

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

Kathy Kalkbrenner, MD
Kara Denz Fluck, PA-C
Lisa LeBon, RRT



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

Recent Pathway Updates (Dec, 2022)



- Flow rates in excess of 2LPM/kg are discouraged (most patients will not benefit from flow rates higher than this)
- Patients receiving continuous albuterol may not receive flow rates in excess of 1LPM/kg (max 45LPM)
- Oxygen demand >50% FiO₂ requires discussion with/approval by attending physician
- Respiratory Therapy must be notified immediately of increases in flow rate to ensure proper selection of nasal prongs (preferably by Voalte)
- Changes to flow rates must be followed by changes to the high flow orders AND communication with the bedside RN
- Patients with no more than moderate work of breathing should be trialed off flow entirely every 24hrs to determine ongoing need for support

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



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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 CO₂
 - Minimizes patient caloric expenditure



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 10LPM of flow will provide around 1cmH₂O 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



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Blender

- The air-oxygen blender is the control for FiO₂ delivery
- The operator, by dialing desired FiO₂, 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% FiO₂
- Unlike a standard nasal cannula, flow rate does not control oxygenation
 - Because flow typically meets or exceeds demand, air entrainment is not a factor



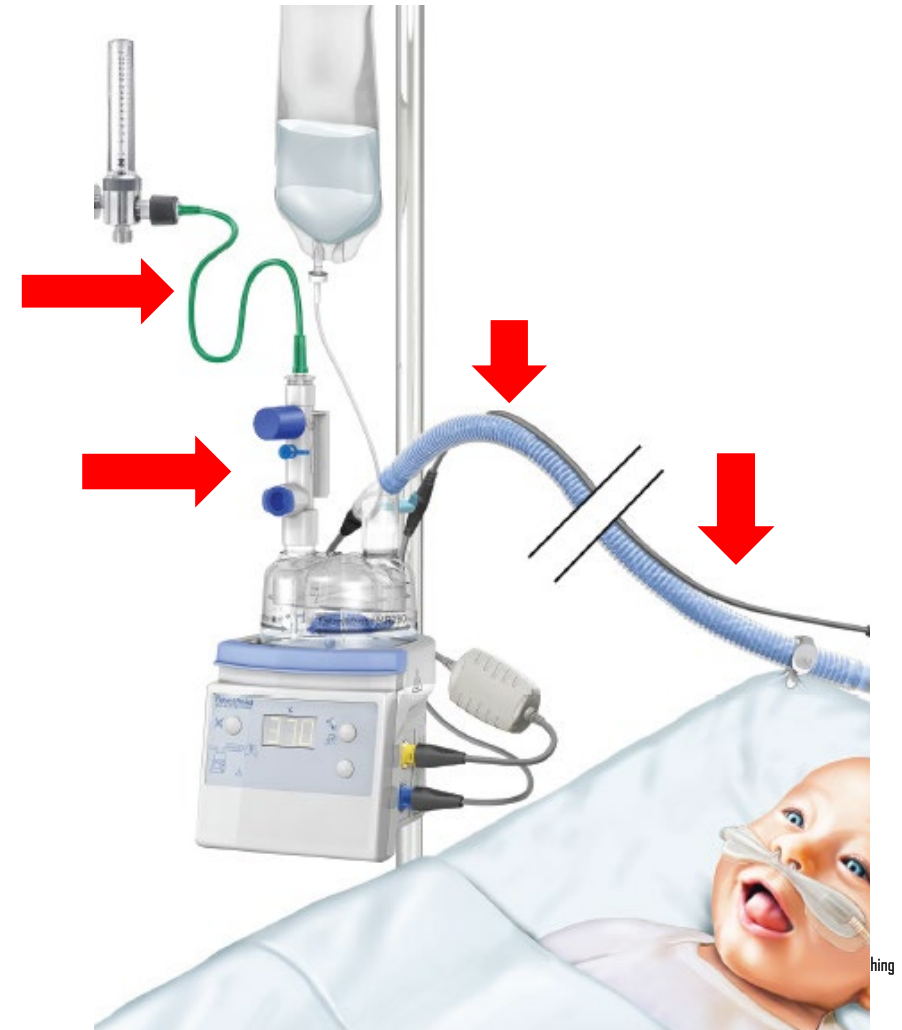
Humidifier

- 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



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 cmH₂O. 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



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 60LPM of flow



| F&P OPTIFLOW JUNIOR NASAL CANNULA | | | | | | | | | | | | | | | | |
|---|-----------|--------------------|---|---|---|----|-----------|----|----|----|----|----|----|--|--|-------------------|
| PRODUCT SIZE | ITEM CODE | APPROX WEIGHT (KG) | | | | | ACCESSORY | | | | | | | | | |
| | | 2 | 4 | 6 | 8 | 10 | | 12 | 14 | 16 | 18 | 20 | 22 | | | |
|  Premature | OPT312 | | | | | | | | | | | | | | | Wigglepads OPT010 |
|  Neonatal | OPT314 | | | | | | | | | | | | | | | |
|  Infant | OPT316 | | | | | | | | | | | | | | | Wigglepads OPT012 |
|  Pediatric | OPT318 | | | | | | | | | | | | | | | |

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



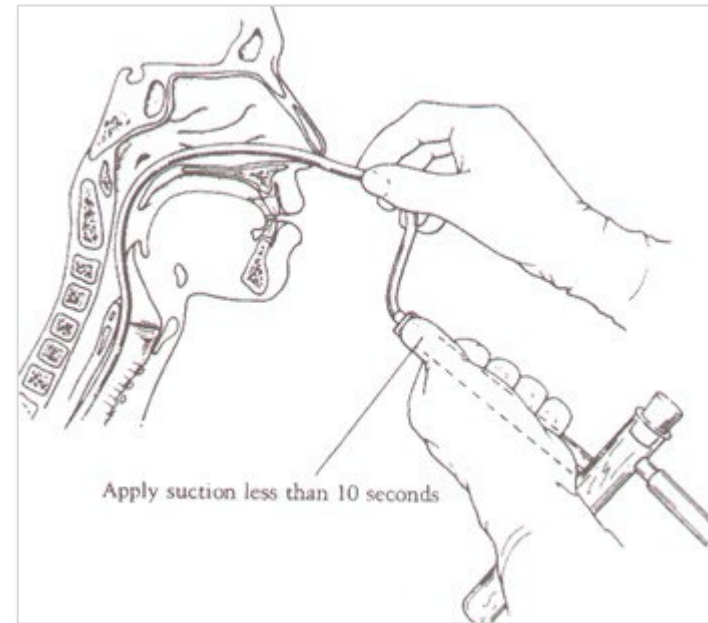
Remember

- 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)



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



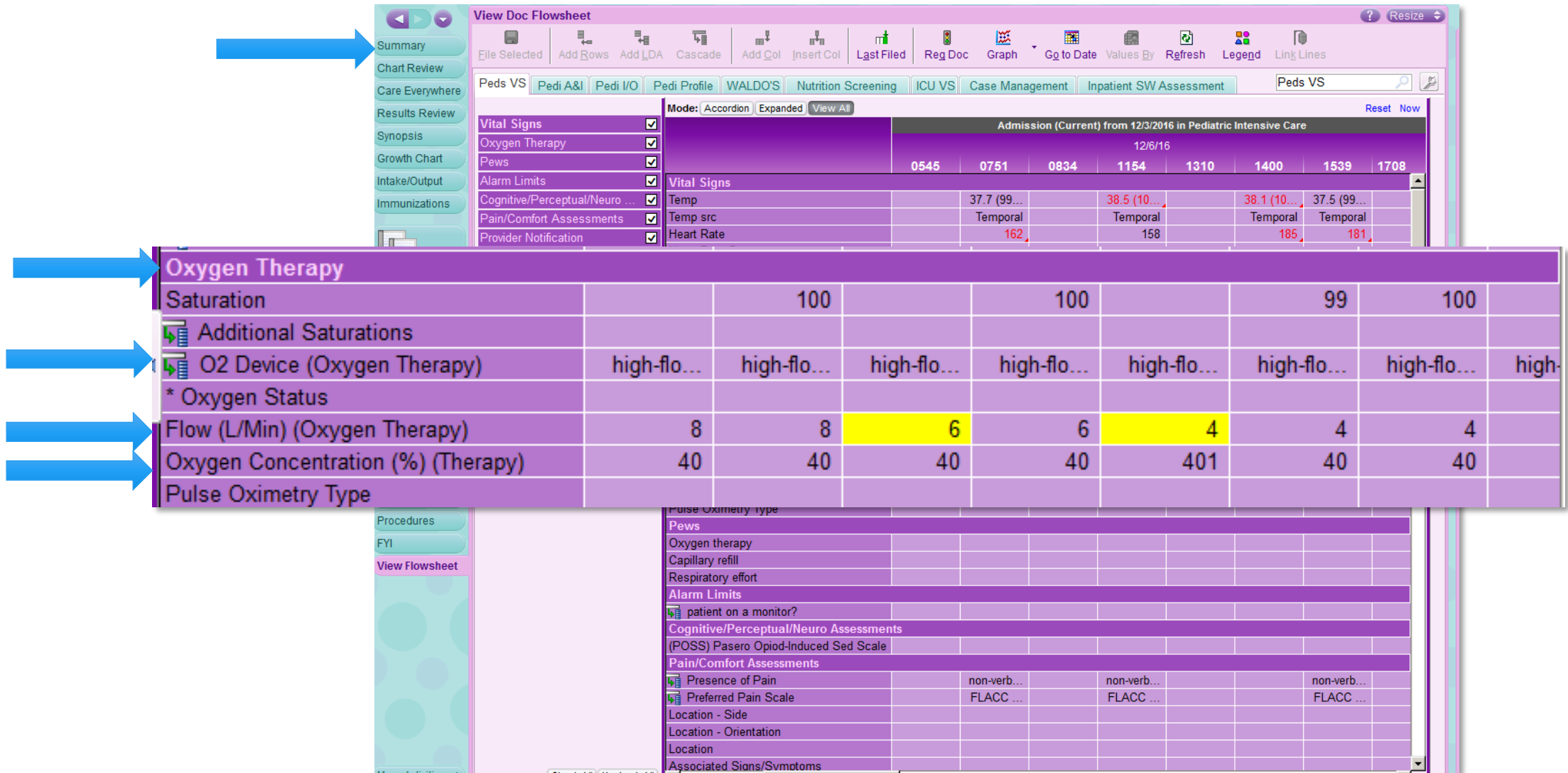
- Open suction kit or catheter using aseptic technique. Do not allow the suction catheter to touch any nonsterile surfaces.
- Secure catheter to tubing aseptically. Coat distal 2-3 inches of catheter with water-soluble lubricant (K-Y Jelly/Lubricant).
- Estimate depth of insertion based on the distance 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



View Doc Flowsheet

File Selected | Add Rows | Add LDA | Cascade | Add Col | Insert Col | Last Filed | Reg Doc | Graph | Gg to Date | Values By | Refresh | Legend | Link Lines

Peds VS | Peds A&I | Peds I/O | Peds Profile | WALDO'S | Nutrition Screening | ICU VS | Case Management | Inpatient SW Assessment | Peds VS

Mode: (Accordion) Expanded View All

Admission (Current) from 12/3/2016 in Pediatric Intensive Care
12/6/16

| | 0545 | 0751 | 0834 | 1154 | 1310 | 1400 | 1539 | 1708 |
|------------------------------------|------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Oxygen Therapy | | | | | | | | |
| Saturation | | 100 | | 100 | | 99 | | 100 |
| Additional Saturations | | | | | | | | |
| O2 Device (Oxygen Therapy) | | high-flo... | high-flo... | high-flo... | high-flo... | high-flo... | high-flo... | high-flo... |
| * Oxygen Status | | | | | | | | |
| Flow (L/Min) (Oxygen Therapy) | | 8 | 8 | 6 | 6 | 4 | 4 | 4 |
| Oxygen Concentration (%) (Therapy) | | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Pulse Oximetry Type | | | | | | | | |

Procedures
FYI
View Flowsheet

Pulse Oximetry type

Peds
Oxygen therapy
Capillary refill
Respiratory effort
Alarm Limits
patient on a monitor?
Cognitive/Perceptual/Neuro Assessments
(POSS) Pasero Opioid-Induced Sed Scale
Pain/Comfort Assessments
Presence of Pain
Preferred Pain Scale
Location - Side
Location - Orientation
Location
Associated Signs/Symptoms

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 (FiO2)* for SpO2 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:

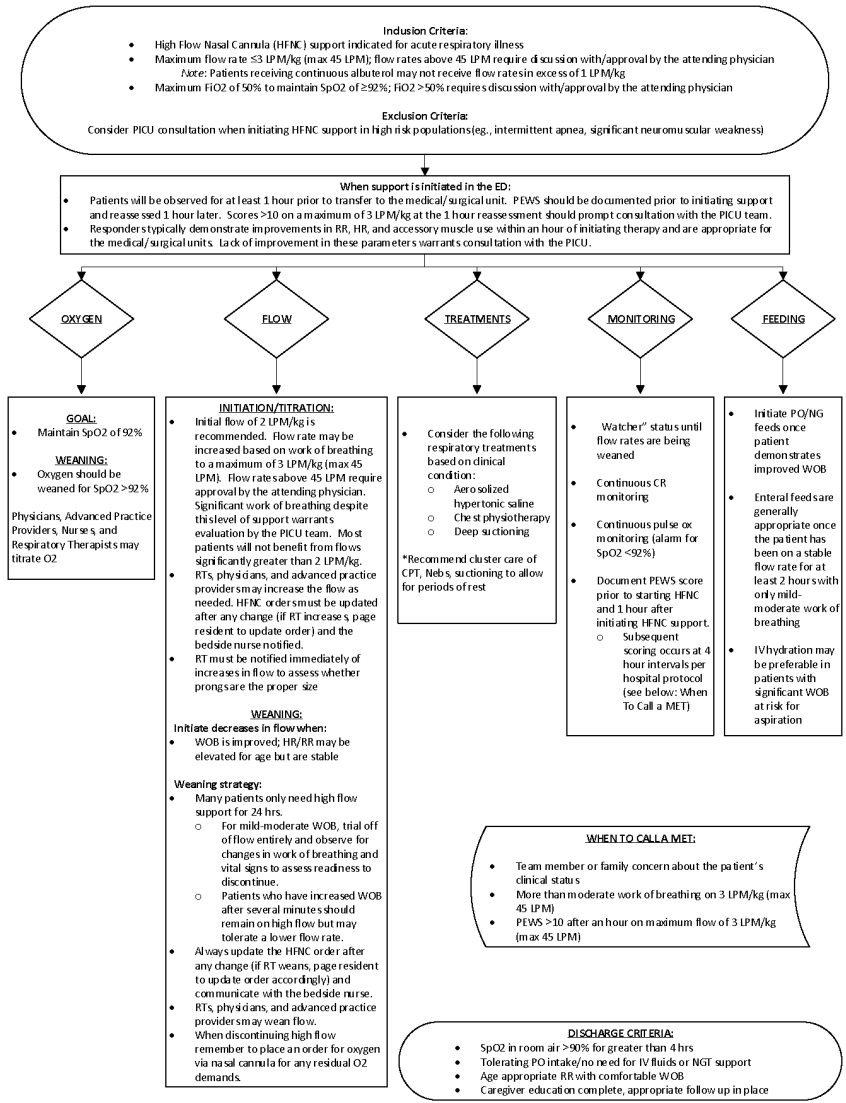
- May wean *oxygen (FiO2)* if patient is clinically stable
- Administer chest physiotherapy and/or deep suctioning as needed for the patient if RT is unavailable
- Communicate with house staff and RT about patient's status and potential changes to care plan
- Document any changes in FiO2 that they or 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 *FiO2* and communicate with RN to document change

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

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This is the High Flow Nasal Cannula Use in Patients Outside of the Intensive Care Unit Clinical Pathway.

We will be reviewing each component in the following slides.

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Inclusion Criteria:

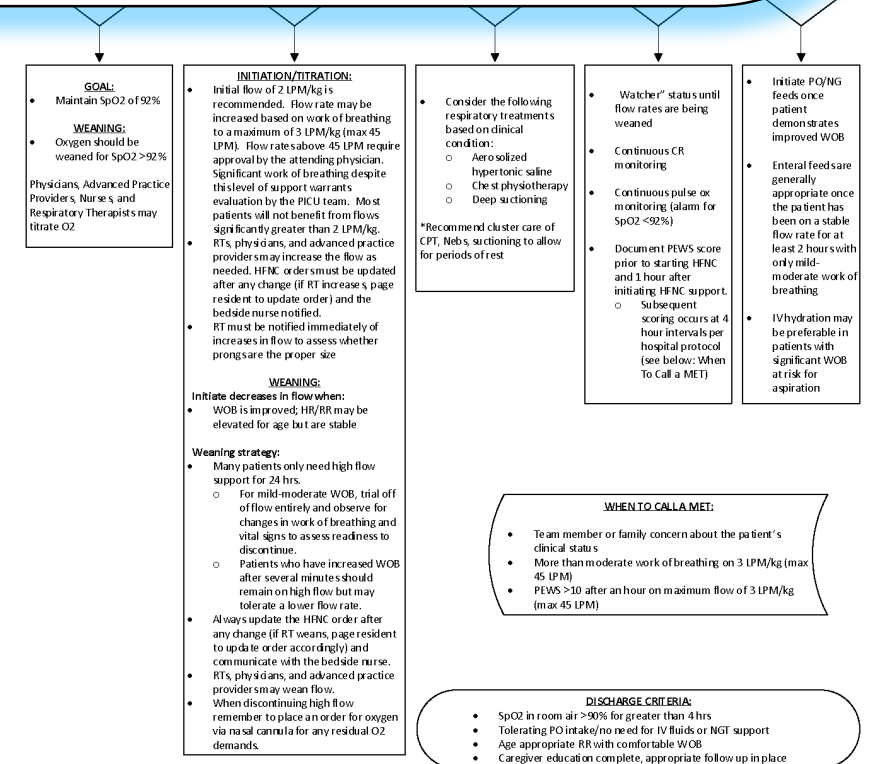
- High Flow Nasal Cannula (HFNC) support indicated for acute respiratory illness
- Maximum flow rate ≤ 3 LPM/kg (max 45 LPM); flow rates above 45 LPM require discussion with/approval by the attending physician
Note: Patients receiving continuous albuterol may not receive flow rates in excess of 1 LPM/kg
- Maximum FiO₂ of 50% to maintain SpO₂ of $\geq 92\%$; FiO₂ $>50\%$ requires discussion with/approval by the attending physician

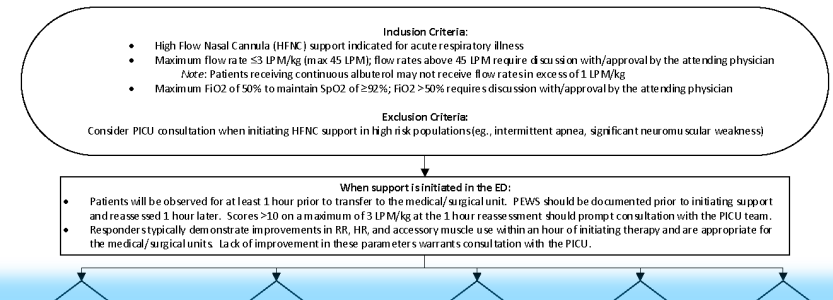
Exclusion Criteria:

Consider PICU consultation when initiating HFNC support in high risk populations (eg., intermittent apnea, significant neuromuscular weakness)

HFNC support can be initiated outside of the ICU for an acute respiratory illness, as long as the following are adhered to:

- Maximum flow rate ≤ 3 LPM/kg (max 45 LPM).
 - **Note:** Any flow rate that is over 45 LPM must be approved by the attending physician
 - Most patients do not benefit from flow rates exceeding 2 LPM/kg
 - Patients receiving continuous albuterol should not exceed 1 LPM/kg flow (max 45 LPM)
- Maximum FiO₂ of 50% to maintain SpO₂ of $\geq 92\%$ (FiO₂ $>50\%$ requires discussion with/approval by the attending physician)





When support is initiated in the ED:

- Patients will be observed for at least 1 hour prior to transfer to the medical/surgical unit. PEWS should be documented prior to initiating support and reassessed 1 hour later. Scores >10 on a maximum of 3 LPM/kg at the 1 hour reassessment should prompt consultation with the PICU team.
- Responders typically demonstrate improvements in RR, HR, and accessory muscle use within an hour of initiating therapy and are appropriate for the medical/surgical units. Lack of improvement in these parameters warrants consultation with the PICU.

| | | | | |
|--|--|---|---|--|
| <p>weaned for SpO2 >92%</p> <p>Physicians, Advanced Practice Providers, Nurse and Respiratory Therapists may titrate O2</p> | <p>approval by the attending physician. Significant work of breathing despite this level of support warrants evaluation by the PICU team. Most patients will not benefit from flows significantly greater than 2 LPM/kg. RTs, physicians, and advanced practice providers may increase the flow as needed. HFNC orders must be updated after any change (if RT increase's page resident to update order) and the bedside nurse notified.</p> <p>RT must be notified immediately of increases in flow to assess whether prongs are the proper size</p> <p>WEANING: Initiate decreases in flow when:</p> <ul style="list-style-type: none"> WOB is improved; HR/RR may be elevated for age but are stable <p>Weaning strategy:</p> <ul style="list-style-type: none"> Many patients only need high flow support for 24 hrs. <ul style="list-style-type: none"> For mild/moderate WOB, trial off of flow entirely and observe for changes in work of breathing and vital signs to assess readiness to discontinue. Patients who have increased WOB after several minutes should remain on high flow but may tolerate a lower flow rate. Always update the HFNC order after any change (if RT weans, page resident to update order accordingly) and communicate with the bedside nurse. RTs, physicians, and advanced practice providers may wean flow. When discontinuing high flow remember to place an order for oxygen via nasal cannula for any residual O2 demands. | <ul style="list-style-type: none"> Aerosolized hypertonic saline Chest physiotherapy Deep suctioning <p>*Recommend cluster care of CPT, Neb's, suctioning to allow for periods of rest</p> | <p>Continuous CR monitoring</p> <ul style="list-style-type: none"> Continuous pulse oximetry monitoring (alarm for SpO2 <92%) Document PEWS score prior to starting HFNC and 1 hour after initiating HFNC support. <ul style="list-style-type: none"> Subsequent scoring occurs at 4 hour intervals per hospital protocol (see below: When To Call a MET) | <ul style="list-style-type: none"> Enteral feeds are generally appropriate once the patient has been on a stable flow rate for at least 2 hours with only mild/moderate work of breathing IV hydration may be preferable in patients with significant WOB at risk for aspiration |
|--|--|---|---|--|

WHEN TO CALL A MET:

- Team member or family concern about the patient's clinical status
- More than moderate work of breathing on 3 LPM/kg (max 45 LPM)
- PEWS >10 after an hour on maximum flow of 3 LPM/kg (max 45 LPM)

DISCHARGE CRITERIA:

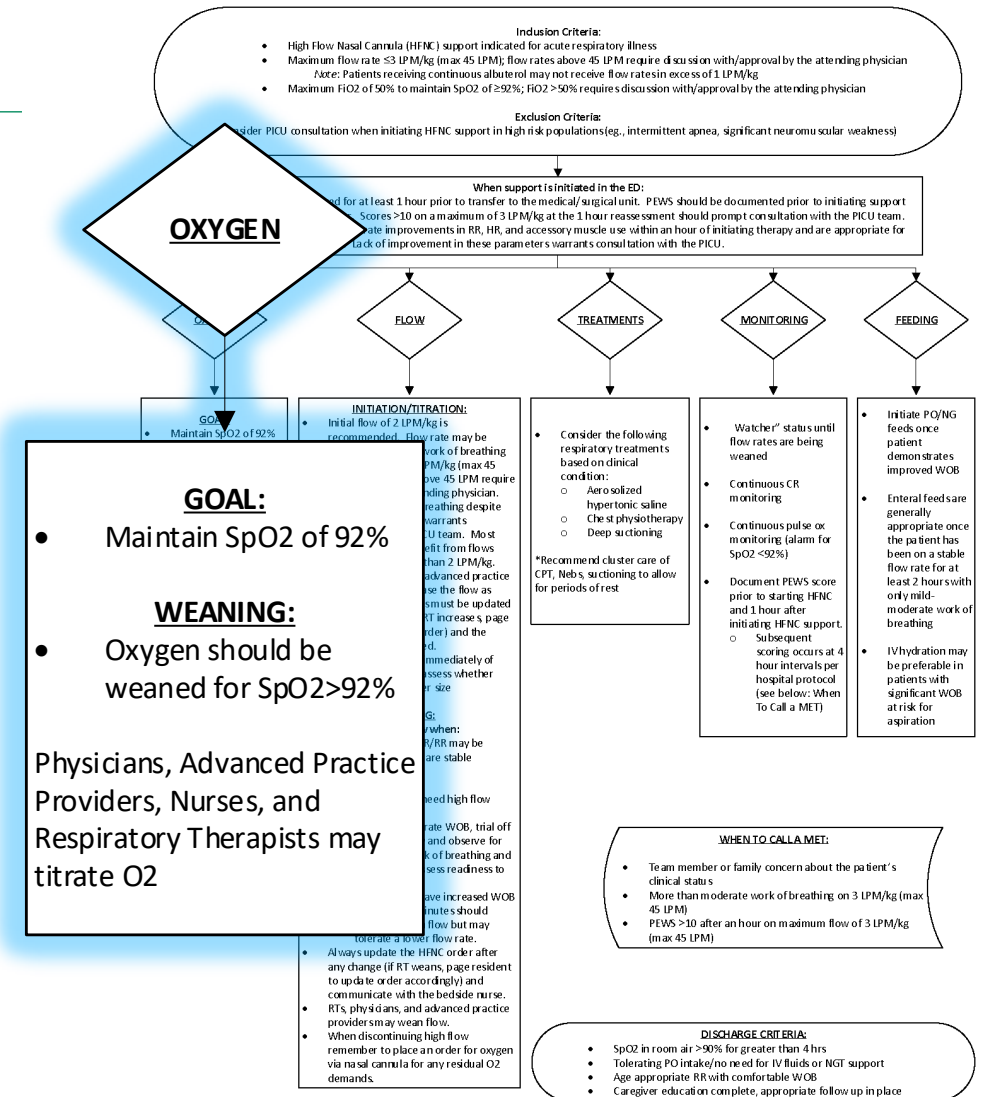
- SpO2 in room air >90% for greater than 4 hrs
- Tolerating PO intake/no need for IV fluids or NGT support
- Age appropriate RR with comfortable WOB
- Caregiver education complete, appropriate follow up in place

Those initiated on HFNC typically respond clinically within 1 hr of initiating therapy.

Lack of improvement in respiratory status despite HFNC warrants ICU consultation.

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- Supplemental oxygen (FiO₂) should be titrated to maintain a minimum SpO₂ of 92%
- Physicians, APPs, Nurses, and RTs may titrate O₂
- Oxygen should be weaned first before any flow changes

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Initiation/Titration of Flow:

- Initial flow rates of 2 LPM/kg are recommended, with increases to a max of 3 LPM/kg (max 45 LPM) PRN.
- Most patients will not benefit from flow rates in excess of 2 LPM/kg
- Any patient with significant WOB despite 3 LPM/kg should be evaluated by the ICU
- RT, physicians or APPs may decrease or increase flow as clinically indicated at bedside
- RT must be notified immediately any time rates are increased, so make sure the patient is fitted with appropriate sized nasal cannula to support the desired flow

Weaning Flow:

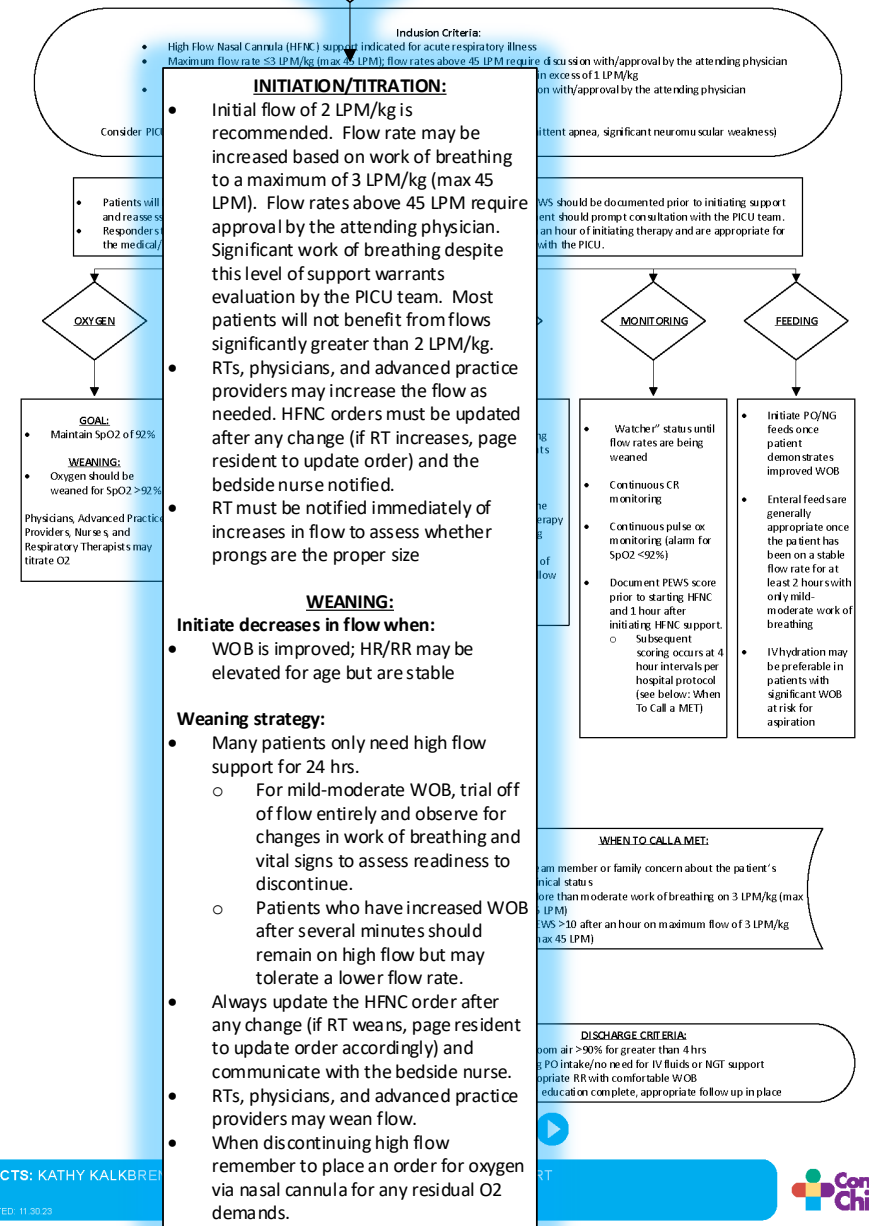
- Patients with no more than moderate WOB should be trialed off flow entirely every 24 hours to determine ongoing need for support
- Once a patient has stable HR/RR/WOB at 4 LPM, transition to a conventional nasal cannula or RA

NOTE:

- Changes to flow rates must be followed by changes to the high flow orders AND communication with the bedside RN

CLINICAL PATHWAY: High Flow Nasal Cannula Use in the Bedside of the Intensive Care Unit

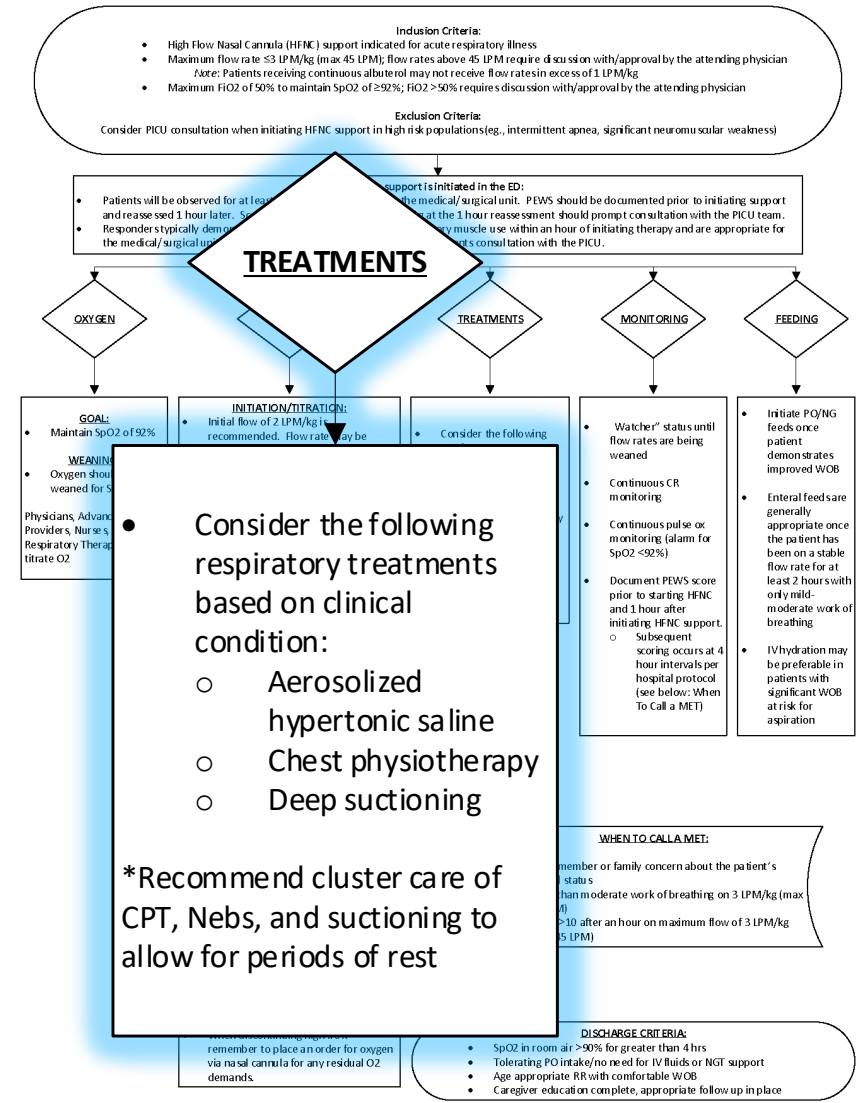
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High Flow Nasal Cannula Use in Patients Outside of the Intensive Care Unit

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Treatments and feeds should be clustered as much as possible to allow for the patient to have periods of rest.



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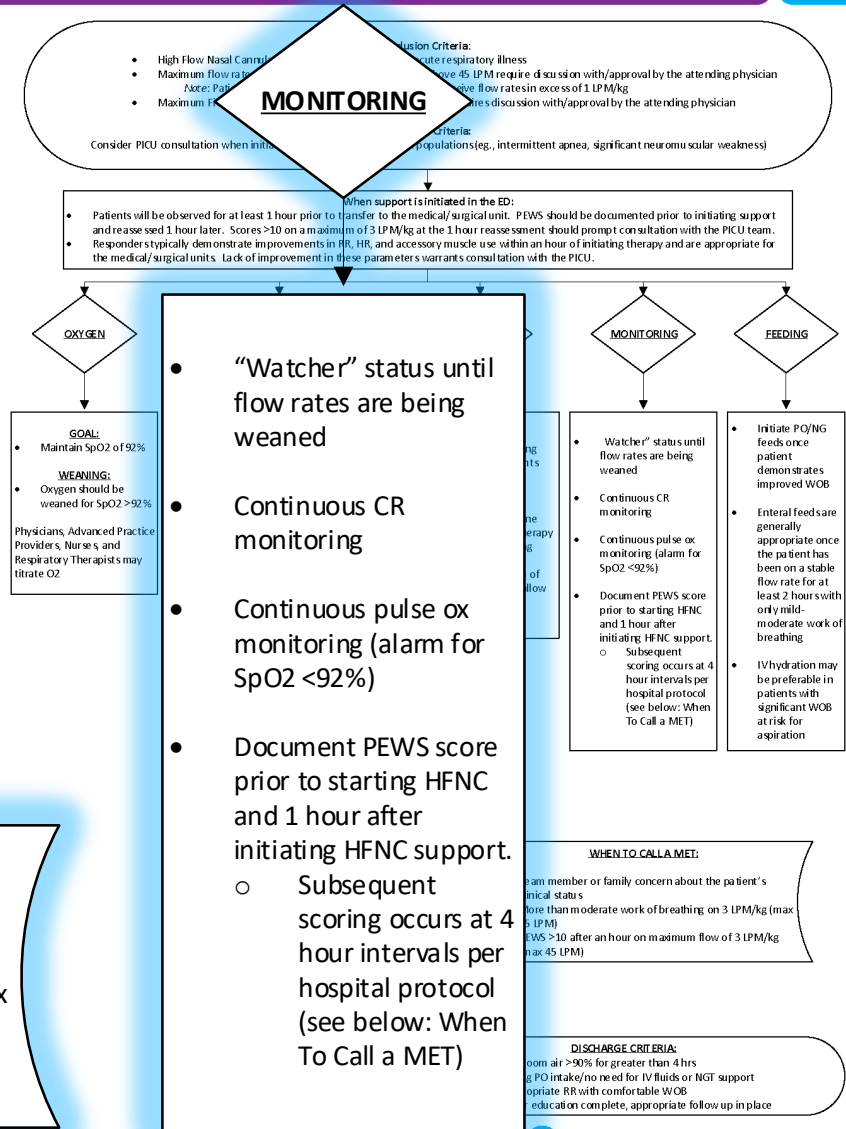
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- Patients will be “WATCHER” status until flow rates are being weaned
- PEWS scores should be documented per policy
 - Note that PEWS scores may be greater than 7 due to flow rates rather than clinical deterioration

WHEN TO CALL A MET:

- Team member or family concern about the patient’s clinical status
- More than moderate work of breathing on 3 LPM/kg (max 45 LPM)
- PEWS >10 after an hour on maximum flow of 3 LPM/kg (max 45 LPM)



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FEEDING

- High Flow Nasal Cannula (HFNC) support in the ED should be initiated with approval by the attending physician
- Maximum flow rate ≤3 LPM/kg (in 45 LPM/kg) for patients receiving continuous albuterol therapy with approval by the attending physician
- Maximum FIO2 of 50% to maintain SpO2 of ≥92%; FIO2 >50% should be used with approval by the attending physician

Exclusion Criteria:
Consider PICU consultation when initiating HFNC support in high risk population (eg., intermittent apnea, significant neuromuscular weakness)

- When support is initiated in the ED:
- Patients will be observed for at least 1 hour prior to transfer to the medical/surgical unit. PEWS should be documented prior to initiating support and reassessed 1 hour later. Scores >10 on a maximum of 3 LPM/kg at the 1 hour reassessment should prompt consultation with the PICU team.
 - Responder typically demonstrate improvement in work of breathing. Lack of improvement should prompt consultation with the medical/surgical units.

OXYGEN

- GOAL:**
- Maintain SpO2 of 92%
- WEANING:**
- Oxygen should be weaned for SpO2 >92%
- Physicians, Advanced Practice Providers, Nurses, and Respiratory Therapists may titrate O2

FLOW

- INITIATION/TITRATION:**
- Initial flow of 2 LPM/kg is recommended. Flow rate increased based on work of breathing to a maximum of 3 LPM/kg (in 45 LPM/kg). Flow rates above 4 LPM/kg should be used with approval by the attending physician. Significant work of breathing at this level of support warrants evaluation by the PICU team. Patients will not benefit if significantly greater than 3 LPM/kg.
 - RTs, physicians, and advanced practice providers may increase the flow rate if needed. HFNC orders should be updated after any change (if RT is the resident to update order, bedside nurse notified).
 - RT must be notified immediately if flow increases to assess if the proper size cannula is being used.
- WEANING:**
- Initiate decreases in flow when WOB is improved; HR/RR are stable and not elevated for age but are still elevated.
- Weaning strategy:**
- Many patients only need support for 24 hrs.
 - For mild/moderate work of breathing, decrease flow of flow entirely and changes in work of breathing and vital signs to assess if weaning is appropriate.
 - Patients who have failed to wean after several minutes remain on high flow. If they tolerate a lower flow rate, decrease flow to that rate.
 - Always update the HFNC order when flow is changed. Communicate with the bedside nurse, RTs, physicians, and advanced practice providers when weaning flow.
 - When discontinuing high flow nasal cannula, remember to place an order for IV fluids or NGT support if appropriate.

MONITORING

- PEWS score <10 on a maximum of 3 LPM/kg for at least 2 hours with only mild/moderate work of breathing.
- PEWS score <10 on a maximum of 3 LPM/kg for at least 2 hours with only mild/moderate work of breathing.
- PEWS score <10 on a maximum of 3 LPM/kg for at least 2 hours with only mild/moderate work of breathing.

FEEDING

- Initiate PO/NG feeds once patient demonstrates improved WOB
- Enteral feeds are generally appropriate once the patient has been on a stable flow rate for at least 2 hours with only mild/moderate work of breathing
- IV hydration may be preferable in patients with significant WOB at risk for aspiration

CALL A MET:

- If there is concern about the patient's work of breathing on 3 LPM/kg (maximum flow of 3 LPM/kg)

CRITERIA:

- PEWS score <10 on a maximum of 3 LPM/kg for at least 2 hours with only mild/moderate WOB appropriate follow up in place

- Initiate feeds when there is an improved WOB
- IV hydration may be preferable based on patient

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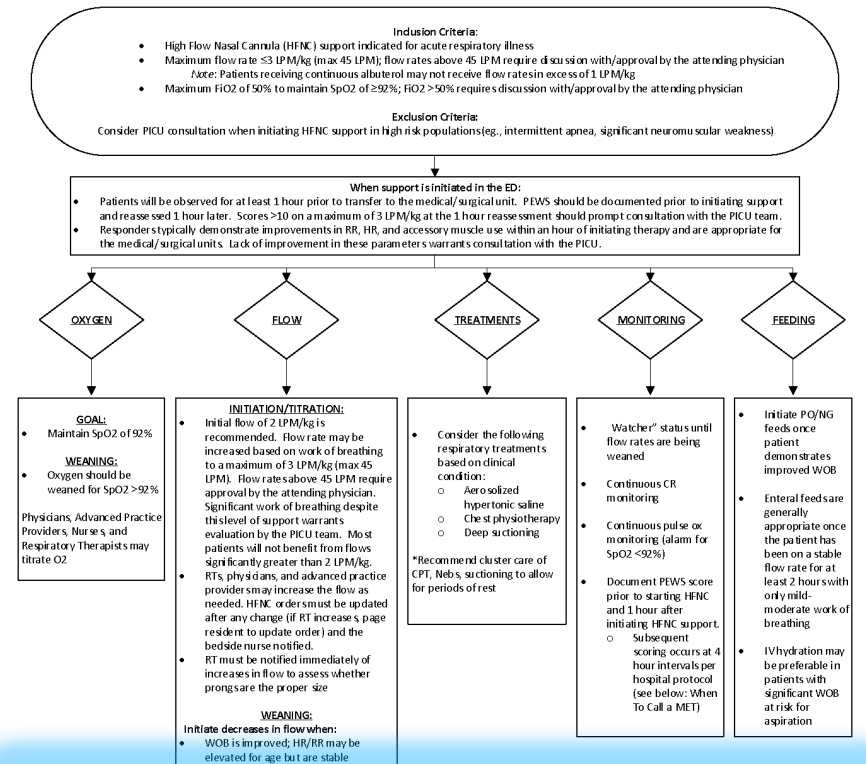
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It is important to closely monitor a patient’s clinical status while on the floors and requiring HFNC support.

A MET activation is indicated in the following situations:

- Staff and/or family concern for patient’s clinical status
- Oxygen demand exceeds 50% FiO_2
- More than moderate WOB on 3 LPM/kg (max 45 LPM)
- PEWS > 10 after an hour on max flow of 3 LPM/kg (max 45 LPM)

WHEN TO CALL A MET:

- Team member or family concern about the patient’s clinical status
- More than moderate work of breathing on 3 LPM/kg (max 45 LPM)
- PEWS > 10 after an hour on maximum flow of 3 LPM/kg (max 45 LPM)

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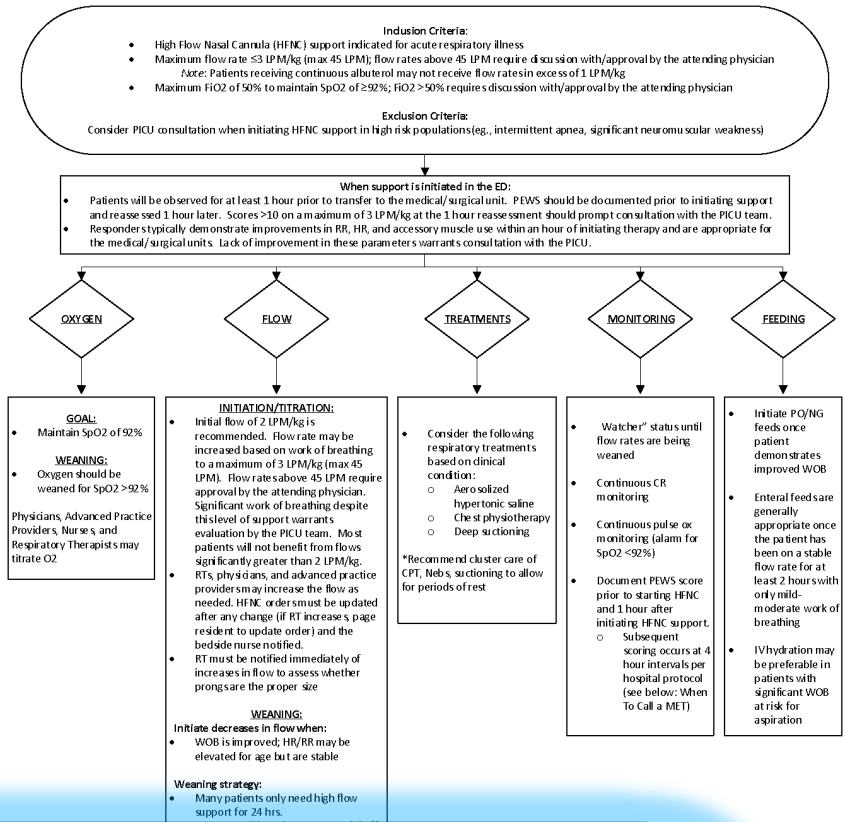


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Patients may be ready for discharge when:

- Stable on room air 90-92% or greater for more than 4 hours
- Tolerating PO intake without need for IVF or NGT support
- Caregiver education complete
- Appropriate follow up in place



DISCHARGE CRITERIA:

- SpO2 in room air >90% for greater than 4 hrs
- Tolerating PO intake/no need for IV fluids or NGT support
- Age appropriate RR with comfortable WOB
- Caregiver education complete, appropriate follow up in place

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Use of Order Set



- Please make sure to use the order set associated with this pathway to ensure pathway adherence
- Preselected items in the order set include Initiate Pathway and MET activations

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

- Days of HHFNC 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
 - Pediatric Hospital Medicine

- Kara Denz Fluck, PA-C
 - Pediatric Hospital Medicine

- Lisa LeBon, RRT
 - Respiratory Therapy

References

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Thank You!



About Connecticut Children's Pathways Program

Clinical pathways guide the management of patients to optimize consistent use of evidence-based practice. Clinical pathways have been shown to improve guideline adherence and quality outcomes, while decreasing length of stay and cost. Here at Connecticut Children's, our Clinical Pathways Program aims to deliver evidence-based, high value care to the greatest number of children in a diversity of patient settings.

These pathways serve as a guide for providers and do not replace clinical judgment.