirements increase. FiO_2 increased to 80%, BAL sent.

- Vent day 3- Vent settings increased to VC 26 450 90% +14. P/F ratio 86. Diagnosed with MRSA PNA. Patient is placed in prone positioning. In attempt to improve gas exchange and minimize patient respiratory effort, deep sedation is ordered, with a RASS goal of -4.

- Vent day 12- Vent settings have been weaned to VC 22 450 50% +8. P/F ratio 185. After 3 prone sessions of 18 hours proned, 6 supine, oxygenation is improved enough to remain supine and begin weaning sedation in an attempt to extubate.
  - Patient is also encephalopathic, pulling at tubes and lines, difficult to redirect when sedation is weaned

Case Study

- Hospital day 19- After 2 days of unsuccessful SAT/SBTs, patient successfully extubated to NIV/HHFNC. Current settings: HHFNC 50L/50%. Speech consult placed for post-extubation swallow eval.

- Hospital day 22- OT/PT successfully mobilize patient to chair on HHFNC. Settings weaned to 40L/40%. Patient is transferred overnight to step-down unit.

- Hospital day 24- Patient weaned to 4L NC. OT/PT working on clearing for discharge to SNF.

Take Aways

- Many different diseases and disorders impact both the RT and the OT/PT/SLP
- Oxygen devices have many pros and cons but are needed to stabilize our respiratory compromised patients.
  - If you have a question, or need assistance with these patients call your RT.
- Opportunities are there for coordination of early mobility between therapies and RT
  - Can impact many outcomes of care
- RT along with OT/PT/SLP can work together to help minimize incidence of PICS in our critically ill patients.

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