Clinical Pathways

High Flow Nasal Cannula Use in Patients Outside of the Intensive Care Unit

Kathy Kalkbrenner, MD
Lisa LeBon, RRT

Connecticut Children's

BEST CHILDREN'S HOSPITALS U.S.News RANKED IN 4 SPECIALTIES 2018-19

MAGNET RECOGNIZED AMERICAN NURSES CREDENTIALING CENTER

2019 WOMEN'S CHOICE AWARD® BEST CHILDREN'S HOSPITALS

What is a Clinical Pathway?

An evidence-based guideline that decreases unnecessary variation and helps promote safe, effective, and consistent patient care.

Objectives of Pathway

- To define the criteria for patients on high flow nasal cannula (HFNC) who may be appropriate to initiate and manage outside of the ICU
- To outline the management for titration and weaning of respiratory support
- To review the feeding and monitoring guidelines for this group of patients
- To identify the circumstances under which a Medical Emergency Team (MET) should be activated

Why is Pathway Necessary?

- To ensure an optimal, consistent approach to the medical management of acute respiratory illness patients who require HFNC therapy

Most Recent Pathway Updates (2024)

- Patients with a PEWS score of 10 or more on maximum support will trigger a MET (previously for patients with a PEWS of 11 or more)

- Patients who require continuous albuterol are no longer candidates for HFNC support outside of the PICU
  - Several models demonstrate significantly decreased drug delivery of aerosols when HFNC is applied, hence these patients are best served by prioritizing albuterol delivery. If additional support is indicated then ICU level care is warranted.

Reference: DiBlasi RM, Engberg RJ, Poli J, Carlin KE, Kontoudios N, Longest PW, Kajimoto M. Aerosol Delivery Efficiency With High-Flow Nasal Cannula Therapy in Neonatal, Pediatric, and Adult Nasal Upper-Airway and Lung Models. Respir Care 2024; 69(9):1146-1160.

HFNC

Overview

- High flow oxygen therapy is defined as oxygen delivered at flow rates that meet, or exceed, the inspiratory flow demands of the patient

- At Connecticut Children's we utilize the Fisher Paykel Optiflow, and Optiflow Jr. nasal cannula setups for delivery of oxygen via HFNC

- The device can be broken down into four main components
  - Blender
  - Humidifier
  - Circuit
  - Nasal Interface

Utticial pediatric teaching hospital of

HFNC

How Does It Work?

- Standard methods of oxygen therapy provide either no humidity, or passive cooling systems (bubble humidifier). Aside from not being able to provide enough flow, improper heating/humidification can lead to :
  - Inflammation of the airways
  - Impaired mucociliary function
  - Increased caloric expenditure to warm and humidify air manually
- The Optiflow system heats and humidifies all gas passed through the system, while using high enough flow rates to flush out anatomical dead space, subsequently converting it to a reservoir of fresh humidified gas for the next breath
  - Minimizes oxygen dilution
  - Minimizes rebreathing of CO_2
  - Minimizes patient caloric expenditure

HFNC

How Does It Work?

- HFNC devices have also shown the ability to increase functional residual capacity (FRC), or lung volume at end expiration
  - Normally a function of PEEP
  - Evidence suggests that HFNC devices provide some level of PEEP, but it is not directly set
  - Possible mechanism of action for improved WOB
- A commonly heard reference is that 10 LPM of flow will provide around 1 cmH2O of PEEP, but is that really true?
  - Many factors need to be considered
    - Patient size
    - Cannula size
    - Mouth open/closed
    - Liter flow
- In short, patients can receive little PEEP, sufficient PEEP, or excessive PEEP depending on these factors, and must be monitored diligently

HFNC

Blender

- The air-oxygen blender is the control for FiO_2 delivery
- The operator, by dialing desired FiO_2, controls patient oxygenation
- The blender will have two oxygen flow meters connected to it
  - One flow meter will increase by increments of 10
  - One flow meter will increase by increments of 1
  - Dual flow meters allow for exact titration of desired flow
- The blender, in order to work properly, must have high pressure connections of both air and oxygen to a wall gas source
  - Patient transports can be done with an oxygen tank at 100% FiO_2
- Unlike a standard nasal cannula, flow rate does not control oxygenation
  - Because flow typically meets or exceeds demand, air entrainment is not a factor

HFNC

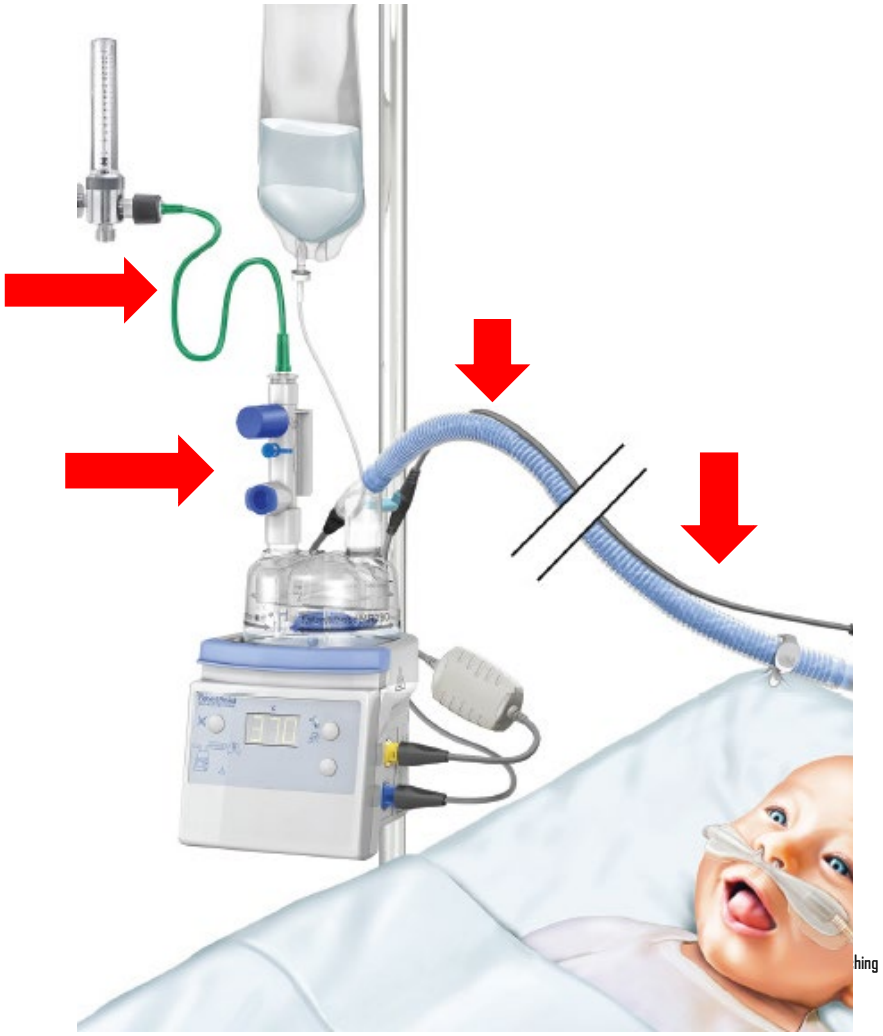
Humidifier

- The humidifier warms inspired gas, working as an artificial nose for patients on HFNC support
- Gas is heated to 37 degrees Celsius in the chamber, increasing the temperature to 40 degrees Celsius at the proximal probe
  - Temperature gradient increases water vapor retention to reduce condensate
  - Humidity and temperature control/promote secretion hydration, cilia movement, and normal physiologic airway conditions
- The humidifier should be set to “invasive mode”, despite being a non-invasive device
  - High flow rates must be humidified to that temperature because the nose is unable to compensate
- Alarms are usually associated with chamber water level, or probe disconnection

HFNC

Circuit

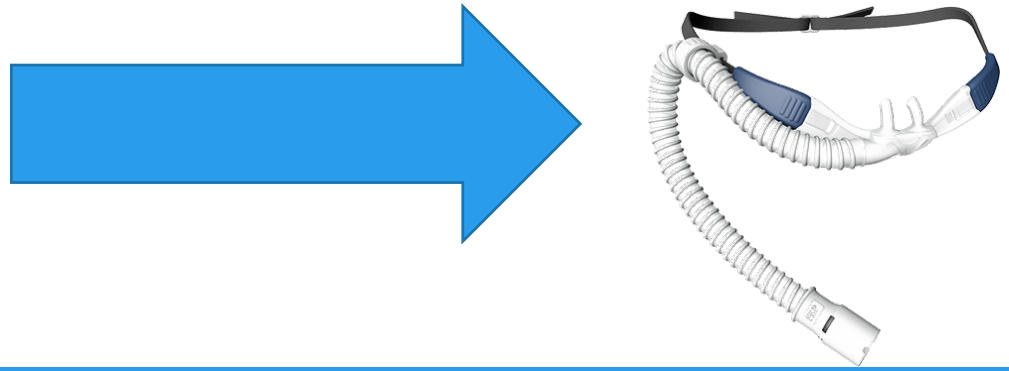
- Pictured is the Optiflow Jr. circuit
  - The Optiflow (large pedi/adult patients) uses a similar set-up, but larger bore tubing
    - Standard ventilator inspiratory limb
- The circuit has 4 main components
  - Tygon, or oxygen tubing, connecting the flow meters to the manifold, which is connected to the “dry” side of the humidifier
  - The high pressure manifold has a high pressure pop-off designed to engage at 40 cmH_2O. During normal use there should be no sound or air emitting from it
    - For the Optiflow circuit, the manifold may be replaced with a straight adapter and connector to provide higher flow rates
  - The circuit tubing is single limb, heated wire, and sources from the “wet” side of the humidifier
  - Plastic clip to affix the tubing to bed sheets, or parent clothing while holding

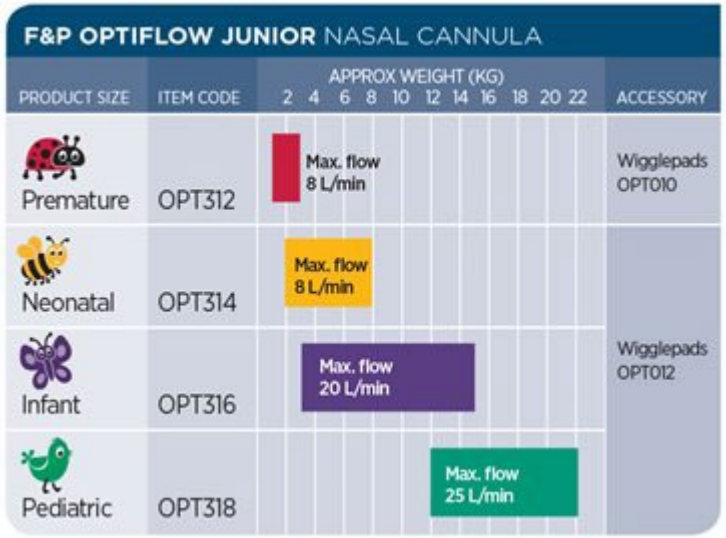


HFNC

Nasal Interface

- The Optiflow Jr cannulas come in various sizes, based on the size of the child
  - Color coded, and the circuit connects at the colored hub
- Cannulas are only rated to deliver set amounts of flow, according to the sizing chart
  - Exceeding flow rate will cause pressure build up in the circuit
  - Respiratory will set up both the device and the cannula
- Optiflow Cannulas come in small, medium, and large sizes, and can deliver up to 60 LPM of flow





HFNC

Nasal Interface Application

- Optiflow Jr. Cannulas are applied by removing the tab from the back of pads, and applying them to the child's face
  - Warming in hands first = easier application
  - Does not need to go over the ears/under chin like standard cannula
    - Flexible coils allow for over the head application, and the cannula can be tightened (loosely) to secure around the back of the patient's head
- Optiflow should be placed in the nares, with the strap going over the top of the patient's head, and tightened to an appropriate level for proper securement
- Nares should not be fully occluded!!
  - May cause excessive airway pressures
  - May cause difficulty exhaling
  - May cause septal breakdown

HFNC

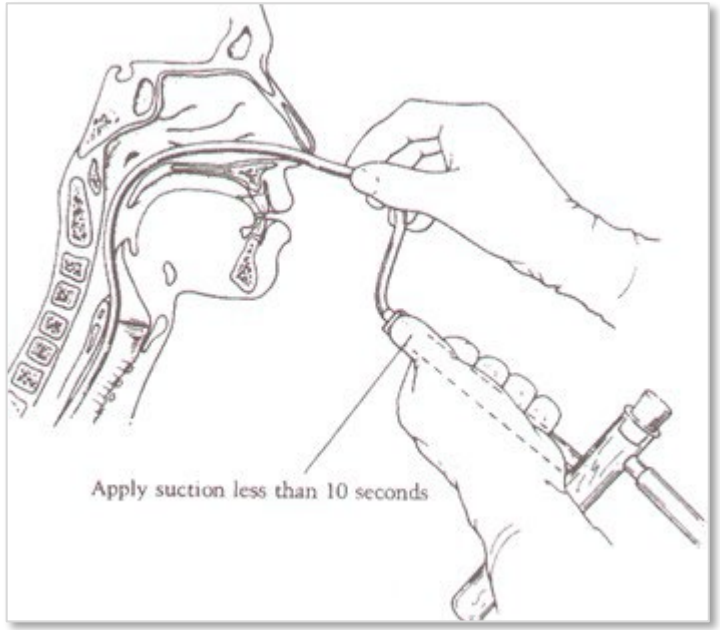
Remember

- Clinical Pathway for HFNC Use Outside of the ICU can be found on the Connecticut Children's Clinical Pathways internet page
- Don't hesitate to contact respiratory if questions, issues, or concerns arise regarding:
  - Alarms
  - Settings
  - Circuit Setup
  - Humidifier Setup
  - Need for replacement parts (wiggle pads/cannula)

ric teaching
al of

Deep Suctioning

- Nasotracheal or deep suctioning is defined as suctioning past the posterior pharynx and through the vocal cords into the trachea
- Nasotracheal suctioning is necessary when a patient is unable to effectively mobilize pulmonary secretions and does not have an artificial airway.



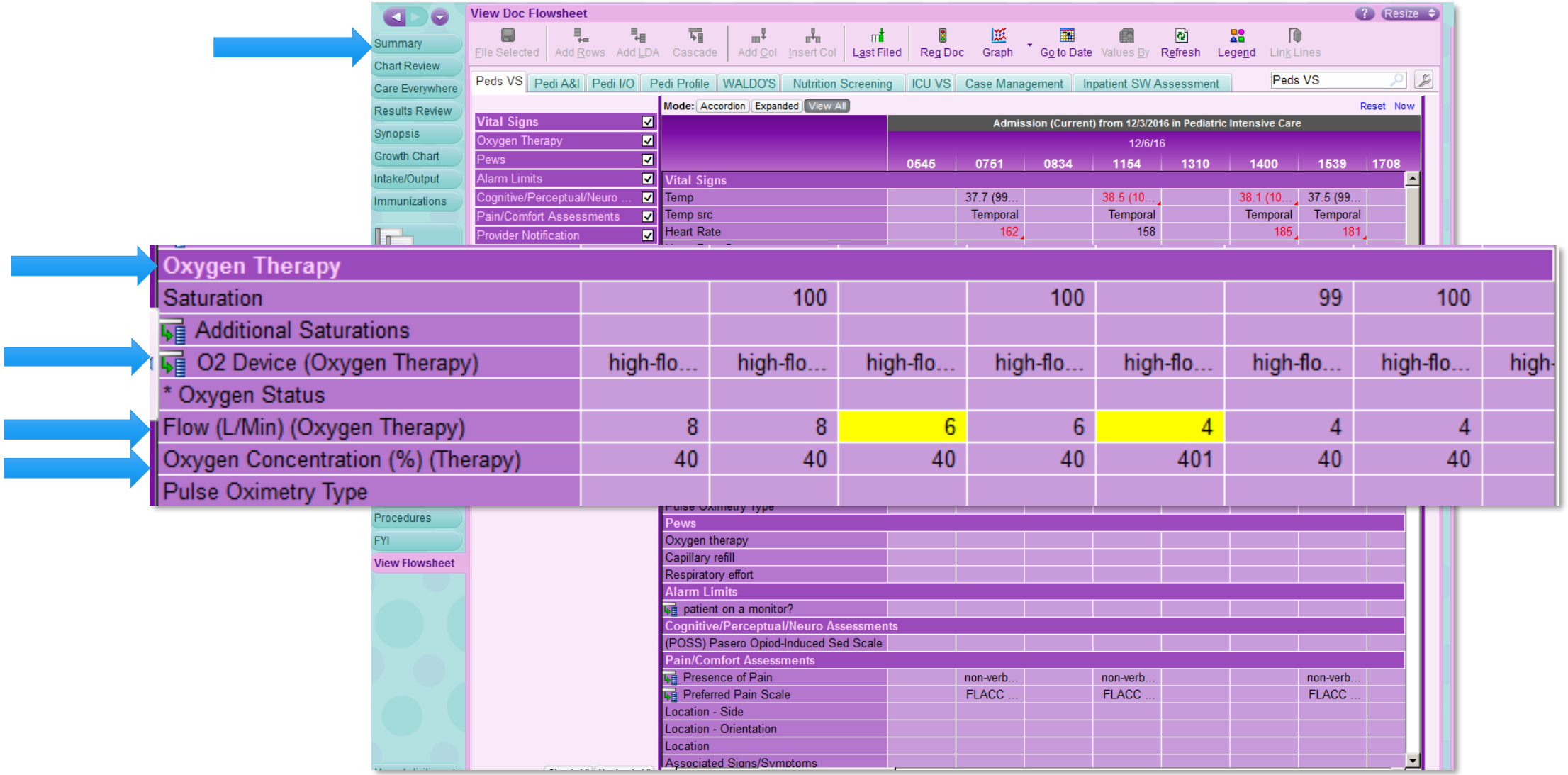
How To Deep Suction

- Open suction kit or catheter using aseptic technique. Do not allow the suction catheter to touch any nonsterile surfaces.
- Secure catheter to tubing aseptically. Coat distal 2-3 inches of catheter with water-soluble lubricant (K-Y Jelly/Lubricant).
- Estimate depth of insertion based on the distance from the patient's nose to the base of the earlobe and then down to the thyroid cartilage as a guide.
- Remove oxygen delivery device with non-dominant hand. Without applying suction, and using the dominant thumb and forefinger, gently but quickly insert the sterile catheter into either naris during inhalation with a slight downward slant.
- Remember that the epiglottis is open during inspiration and facilitates insertion of the catheter into the trachea.

How To Deep Suction (continued)

- Do not force the catheter. Try the other naris if insertion meets resistance or is difficult to insert.
- Apply intermittent suction by placing and releasing non-dominant thumb over the vent of catheter. Slowly withdraw the catheter while rotating it in a circular motion with suction on for as long as 10-15 seconds.
- Assess the need to repeat suctioning procedure. Allow adequate time between suction passes for ventilation and oxygenation. Keep oxygen readily available in case the patient exhibits signs of hypoxemia. Administer oxygen to the patient between suctioning attempts
- When the pharynx and trachea are cleared of secretions, perform oral suctioning to clear the mouth of secretions. Do not suction the nose or trachea after suctioning the mouth.
- Deep suctioning may cause trauma and/or edema to the mucosa. Discontinue deep suctioning if bleeding occurs, until discussed with the physician/practitioner.

How To Find HFNC Data in Epic



Provider Roles

Respiratory Therapist (RT):

- In charge of HFNC equipment set-up
- Every 4 hour checks on patient, administers nebulizer treatments, chest physiotherapy and deep suctioning
- May decrease or increase *flow* as clinically indicated and communicate with provider team and RN
- May adjust *oxygen (FiO_2)* for SpO_2 of >92% and communicate with RN
- Communicate with house staff every 4 hours about patient's status and any potential changes to care plan
- Responsible for documentation of HFNC in EPIC

Nursing Staff:

- May wean *oxygen (FiO_2)* if patient is clinically stable
- Administer chest physiotherapy and/or deep suctioning as needed for the patient if RT is unavailable
- Communicate with house staff and RT about patient's status and potential changes to care plan
- Document any changes in FiO_2 that they or the providers make on rounds and during the day

Providers (attending physician, advanced practice providers and house staff):

- Assess patient with RT and RN at least every 4 hours and communicate clearly about care plan
- May decrease or increase flow as clinically indicated, put in orders pertaining to flow changes and communicate with RT and RN
- May adjust *FiO_2* and communicate with RN to document change

Review of Key Points

- This pathway is for acute respiratory illness patients who require HFNC outside of the ICU
- Continue patients on WATCHER status until flow rates are being decreased
- Cluster respiratory treatments and feeding if possible
- Have a low threshold to call a MET if a patient is clinically worsening and has the need for escalated care

Quality Metrics

- Days of HFNC support
- Percentage of patients with MET activations
- Percentage of patients requiring transfer to the PICU for additional respiratory support
- Hospital length of stay

Pathway Contacts

- Kathy Kalkbrenner, MD
- Lisa LeBon, RRT

References

- Venanzi A, Di Filippo P, Santagata C, Di Pillo S, Chiarelli F, Attanasi M. Heated Humidified High-Flow Nasal Cannula in Children: State of the Art. *Biomedicines*. 2022 Sep 21;10(10):2353. doi: 10.3390/biomedicines10102353. PMID: 36289610; PMCID: PMC9598483.

- Nolasco S, Manti S, Leonardi S, Vancheri C, Spicuzza L. High-Flow Nasal Cannula Oxygen Therapy: Physiological Mechanisms and Clinical Applications in Children. *Front Med* (Lausanne). 2022 Jun 3;9:920549. doi: 10.3389/fmed.2022.920549. PMID: 35721052; PMCID: PMC9203852.

Thank You!

About Connecticut Children's Clinical Pathways Program

The Clinical Pathways Program at Connecticut Children's aims to improve the quality of care our patients receive, across both ambulatory and acute care settings. We have implemented a standardized process for clinical pathway development and maintenance to ensure meaningful improvements to patient care as well as systematic continual improvement. Development of a clinical pathway includes a multidisciplinary team, which may include doctors, advanced practitioners, nurses, pharmacists, other specialists, and even patients/families. Each clinical pathway has a flow algorithm, an educational module for end-user education, associated order set(s) in the electronic medical record, and quality metrics that are evaluated regularly to measure the pathway's effectiveness. Additionally, clinical pathways are reviewed annually and updated to ensure alignment with the most up to date evidence. These pathways serve as a guide for providers and do not replace clinical judgment.