



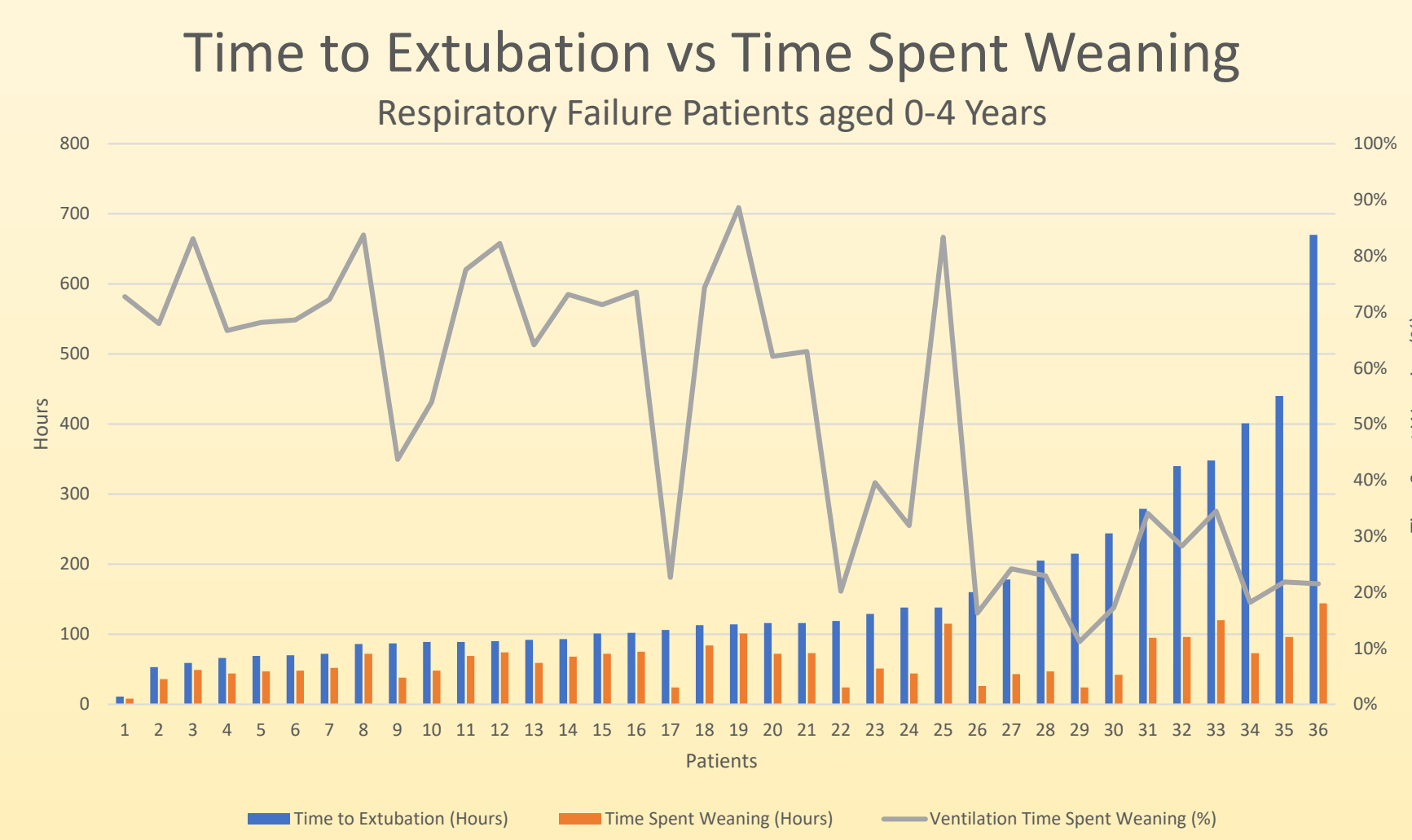
# Pediatric Ventilator Weaning Protocol

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## Background

- Many Pediatric Intensive Care Unit (PICU) patients have respiratory failure and require invasive mechanical ventilation.
- In the PICU at Blank Children's Hospital, ventilator weaning typically occurs no more than twice within a 24-hour period when pediatric intensivists are present in the PICU at Blank Children's Hospital, thus potentially prolonging time to extubation.
- Prolonged invasive mechanical ventilation is associated with complications (risks of pneumonia, dependence on opioids/benzos, muscle weakness, poor feeding). Patient outcomes and costs may improve with decreased ventilator hours.<sup>5</sup>
- An opportunity was identified to standardize weaning practices amongst intensivists and use licensed staff to progress children through hospital course during all shifts.
- A weaning protocol for use by nurses and respiratory therapists could lead to ventilator changes throughout a 24 hour period and reduce time to extubation.

## Current Practice



Provider-Driven/Non-Protocol Weaning  
Pre-Implementation Respiratory Failure Patients aged 0-4 years

Mean Time to Extubation (Total Ventilation Time)	161 Hours
Mean Time Spent Weaning	62 Hours
Mean Percentage of Total Ventilation Time Spent Weaning	52%

## Synthesis of Evidence

- Pediatric ventilator weaning protocols are safe.<sup>3,4,6,7</sup>
- No one best method to wean pediatric patients from a ventilator; consistent weaning appears to be the best approach.<sup>4,5</sup>
- Pediatric studies demonstrate that consistency in weaning decreases time to extubation.<sup>3,5,7,8</sup>
- Leading pediatric institutions in the United States use protocolized ventilator weaning.<sup>1</sup>

## Theme and Aims

- Theme:** Large variety of patient population with a significant amount of respiratory patients; complex assessments and interventions; variability in experience of PICU RN, respiratory therapy, and resident physician staff; extensive sphere of experts and resources; family-centered care
- Aim:** Safely reduce the time pediatric patients are invasively ventilated by >12 hours by targeting identification of readiness to wean and weaning time

## Implementation Plan

- Create Awareness & Interest + Build Knowledge & Commitment<sup>2</sup>**
  - Institutional Review Board Approval-Human Subjects Research (Chart Review)
  - Obtained one year of baseline data from chart review regarding ventilator hours, weaning time, and complications
  - Used a time series design for comparison between pre-implementation respiratory season and post-implementation respiratory season
  - Developed evidence-based patient weaning protocol for use by licensed PICU staff
  - Identified key stakeholders and champions
  - Provided education on weaning protocol to providers, nurses, and respiratory therapists in series of department and cohort meetings; provided written material
- Promote Action & Adoption<sup>2</sup>**
  - Implemented protocol and provided support to staff with frequent pulse checks
- Pursue Integration & Sustained Use<sup>2</sup>**
  - Obtained, compared, and analyzed post-implementation data
  - Modify protocol based on data analysis and provider/staff feedback, continue future PDSA cycles

## PDSA Cycles

- PDSA #1: Implement protocol for PICU patients aged 0-4 years intubated for respiratory failure due to infectious process, excluding tracheostomy patients.

Blank Children's Hospital PICU Ventilator Weaning Protocol 2018

**Consider Ventilator Weaning Protocol Weaning If:**

- PEEP ≤ 8
- FiO<sub>2</sub> ≤ 50%
- SpO<sub>2</sub> ≥ 90%
- pCO<sub>2</sub> ≤ 60
- RR ≤ 1.5x normal for age\*
- pH 7.35-7.45
- COMFORT score 17-21
- Hemodynamically stable without inotropic support
- Clinical judgment of provider

Any PICU provider (MD, DO, RN, RT) may suggest entry into protocol. Provider to Order "Wean Ventilator by Protocol" in ventilator settings comment. RN and/or RT to assess patient every 4 hours for weaning potential. RT to make ventilator changes. If patient ventilated >5 days, consider changing to intermittent sedation dosing.

**Extubation Readiness Trial**

When minimum settings maintained for 4 hours, Respiratory Therapist to perform:

Set PEEP 5  
Set PS based on ETT size:  
ETT 1.0-3.5: 10  
ETT 4.0-6.0: 8

Monitor patient for 5 minutes. Maintain:  
ETCO<sub>2</sub> or TCM ≤ 50  
AND  
Observed RR ≤ 1.5x normal for age\*  
AND  
TV 5-8 ml/kg  
AND  
SpO<sub>2</sub> ≥ 90%  
If patient with severe BPD, maintain ETCO<sub>2</sub> or TCM ≤ 60

**Pass:** Leave on PS/CPAP. Return to minimal settings if still on PS/CPAP after 4 hours. Notify Provider. Consider NPO. If ventilated <5 days, consider decreasing or stopping sedation infusion(s).

**Fail:** Return to previous settings. Repeat Extubation Readiness Trial in 4 hours.

**Extubate per Intensivist Decision**

\*Normal Respiratory Rates for Ages:  
Infant ≤ 11 months: 20-55 breaths per minute  
Toddler 12-35 months: 22-36 breaths per minute  
Preschooler 36-48 months: 20-28 breaths per minute  
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**Minimum Settings**

- TV: 5-8 ml/kg (or 5% set to achieve this TV)
- Rate: 10
- PEEP: 5
- FiO<sub>2</sub>: 21N-30N

If acute decompensation, consider DOPE:  
Displacement, Obstruction, Pneumothorax, Equipment Failure

If patient is unable to maintain nonlabored breathing effort, physiologic stability, or vital parameters, return to previous ventilator settings. If unable to maintain physiologic stability or vital parameters after moving back to previous settings, notify provider.

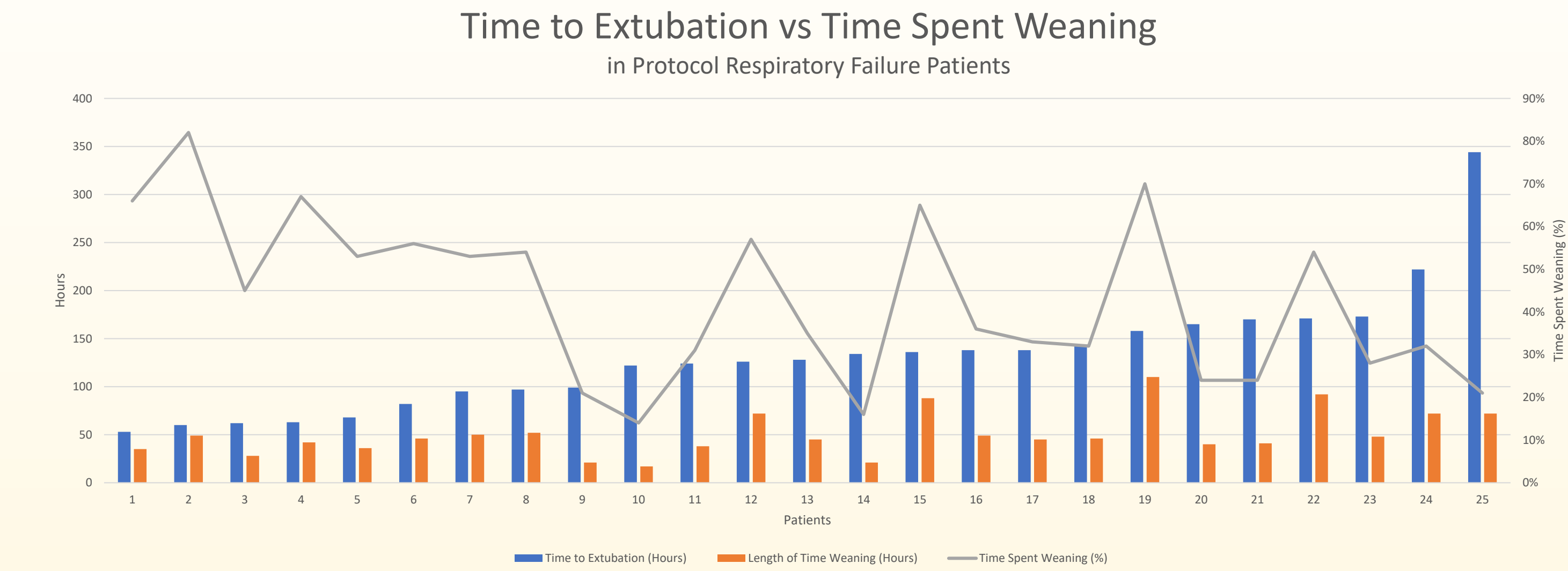
Daily air leak test to be performed daily at 0600 by RN. Notify provider and leave cuff deflated if no leak present. Consider steroids.

- PDSA #2: Discussed protocol and implementation barriers with PICU intensivists and educator after initiation. Decision to continue current protocol and further evaluate for barrier patterns.
- PDSA #3: Discuss all post-implementation data and analysis with PICU intensivists and educator, make protocol changes.
- PDSA #4: Continue to evaluate protocol. Expand to larger population of ventilated PICU patients. Transition protocol management from author to current PICU team.

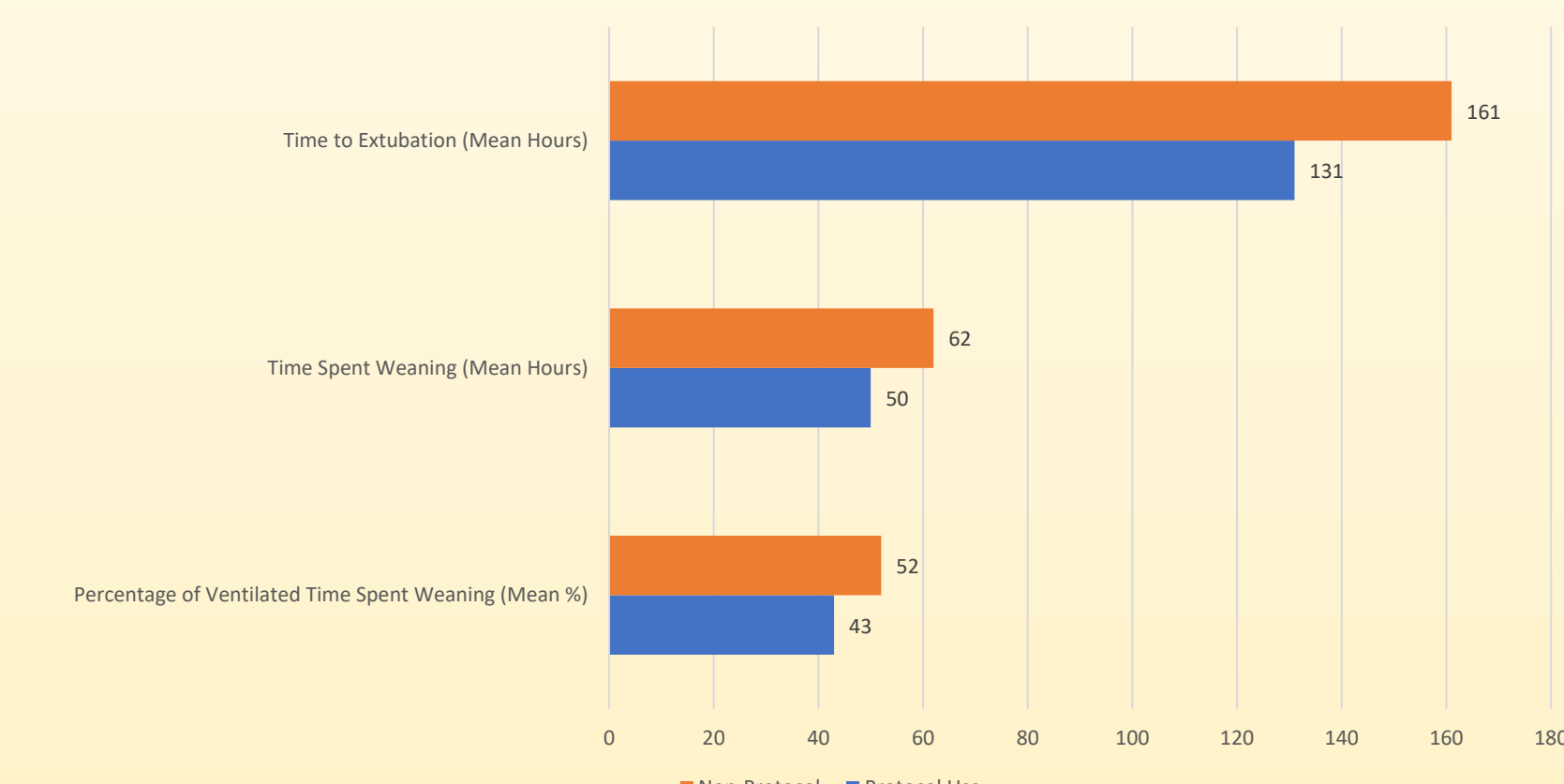
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## Results



Time to Extubation and Time Spent Weaning  
Protocol Use vs Non-Protocol Weaning



Welch's Two-Sample T-Test

	T-Statistic	*Degrees of freedom	p-value
Time Spent Weaning	-1.8291	58.515	0.0725
Time to Extubation	-1.1892	52.557	0.2397

\*Clinical Significance

## Lessons Learned

- Barriers:**
- Need to address age adjustments for babies 0-6 months- specifically minimum set respiratory rate and PS/CPAP trials (physiology of breathing and anatomy is different than with older infants and toddlers)
  - Education given via multiple modalities; however, many staff say they don't know how to use protocol
  - Continue to reinforce ability to wean patients overnight
- Successes:**
- Think about weaning sooner
  - Patients being weaned overnight; need to continue to hardwire this process
- Recommendations for Future Projects:**
- PS/CPAP trials-length, frequency, amount
  - Sedation while intubated/sedation wean-are patients too sedated?
  - Mobility while on ventilator
  - Extubation to non-invasive ventilation versus nasal cannula/room air
- Implications for CNL Role:**
- Implementation of Best Practices Based on Data- protocol implemented, positive results seen, continue to use EBP to expand protocol
  - Quality Improvement/Outcomes Measurement- monitor data through PDSA cycles and continue to grow to reach wider population while maintaining safe practices
  - Interprofessional Communication & Team Leadership- allows nursing and respiratory therapy to practice at full extent of licensure

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