



# Essentials in Paediatric Oxygen Therapy & Heated High Flow

2022

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# Webinar Guidelines



Use mute when you are not speaking.  
Unmute anytime to ask questions.



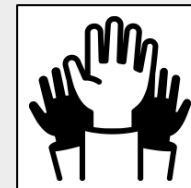
Turn video on for a more personalized/engaging experience.  
If internet connection is low turn on when speaking.



Use chat for additional comments/questions you'd like to share.



Avoid multitasking during the session.



Participation is encouraged.



Tell us about yourself

# Objectives

- ✓ Identify the indications for applying oxygen therapy
- ✓ Select the appropriate form of oxygen therapy for a paediatric patient
- ✓ Describe the different types of oxygen therapy used
- ✓ Troubleshoot common concerns with oxygen therapy using clinical cases
- ✓ Safely manage a paediatric patient on heated high flow therapy

# Presentation Overview

- Oxygen basics
- Respiratory Syncytial Virus (RSV)
- Signs of hypoxia
- Forms of oxygen therapy
  - Nasal Prongs
  - Simple Mask
  - Standard high flow oxygen devices
  - Non-Rebreather
  - HHFT
- When to call the respiratory therapist (RT)



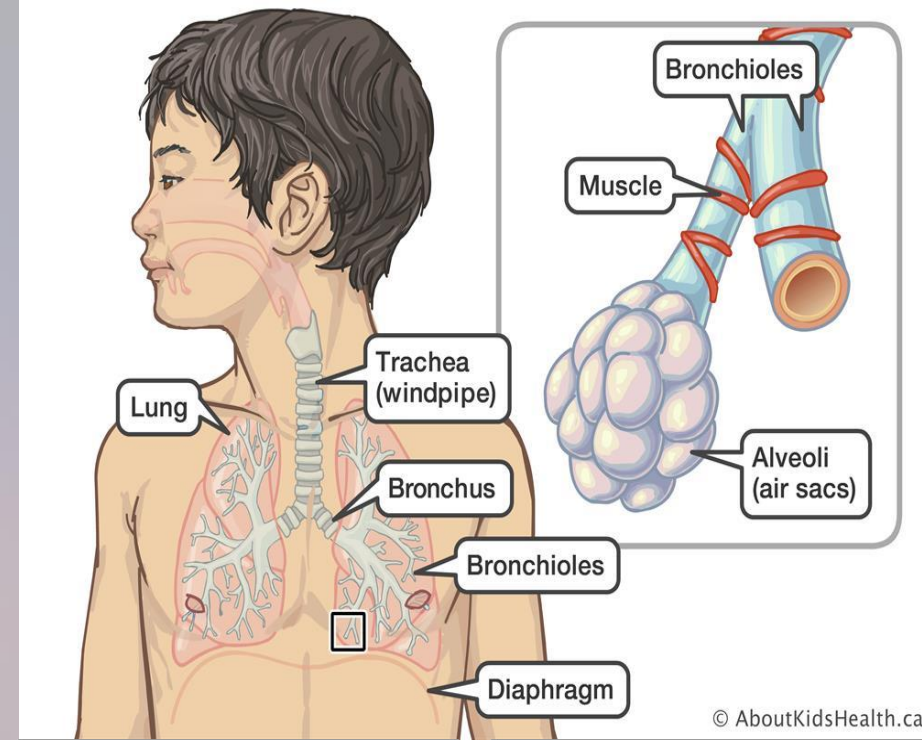
# RSV - Respiratory Syncytial Virus

## Bronchiolitis

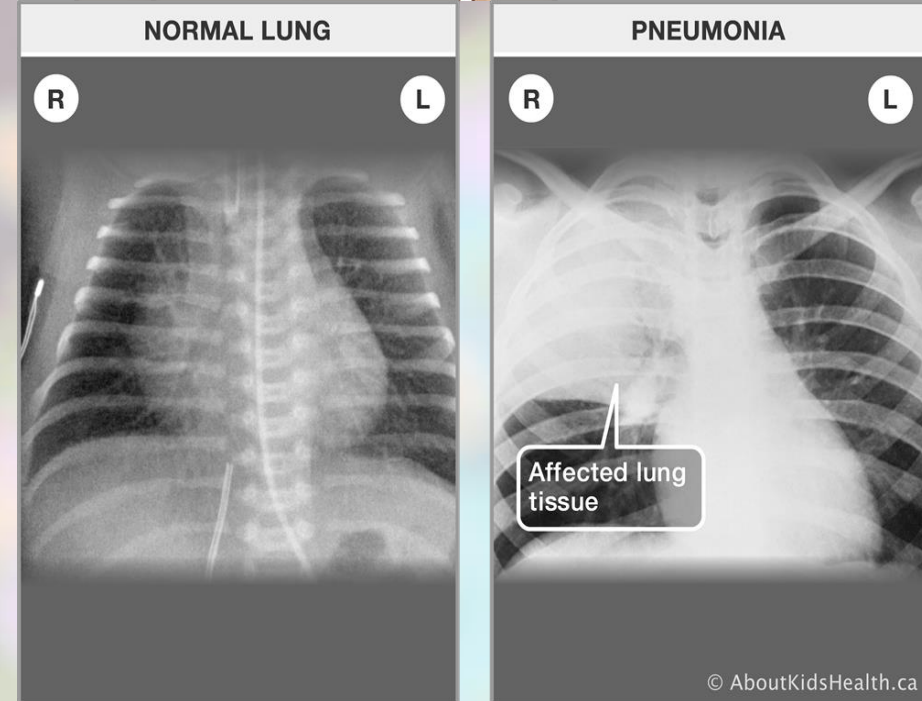
- inflammation & congestion in the small airways
- Most common in young infants
- Commonly caused by RSV but other viruses too
- Fever, runny nose, cough
- Advanced: WOB, tachypnea, accessory muscle use, wheezing, trouble eating and sleeping, irritability
- Can lead to pneumonia

## Covid-19

- Coronavirus
- fever, sore throat, cough, difficulty breathing



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# The Basic Terms

**FiO<sub>2</sub>** = Fraction of inspired oxygen

oxygen concentration/percentage of oxygen (%)

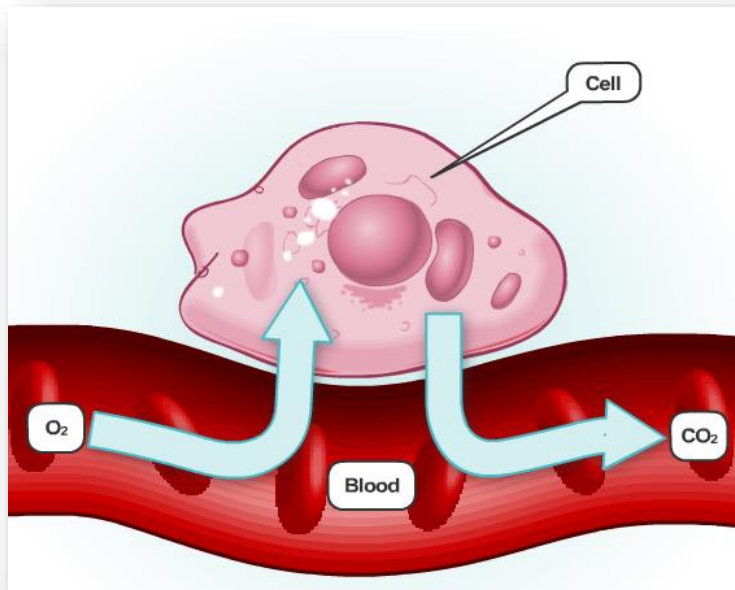
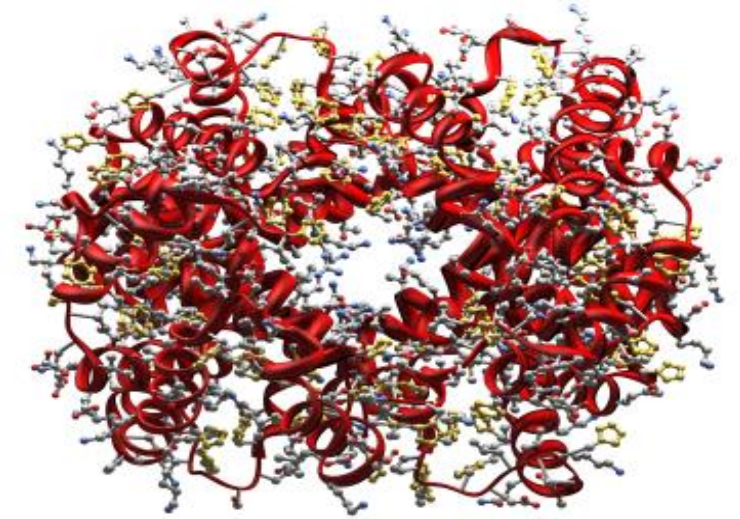
- ✓ Room Air is **FiO<sub>2</sub> = 0.21 or 21% O<sub>2</sub>**
- ✓ Oxygen (pure) is **FiO<sub>2</sub> = 1.0 or 100% O<sub>2</sub>**





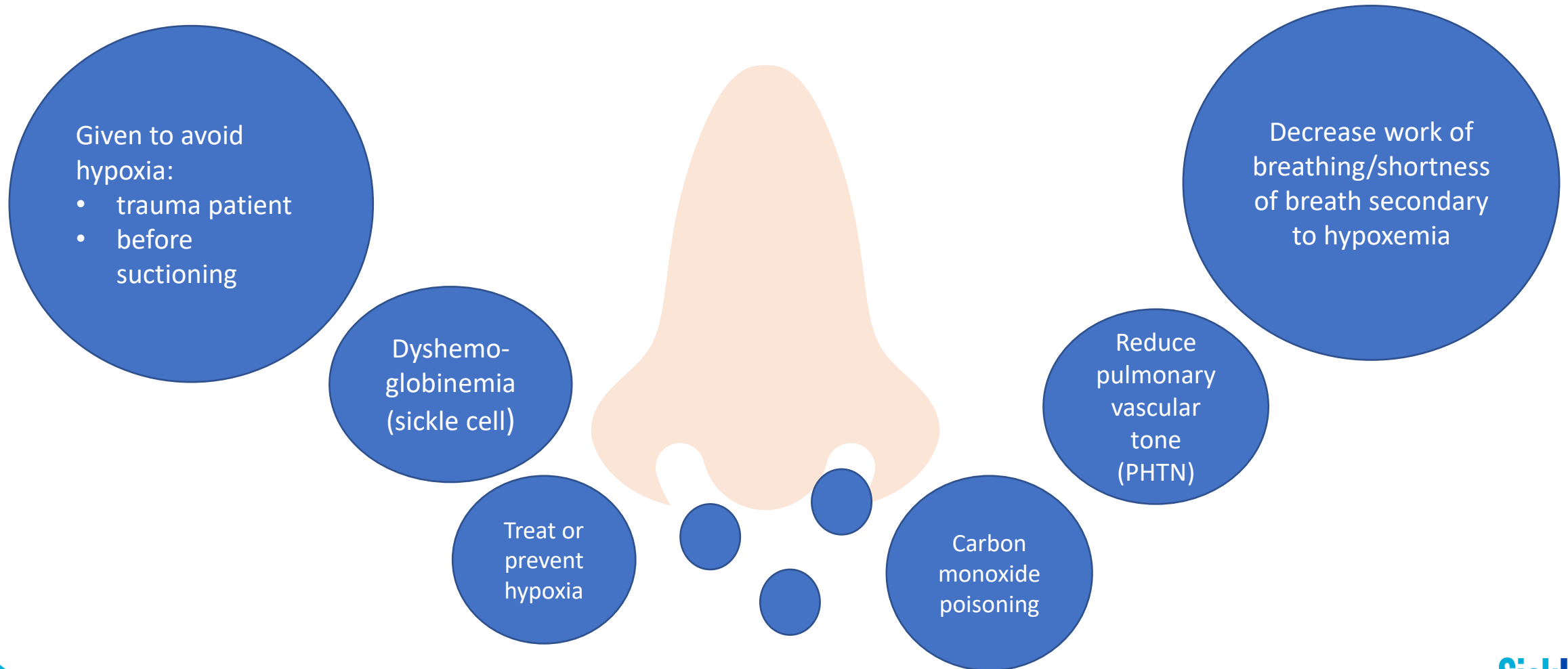
# Measuring Oxygen

$SpO_2$  = % of hemoglobin that are carrying  $O_2$  in the arterial blood



- $PaO_2$  = partial pressure of  $O_2$  in the arterial blood
  - Normal 60-100mmHg
- Typical target  $SpO_2 > 92\%$

# Why Apply Oxygen?

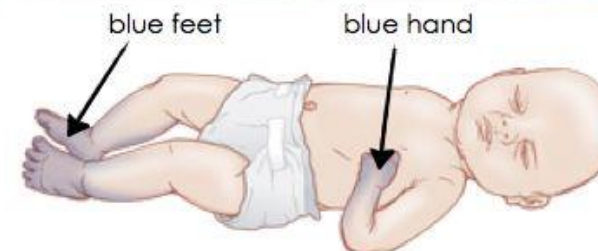


# Signs & Symptoms of Hypoxia

- Decreased oxygen saturation
- Tachypnea
- Change in heart rate
  - Bradycardia in children
- Dyspnea
- Cyanosis
  - Central vs. Peripheral
- Decreased level of consciousness



Image Available From: <https://www.pulmonologyadvisor.com/home/topics/critical-care/new-recommendations-for-home-oxygen-therapy-in-children/>



# Interpreting Pulse Oximetry Pleth

- Saturation may not always read accurately.
- Important to decipher clinical presentation from faulty reading.
- Poor Perfusion – consider new site or warming limb.

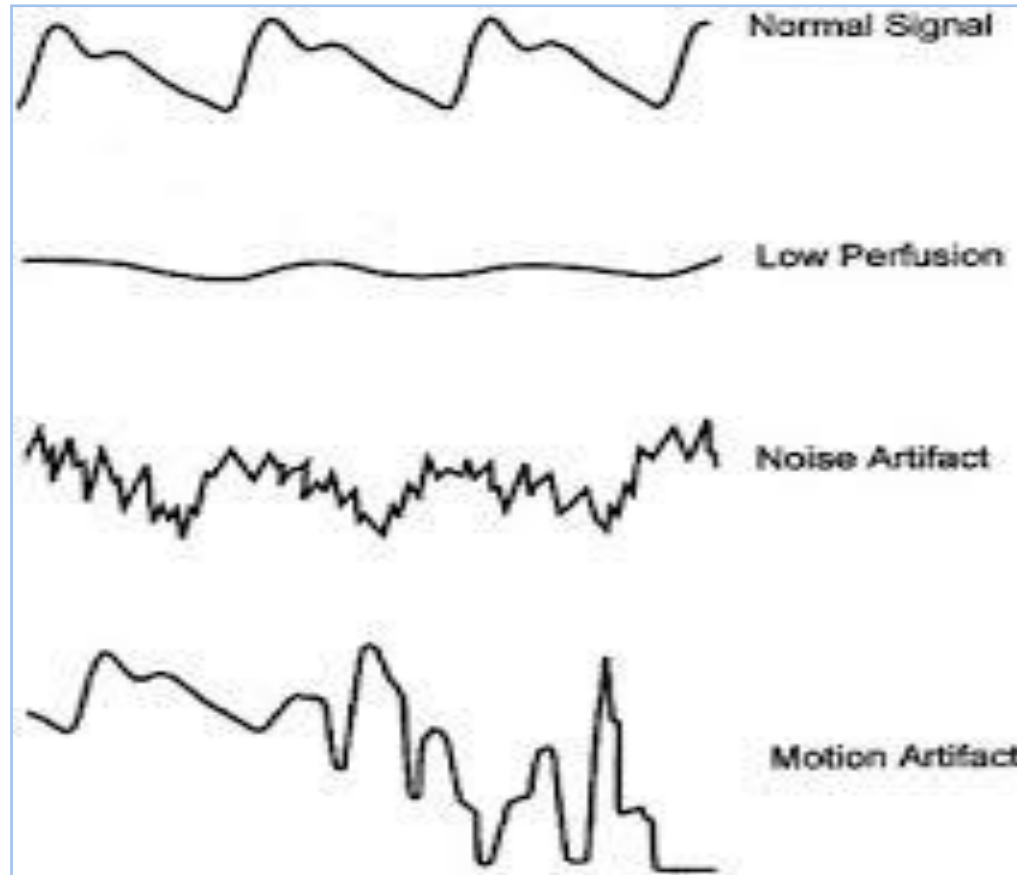


Image Available from: <https://www.jems.com/>

# Your Hospital Policy

Familiarize yourself with your hospital policy

For example, at SickKids:

- **Increasing oxygen demand – Notify the most responsible physician (MRP)**
  - The MRP will be notified of any significant or sustained relative increase in oxygen requirements.
- **FiO<sub>2</sub> greater than 0.40 - Page the RRT**
  - An RT will be consulted when a child requires concentrations of supplemental oxygen > 40 %.
- All patients requiring oxygen must have an additional cylinder stocked on the in-patient unit. Ensure the cylinder pressure gauge reads equal to or greater than 1000 pounds per square inch (psi).





Questions?





# Oxygen Therapy Devices



A close-up photograph of a child's hand holding a white nebulizer mask. The child's fingers are wrapped around the mask, and the background is a blurred hospital room. Overlaid on the image are three callout boxes with white ovals on the left and white rectangles on the right, connected by thin lines. The ovals contain the text 'Oxygen need', 'Patient considerations', and 'Humidity need'. The rectangles contain the text 'High or Low Flow', 'Interface requirements, mobility/portability, frequency of aerosolized meds?', and 'Usage: short versus long-term' respectively.

**Oxygen need**

**High or Low Flow**

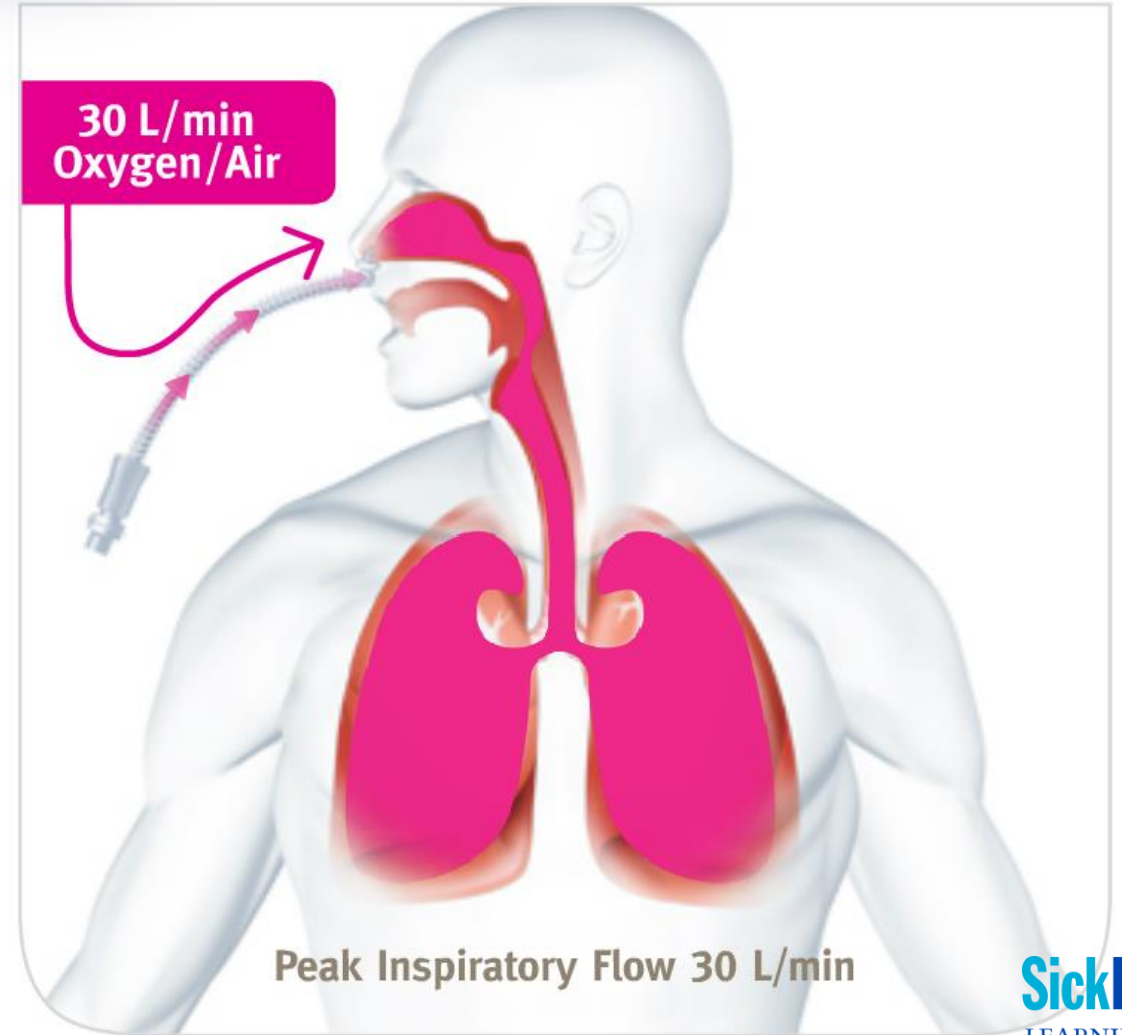
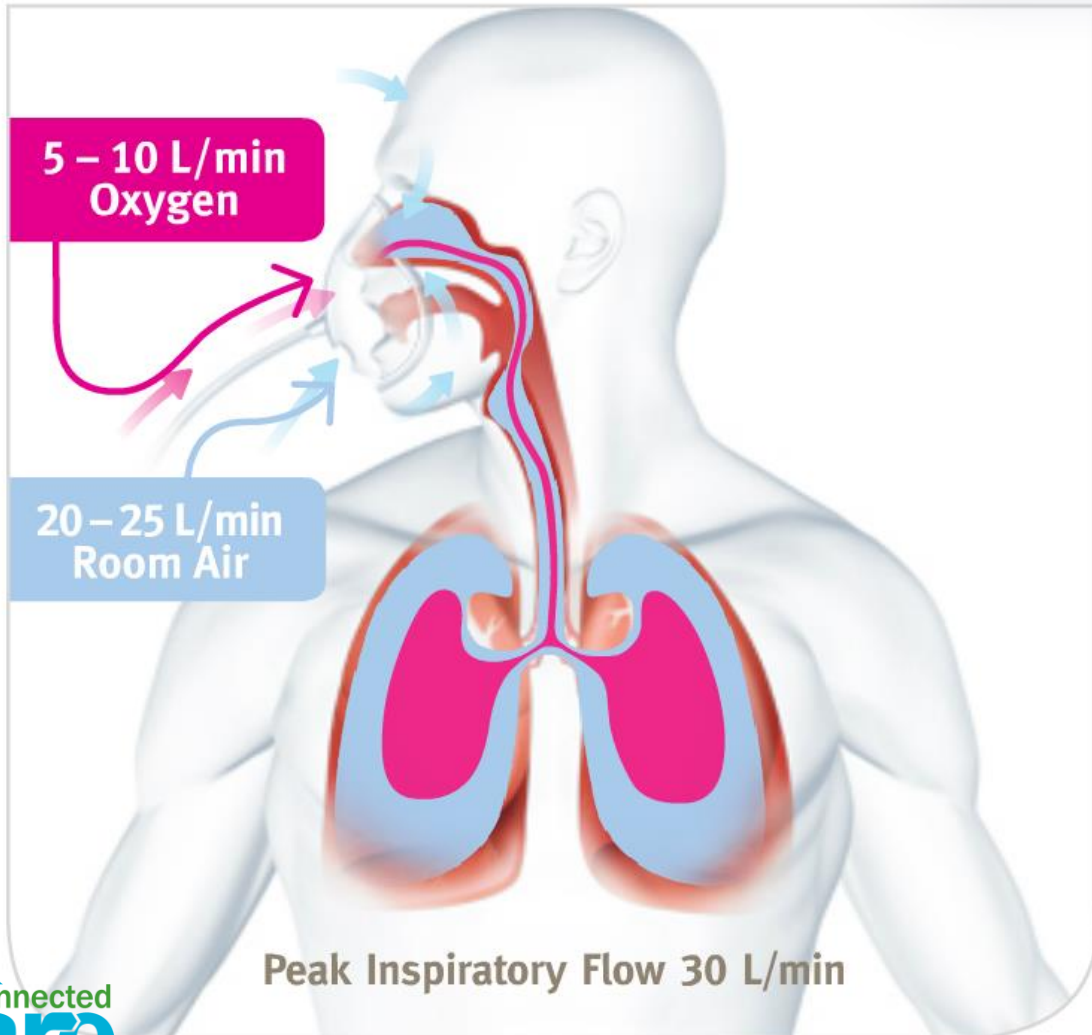
**Patient  
considerations**

**Interface requirements,  
mobility/portability, frequency of  
aerosolized meds?**

**Humidity  
need**

**Usage: short versus long-term**

# Low-Flow **VS** High-Flow



# Types of Oxygen Therapy

LOW  
Flow

- Nasal Prongs
- Simple Mask

*Does NOT  
Guarantee  $FiO_2$*

High  
Flow

- Face Masks (Venturi, LVN)
- HHFT (HFNC, Airvo with facemask)

*Does Guarantee  
 $FiO_2$*

# Oxygen Therapy Devices at SickKids

## Low-flow Oxygen Devices



**Nasal Prongs  
(Nasal  
Cannula)**

**Flowrates:**

Newborn  $\leq 1$  LPM

Infant  $\leq 2$  LPM

Child  $\leq 4$  LPM

Teen  $\leq 6$  LPM

Prongs should occupy less than 50% of nare.

**Document:**

✓ Interface

✓ Flowrate

- Commonly secured with hypafix for infants/toddlers.
- Teens can wear looped around ears with tubing below chin.
- Use bubblers if symptoms of dryness or flows  $> 4$ LPM



**Simple O<sub>2</sub>  
Mask**

**Flowrates:**

6-10 LPM

Flow **always** above 6 LPM

**Document:**

✓ Interface

✓ Flowrate

- For short-term O<sub>2</sub> therapy.
- Commonly used post-anesthetic.
- Flows less than 6 LPM may lead to CO<sub>2</sub> re-breathing in mask.



# Oxygen Therapy Devices at SickKids

## Low-flow Oxygen Devices



### Nasal Prongs (Nasal Cannula)

#### Flowrates:

Newborn  $\leq 1$  LPM

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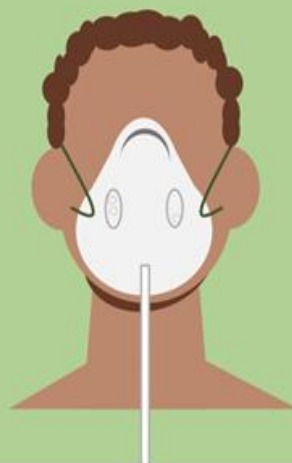
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# Nasal Prongs

- Does NOT guarantee an exact  $\text{FiO}_2$
- Maximum Infant Flowrate: **2 Lpm**
  - 2 Lpm can equate to as high as  $\text{FiO}_2$  0.50 in some infants
  - For rate  $< 1$  Lpm, low-flow flowmeters are available
- Maximum Paediatric Flowrate: **4 Lpm**
- Maximum Adult Flowrate: **6 Lpm**
- Available in a variety of sizes:
  - Neonatal / Infant / Paediatric / Adult



Image Available From: Shutterstock.com

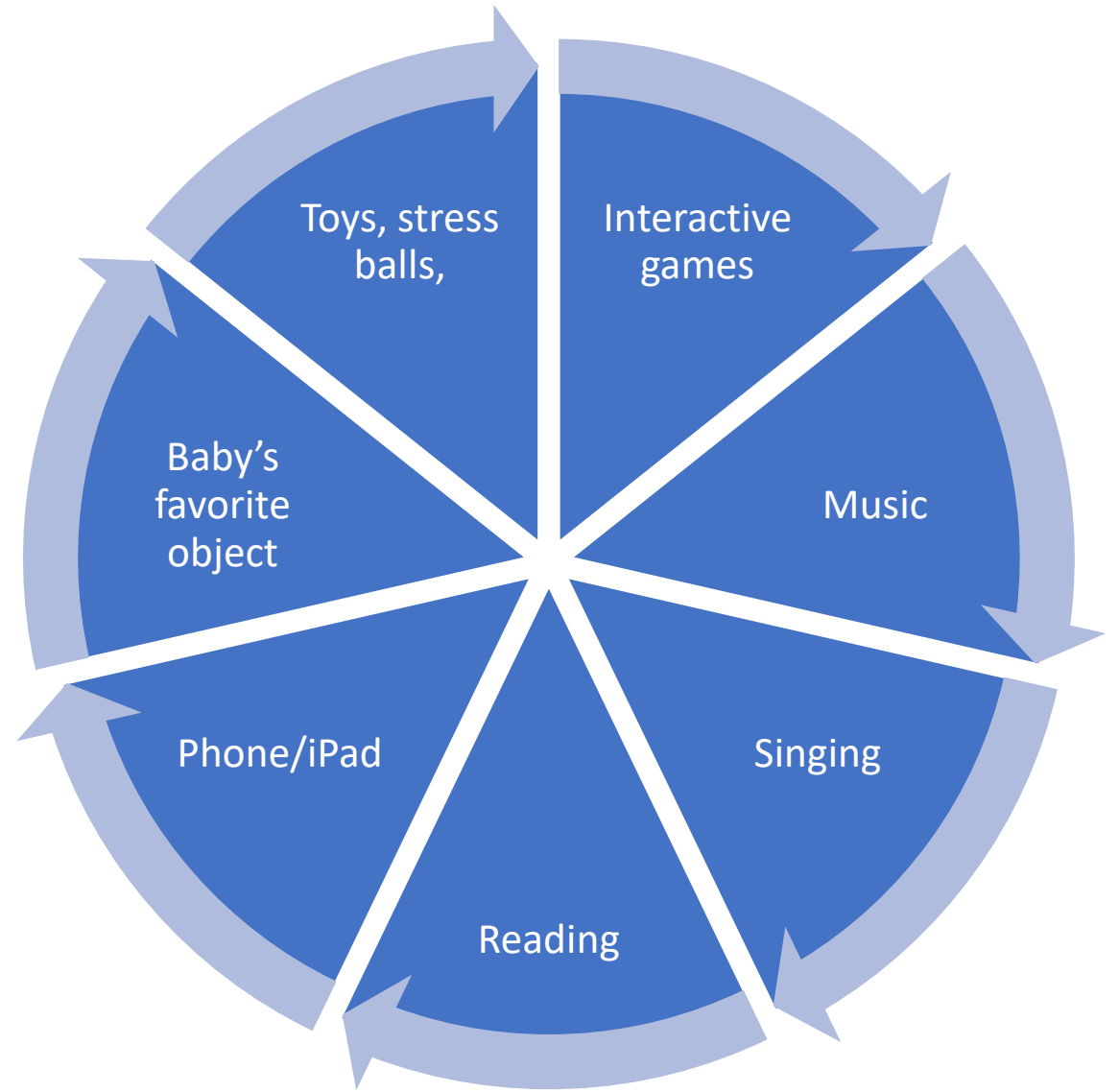


Fisher&Paykel



Medaid

# Distraction techniques





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**Simple O<sub>2</sub>  
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**Flowrates:**

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Flow always above 6 LPM

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- For short-term O<sub>2</sub> therapy.
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- Flows less than 6 LPM may lead to CO<sub>2</sub> re-breathing in mask.

# Simple Mask

- Does not guarantee an exact  $\text{FiO}_2$
- Available in small & large
- For short-term, intermediate amount of  $\text{O}_2$  (e.g. post-operative recovery)
- Flow-rate recommended: **6-10 Lpm** (PALS recommendation)
- Cannot set below 6 Lpm
  - Risk of rebreathing  $\text{CO}_2$


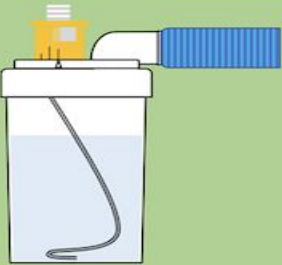








Image Available From: <https://www.cpapusa.com>



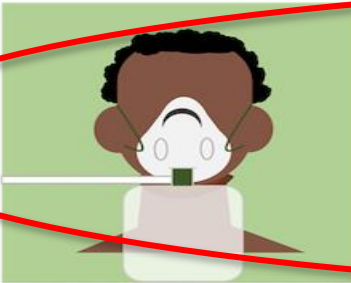
Image Available From: <https://www.healthproductsforyou.com>

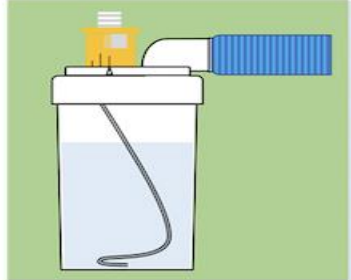
# High-Flow Oxygen Devices


	<p><b>Non-rebreather O<sub>2</sub> Mask</b></p>	<p><b>Flowrates:</b> 10-15 LPM</p> <p>Bag should stay inflated.</p>	<p><b>Document:</b> ✓ Interface ✓ Flowrate</p>	<ul style="list-style-type: none"> <li>• For short-term emergency O<sub>2</sub> therapy.</li> <li>• Flow should keep the bag inflated on the mask; use &gt;15 LPM if needed.</li> <li>• Found in airway boxes, on code carts.</li> </ul>	
	<p><b>Large Volume Nebulizers (LVN)</b></p>	<p><b>FiO<sub>2</sub></b> 28%-96%</p> <p><b>Flowrate:</b> set the LPM indicated on the collar.</p>	<p><b>Document:</b> ✓ Interface ✓ Flowrate ✓ FiO<sub>2</sub></p>	<ul style="list-style-type: none"> <li>• Blow-by is not a recommended therapy.</li> <li>• Cool humidity not an evidenced-based practice for croup/bronchiolitis.</li> <li>• Use for tracheostomy tubes, if not using Airvo.</li> <li>• Considered an AGMP.</li> </ul>	
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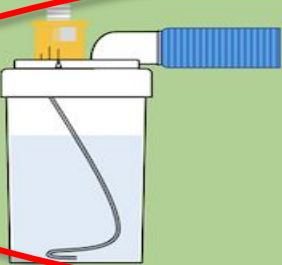






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# Non-rebreather Mask

- For short-term, emergency oxygen therapy
- Flow should keep bag on mask inflated; use >15 Lpm if needed
- Should be set typically **10-15 LPM** (PALS recommendation)
- Found in airway boxes, code carts



# High-Flow Oxygen Devices

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# Large Volume Nebulizer (LVN)

If patient's don't tolerate nasal prongs

Works by mixing  $O_2$  with Air to create desired  $FiO_2$

Set the  $O_2$  flowrate to the corresponding  $FiO_2$

- Guaranteed to patient's lungs



trach mask




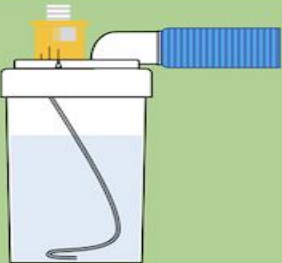






face mask



oxyhood



# High-Flow Oxygen Devices

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# Venturi Mask

- Used to deliver specific FiO<sub>2</sub> without humidity when patients do not tolerate nasal prongs
- Venturi mask: 24-60% O<sub>2</sub>
- Used on transport if patient is on large volume nebulizer (LVN)
- Venturi connectors (and LVN's) can be setup with:  
a face mask, face tent, trach mask, oxyhood



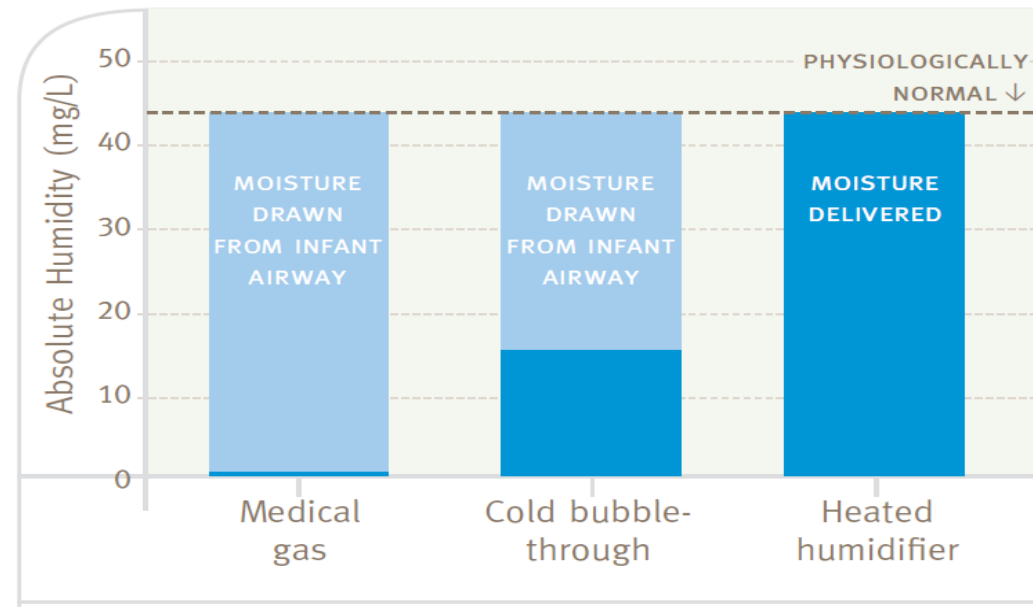
# Key Points

- Maximum Nasal prongs flowrates are:
  - 2 LPM for infants; &
  - 4 LPM for children
  - 6 LPM for older teens/adults
- Simple mask and NRB are used for emergencies, quick O<sub>2</sub> and should not be set less than 6 LPM and 10 LPM, respectively
  - short-term use
- Venturi – look at connection
- LVN is used to track oxygen % and provide some humidity
  - Masks for child/teen

*It is important to know your patient's 'baseline status' for oxygen therapy and work of breathing*

# A little note about humidity

- Generally, bubblers provide minimal humidity to the patient
- Cool humidity is not an evidenced-based practice according to bronchiolitis/croup guidelines
- Blow-by therapy (via LVN) is not a recommended therapy
- Aerosolized humidity = AGMP



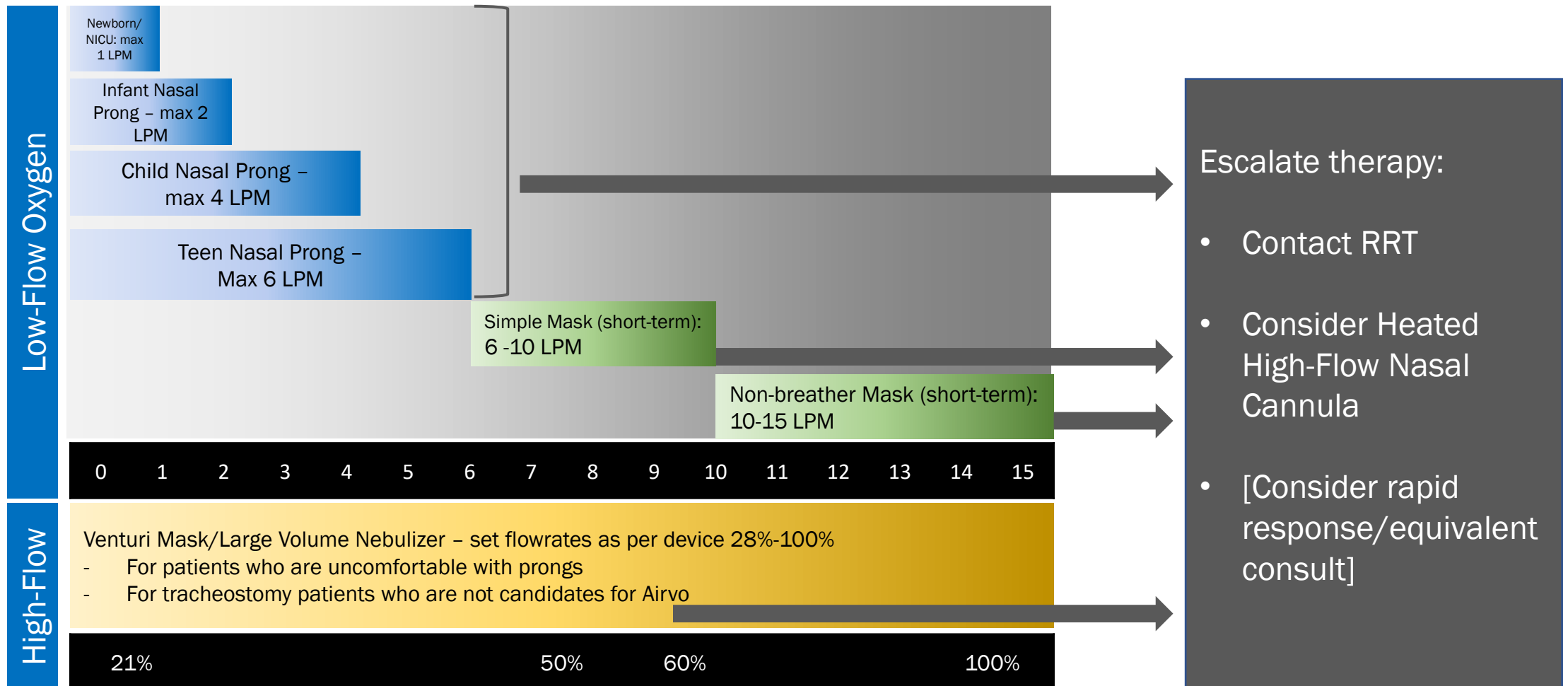
# Double Check Your O<sub>2</sub> Setup

- Double check your device AND bedside set up at minimum start of shift!
- Examples of safety errors/risks:
  - Connection to air
  - Low flow flowmeters
  - Accidental bumps to settings
  - Accidental loose connections/disconnections
  - Unavailable connections to bagging system!





# A Simplified O<sub>2</sub> Pathway: general guidance



Questions?

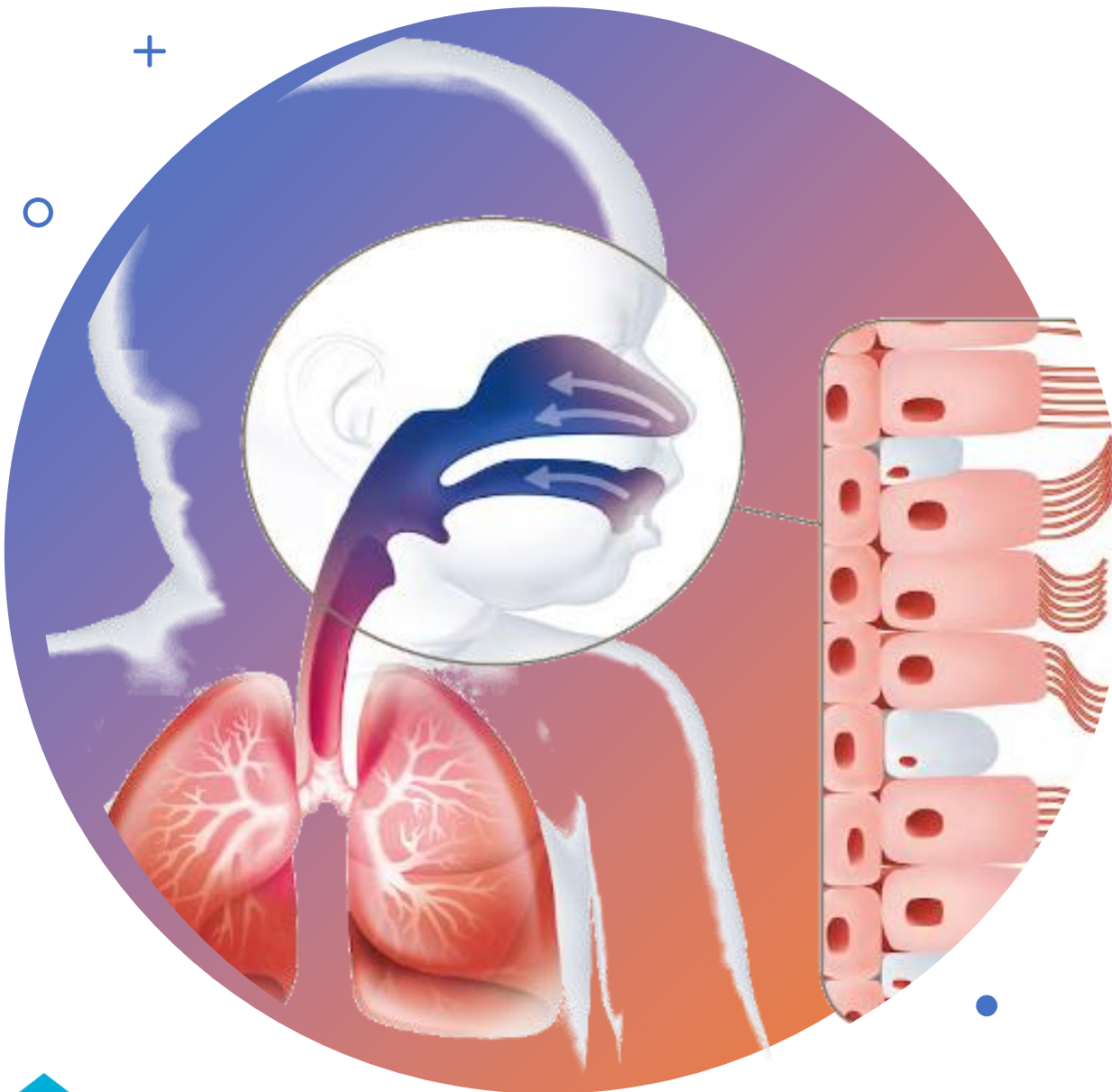






*Heated High  
Flow (Airvo) –  
An Intro*

# Normal Airway Physiology



- Major lung functions:
  - Ventilation & Oxygenation
  - Airway defense
- Preservation of these functions by the lung is dependent on the mucociliary transport system to:
  - Maintain clear airways through secretion clearance (ventilation)
  - Remove pathogens via secretion clearance (airway defense)

# Heated High Flow Therapy Terminology



- Goal: To deliver humidified gas to the lung which is optimal for cilia function
- AIRVO = the device that provides the humidified gas
- **HFNC** = high flow nasal cannula
  - Makes breathing more efficient
  - Can reduce WOB
- Heated High Flow = warm humidified O<sub>2</sub> therapy (e.g., face mask)
  - Does NOT affect WOB

# Heated High Flow Therapy: Airvo

## Indications:

- Patients with mild WOB and hypoxia
- Thick, tenacious secretions that are difficult to clear
- Tracheotomized patients for humidification

## Contraindications:

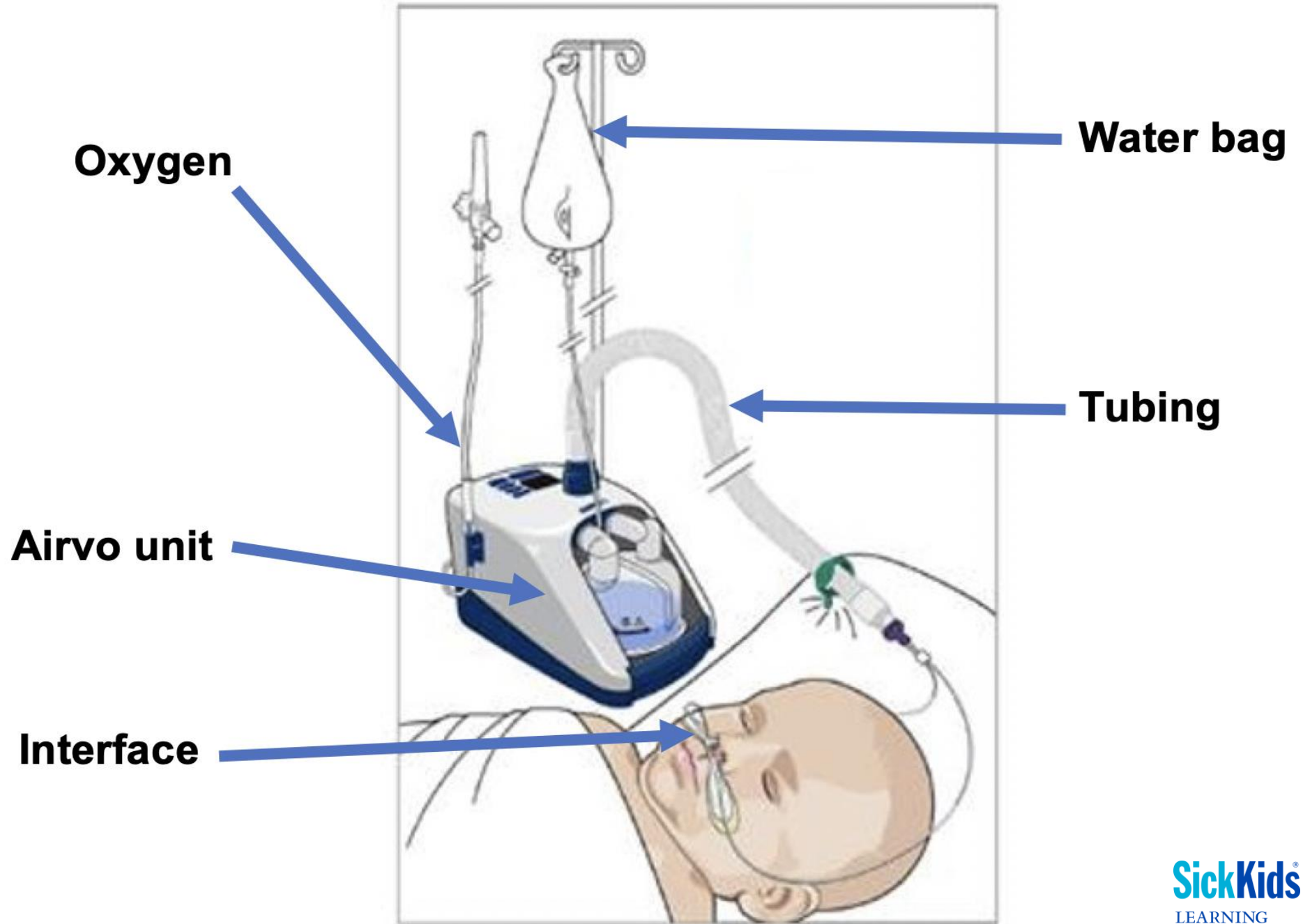
- Acute decrease in level of consciousness
- Severe respiratory distress
- Impending respiratory failure
- (Need for non-invasive or invasive ventilation)



*Up to 2.0 Lpm/Kg with .60 FiO2 on the wards*

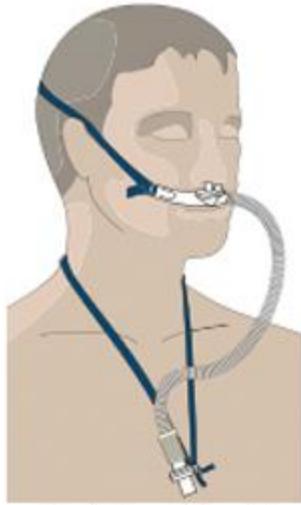


# Airvo Setup





# What interfaces can be used with Airvo?



Optiflow Nasal Interface



Tracheostomy Interface



Adapter w/  
Oxygen Mask



Adapter w/  
Tracheostomy Mask



Optiflow **Junior** nasal interface used for children



F&P OPTIFLOW JUNIOR													
OPTIFLOW JUNIOR NASAL CANNULA	ITEM CODE	APPROX WEIGHT (KG)										SPARE WIGGLEPADS	
		2	4	6	8	10	12	14	16	18	20	22	
Premature Size	OPT312	Max. flow 8 L/min											OPT010
Neonatal Size	OPT314	Max. flow 8 L/min											OPT012
Infant Size	OPT316	Max. flow 20 L/min											
Pediatric Size	OPT318							Max. flow 25 L/min					

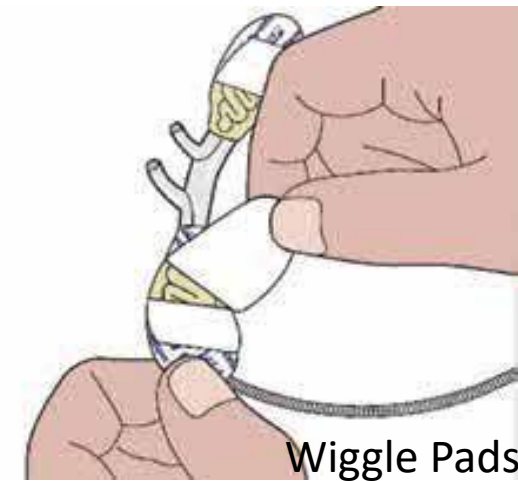
# Applying High Flow Nasal Cannula (Optiflow) Interface



*Incorrect size*



*Correct size*



# What should your orders include?

**Name of Therapy:** Heated High Flow Humidity Therapy (Airvo)

**Interface:** nasal cannula or face mask

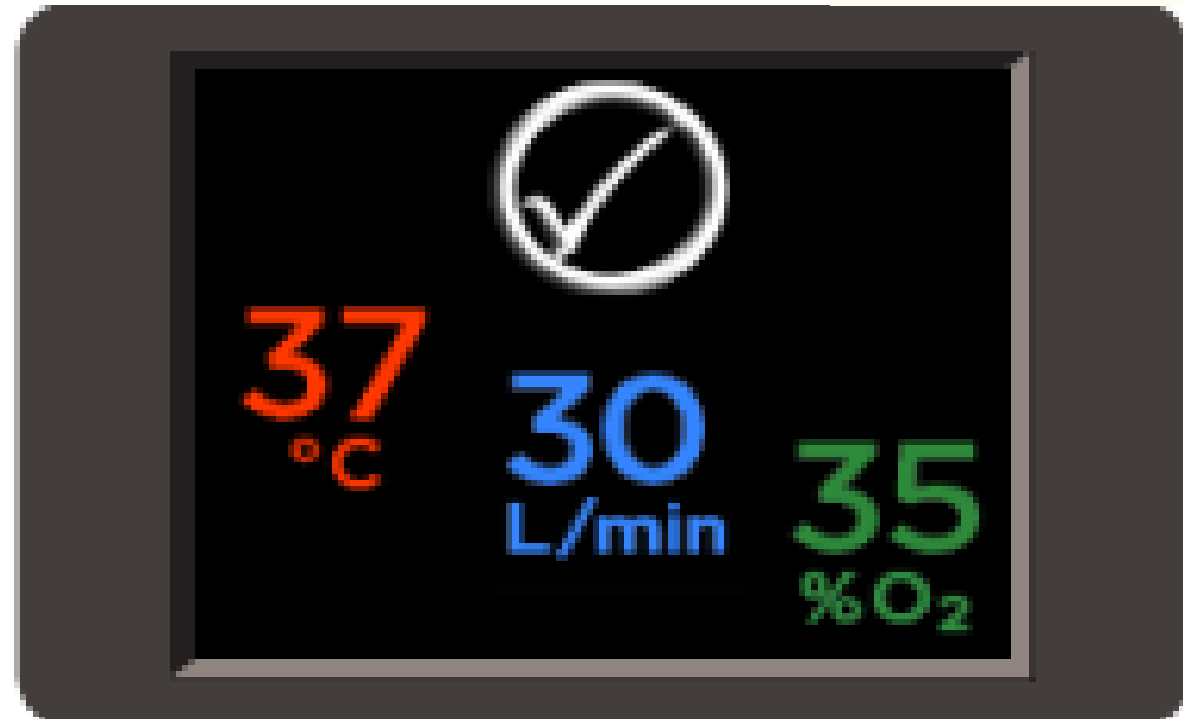
**Temperature Setting:** either 31, 34 or 37°C

**Flow Setting:** in Lpm (based on hospital policy)

**Oxygen prescription:** 0.21 or target saturations

Weight	High-flow rates
0–12 kg	2 L/kg/min Max 25 L/min
13–15 kg	30 L/min
16–30 kg	35 L/min
31–50 kg	40 L/min
>50 kg	50 L/min

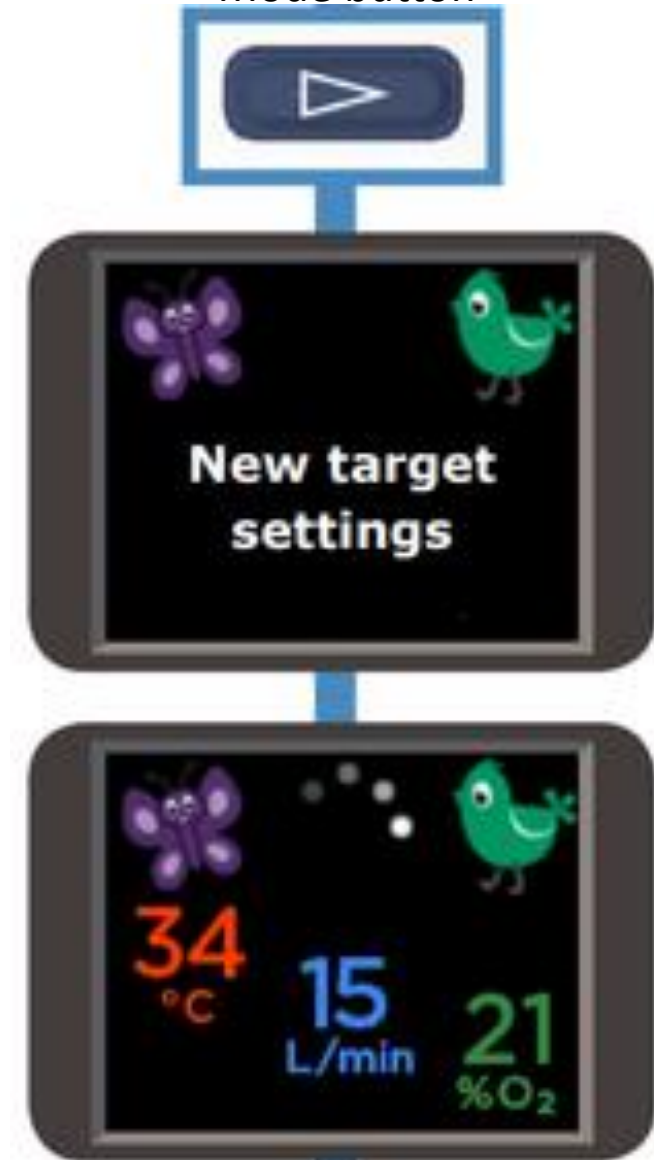
*Paris 2 Protocol*



## Accessing the Junior (paediatric) Mode

- Press and hold mode button for 5 seconds --> Junior mode is activated (butterfly & bird)
- 'New target settings' will appear on screen
- Airvo unit will now set temperature limit to 34°C and the flow rate to 25 Lpm
- To deactivate, hold the mode button for 5 seconds

Mode button



# Setup Checklist

## Device Setup

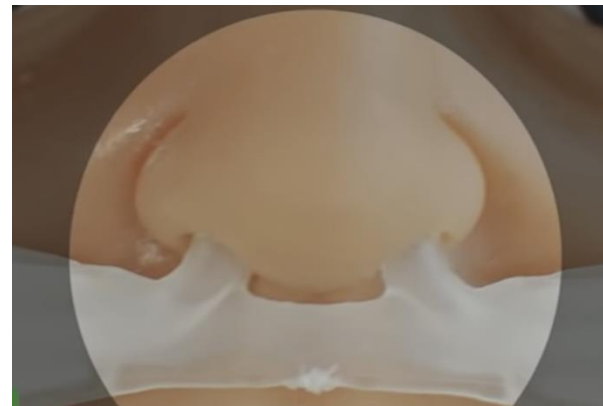
- ✓ Water in chamber
- ✓ Circuit and interface clean
- ✓ No cracks/leak in circuit or interface
- ✓ Circuit is not wrapped in the bed sheets/blankets
- ✓ Circuit is not placed against skin or other wires

## Verify Settings

- ✓ Flowrate
- ✓ Temperature
- ✓ FiO<sub>2</sub>

## Respiratory Assessment

- ✓ Vitals: HR,RR,SpO<sub>2</sub>, chest assessment, suction, oximeter
- ✓ Medical team to adjust settings. If settings you check are different than prescribed, please speak to the child's MRP



## Remember!

Prior to applying interface check to see if:

- The nares are patent
- Prongs are patent
- Prongs are in good condition; not kinked/stretched/broken/torn
- Prongs are the proper size (50% of the nare diameter)
- Gap at septum



# Monitoring

Understand when therapy is indicated for child

Perform vitals before, during and after use

Continuous oximeter monitoring, RR, HR, WOB/comfort

Perform nasal and oral care q4h and PRN (or as per your centre/agency's policies). If patient requires suctioning, suction one nare at a time.

Assess patients on HHF q1h and PRN or as per your hospital's policies.

- In hospital, initial assessment at start of shift to be done in collaboration with RRT and RN to assess patient, plan care for the shift (including escalation of care or weaning), and review HHF setup.

Assess skin for any breakdown. Adjust prongs and tubing regularly. Reapply new wiggle pads PRN.

When delivering an inhaled medication, the nasal prongs must be removed. Normal saline nebulizers are not recommended as High Flow is already humidified.

Feeding (PO or tube) should be commenced if patient is tolerating HHF. To be assessed per patient and adjusted as needed.



# Alarms

**Common Alarms (press alarm mute button to silence alarm for 115 secs):**

**Check Tube:** check that the heated breathing tube is plugged in properly and not damaged

**Check for Leaks:** check that water chamber is pushed in, tubing is connected, interface is fitted properly, and filter is attached

**Check for Blockages:** check interface, tubing for any blocking

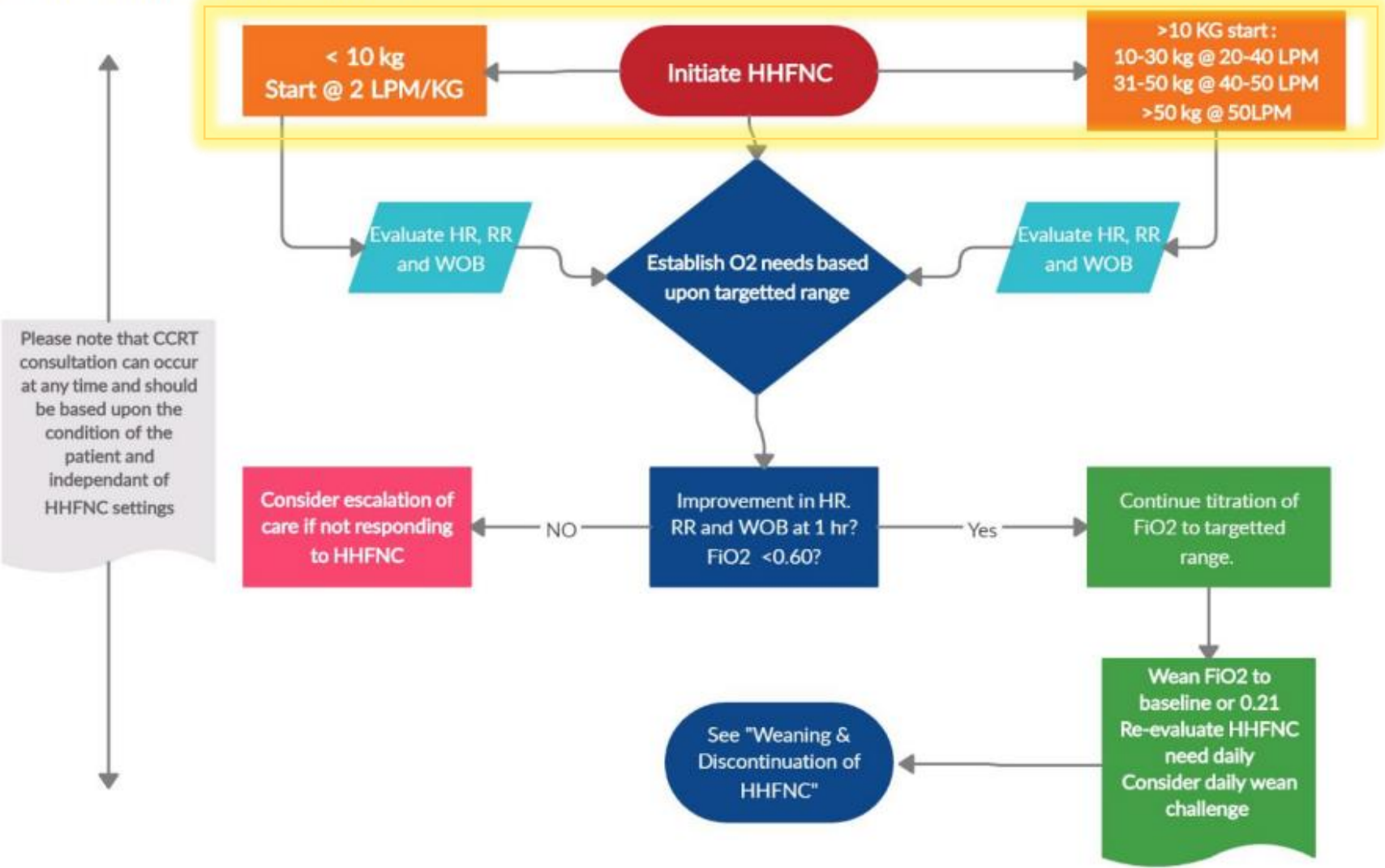
**Check Water:** chamber has run out of water

# Bronchiolitis Bundle

- Use minimal handling strategy whenever possible, bundle cares, dim lights and limit stimulation.
- Assess for fever and treat with antipyretics as indicated
- Assess hydration status - Consider TFI of 80-100% maintenance needs if not significantly hypovolemic.
- Nasal suction & reposition as needed for mild desaturations
- If SpO<sub>2</sub> <90% awake, <88% asleep, apply low flow nasal cannula
  - Max flow rate: 0-90 days: 1 Lpm, 91 days-6 months: 1.5L/min; 6 months-2 years: 2L/min
  - Attempt O<sub>2</sub> wean Q12 hrs. Attempt O<sub>2</sub> wean Q4hrs after initial successful wean.
- Assess and document WOB Q4H (or sooner as needed)

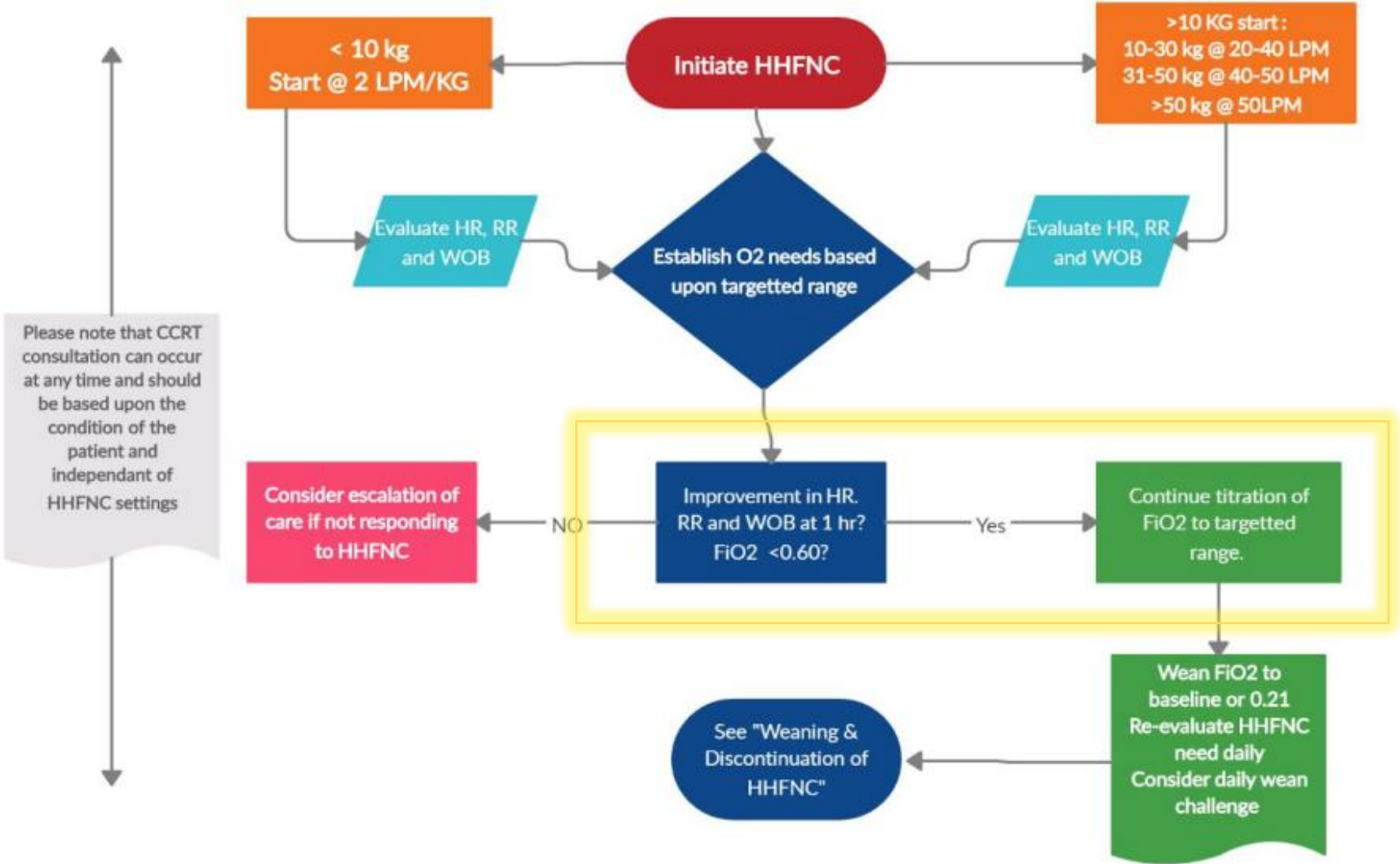
# Initiation Guidelines: we use a standard pathway

Figure 1. Initiation of HHFNC



# Patients will have a good response within the first hour

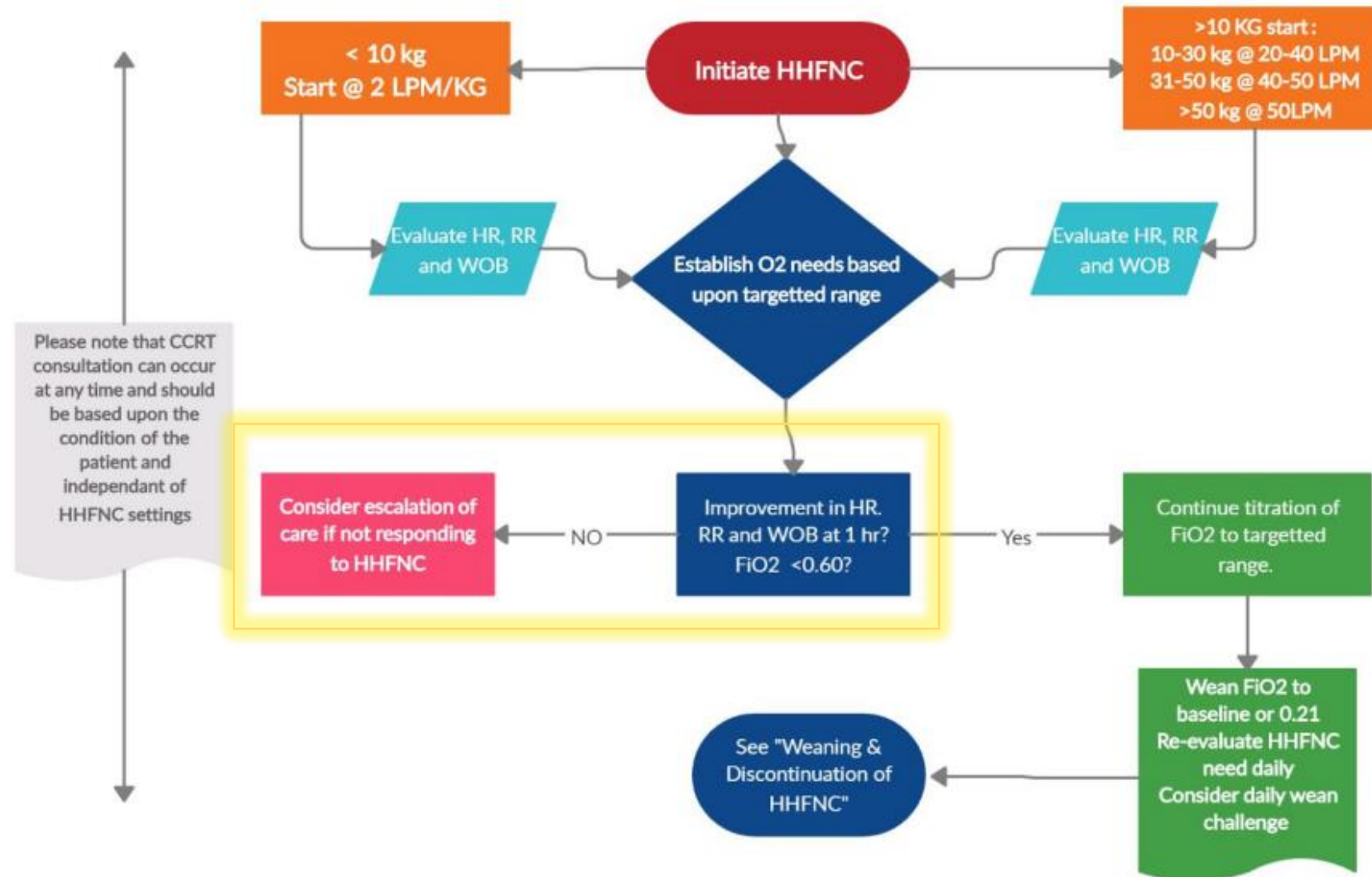
Figure 1. Initiation of HHFNC



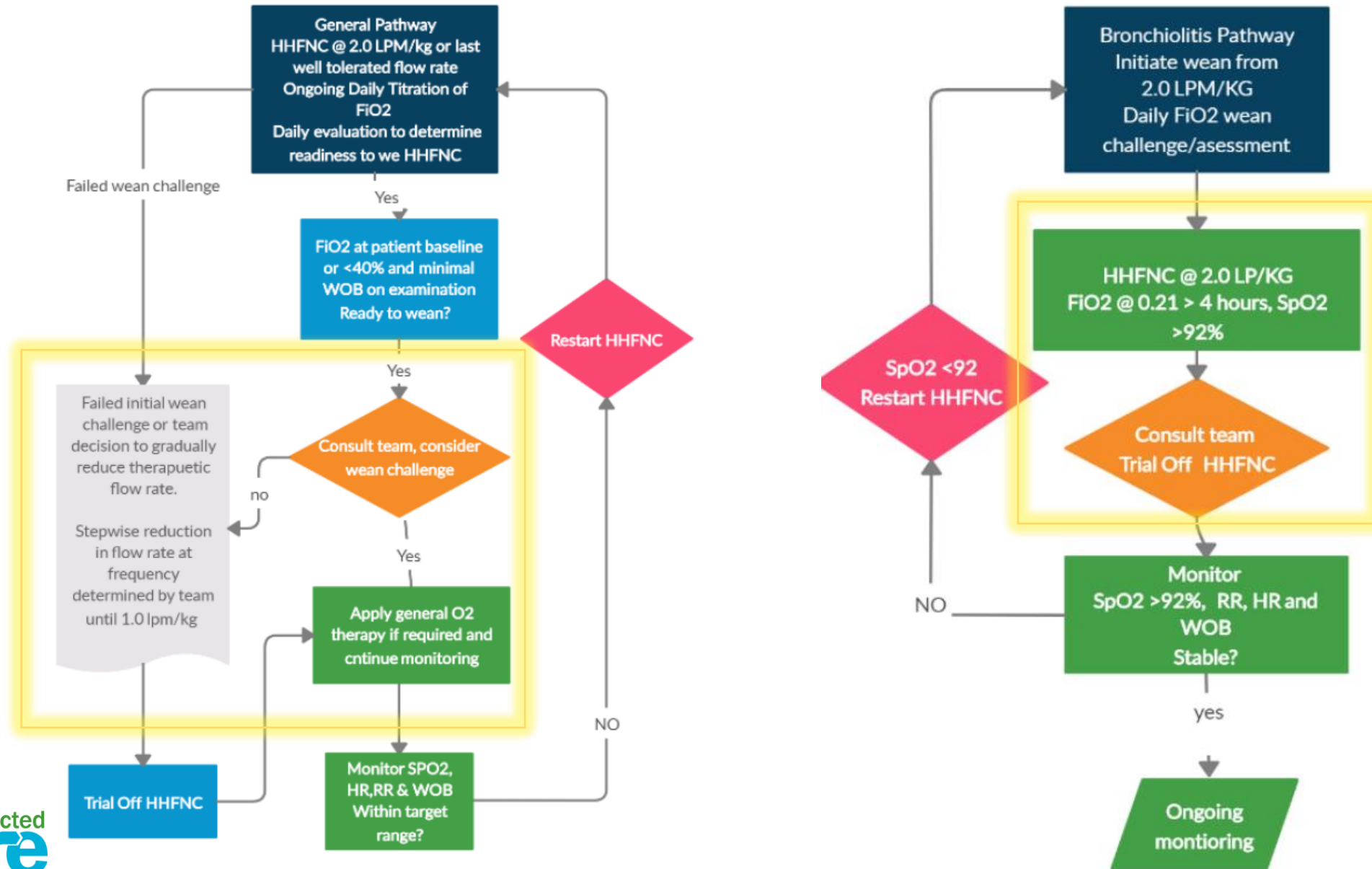


# Patients who are not tolerating HFNCP will receive consults to appropriate teams for consideration of escalation

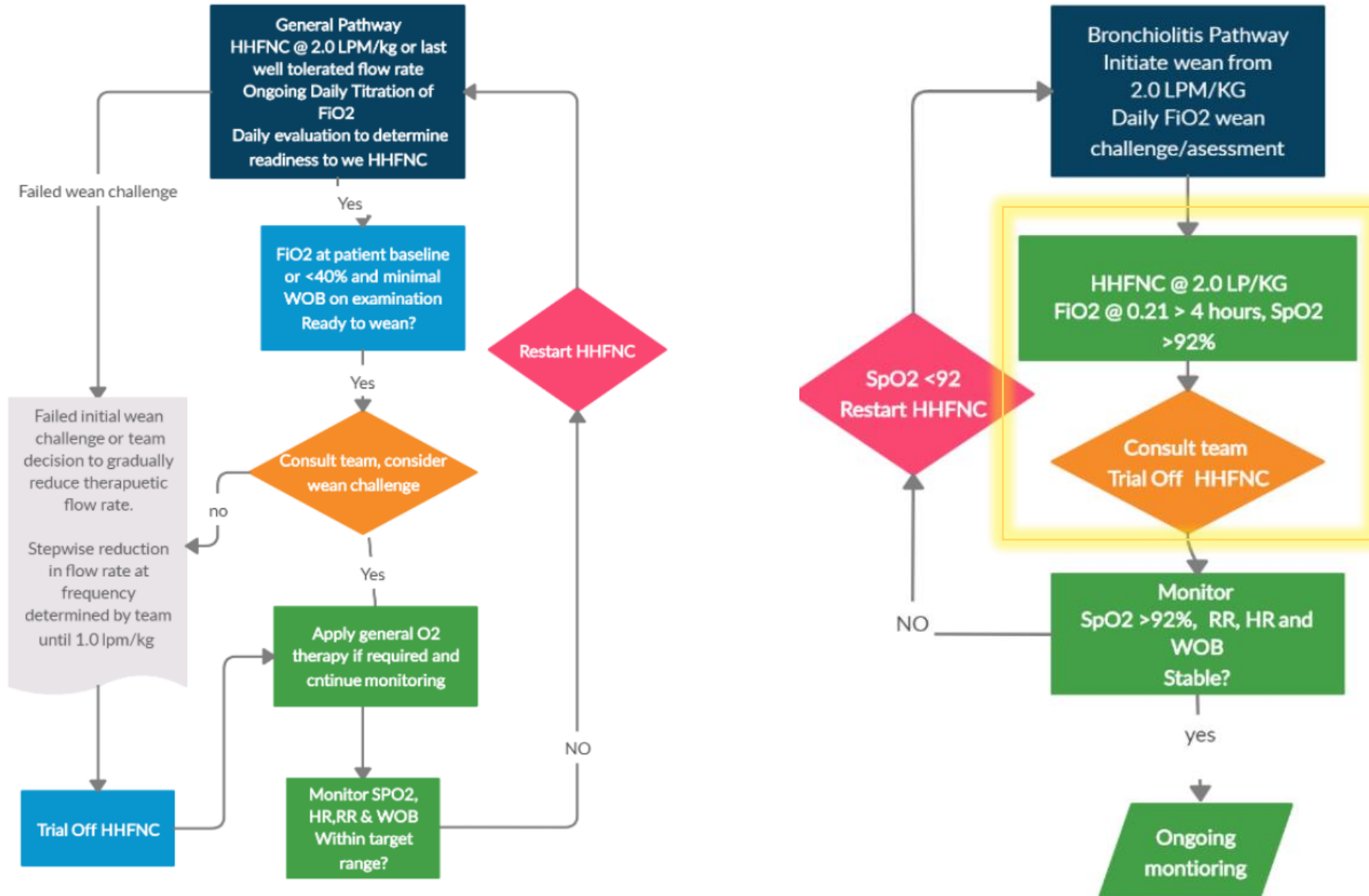
Figure 1. Initiation of HHFNC



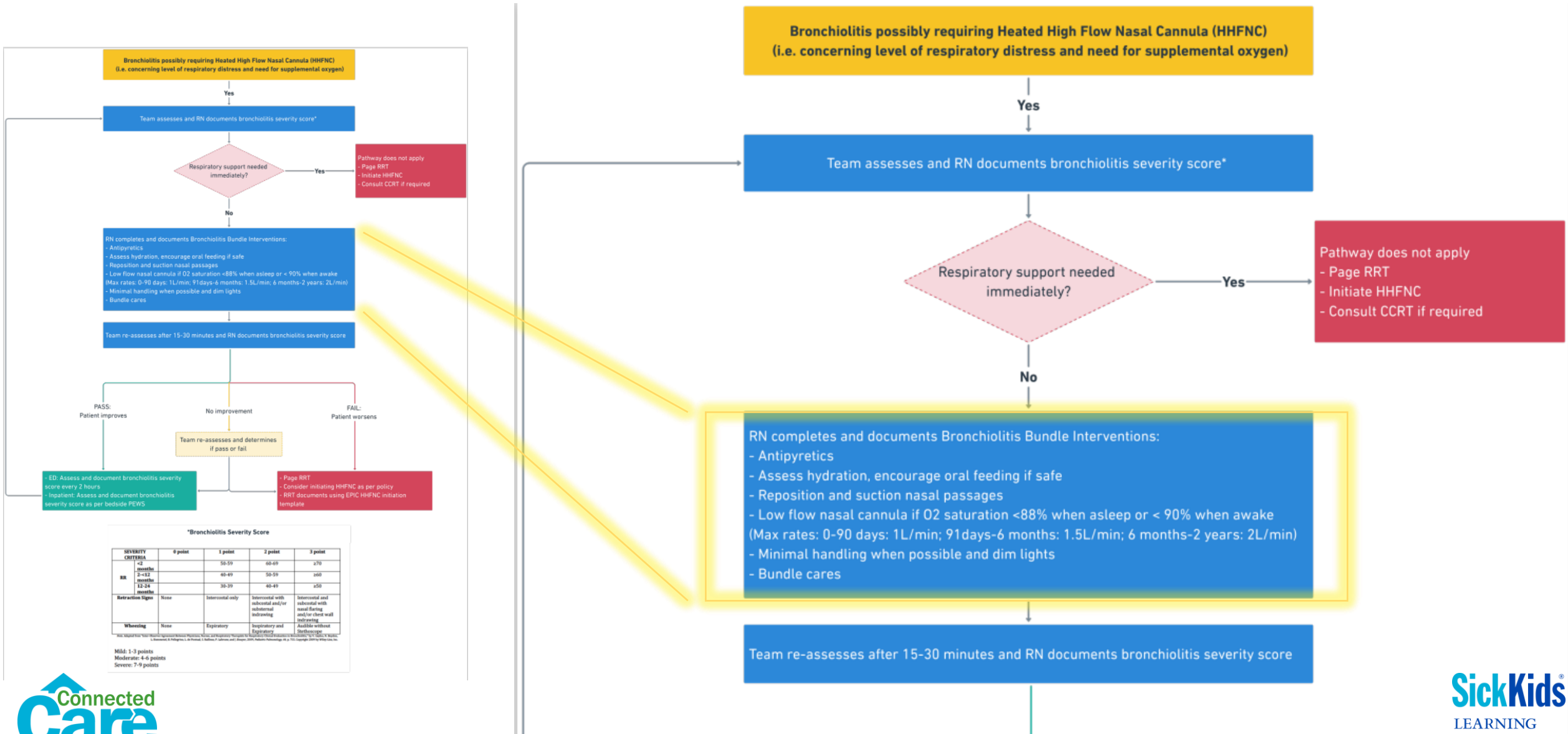
# Weaning Guidelines: two approaches



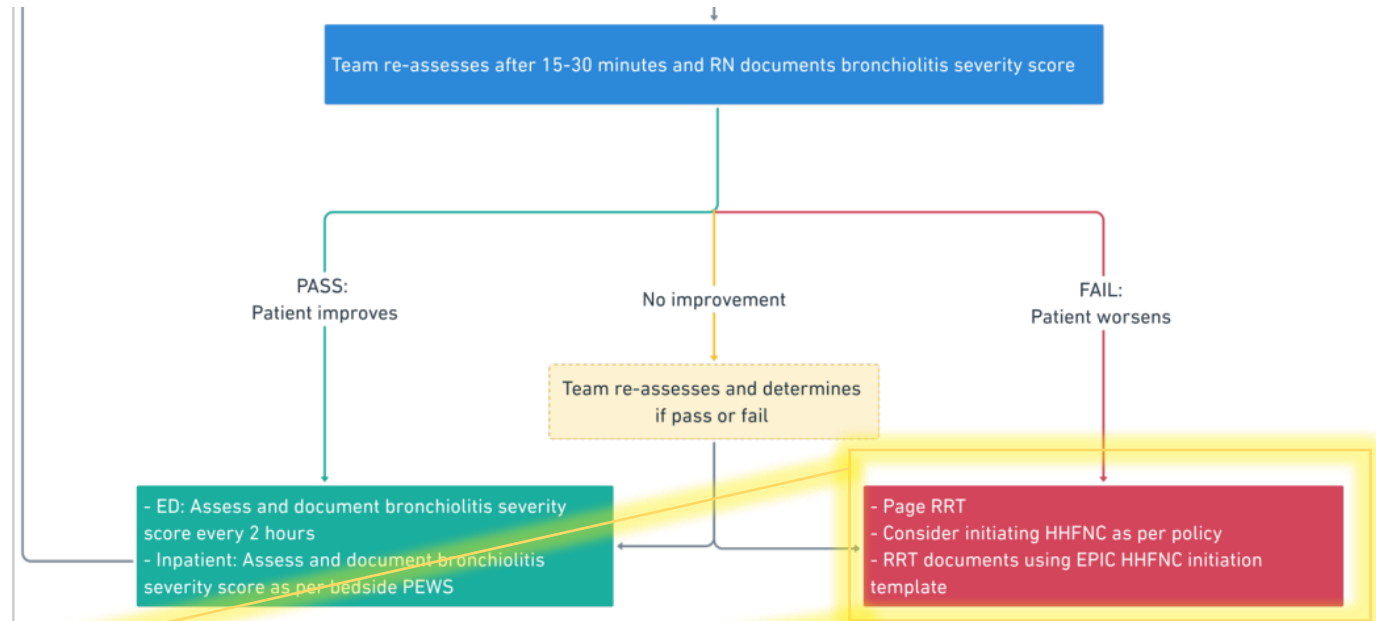
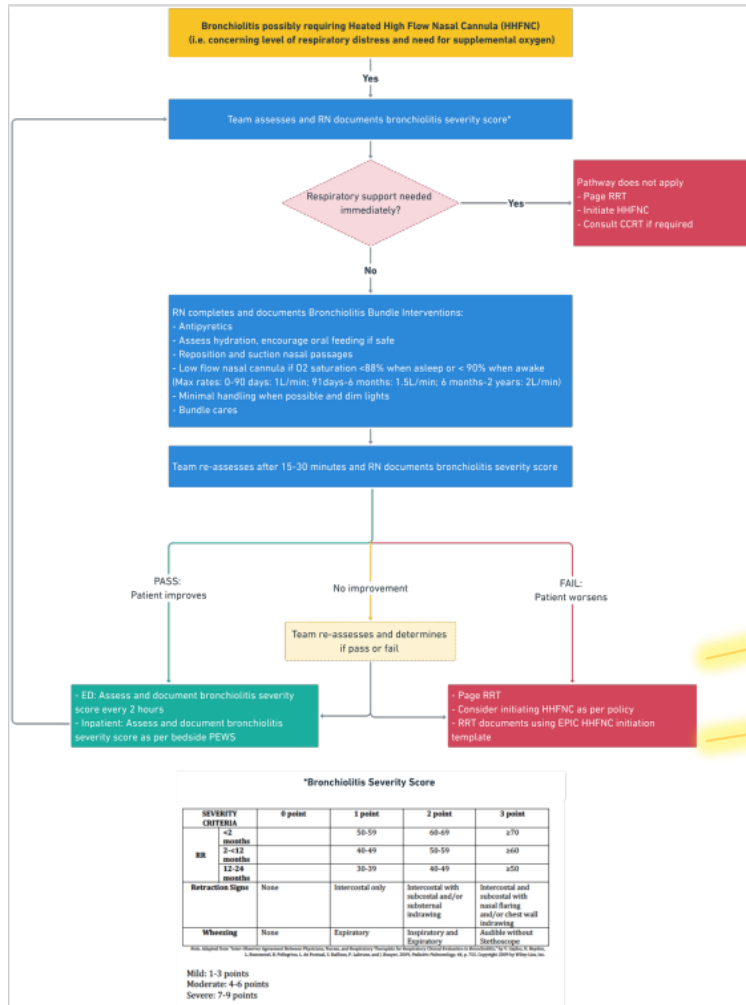
# Weaning Guidelines: two approaches



# Appropriate usage of resources is also important



# Appropriate usage of resources is also important



**\*Bronchiolitis Severity Score**

SEVERITY CRITERIA	0 point	1 point	2 point	3 point
RR	<2 months	50-59	60-69	≥70
	2-<12 months	40-49	50-59	≥60
	12-24 months	30-39	40-49	≥50
Retraction Signs	None	Intercostal only	Intercostal with subcostal and/or substernal indrawing	Intercostal and subcostal with nasal flaring and/or chest wall indrawing
Wheezing	None	Expiratory	Inspiratory and Expiratory	Audible without Stethoscope

Note: Adapted from "Inter-Observer Agreement Between Physicians, Nurses, and Respiratory Therapists for Respiratory Clinical Evaluation in Bronchiolitis," by V. Galdo, R. Beykin, L. Bonneret, & Pellegrino, L. de Pastau, S. Ballieu, P. Labrousse, and J. Bouyer, 2009, Pediatric Pulmonology, 44, p. 753. Copyright 2009 by Wiley-Liss, Inc.

Mild: 1-3 points  
Moderate: 4-6 points  
Severe: 7-9 points





# Case Study Discussion

# Case Study # 1

Xavier is a 18 month old boy admitted to the hospital with bronchiolitis. You receive him (day 1) at the beginning of your shift on **0.5 Lpm N/P**. You are told on report he has developed increased secretions overnight, but is demonstrating a strong cough to clear them.

You go in to complete your morning assessment while Xavier is sleeping and you see the following vitals:

<b>HR</b>	<b>135 bpm</b>
<b>RR</b>	<b>42 BPM</b>
<b>SpO<sub>2</sub></b>	<b>87%-90%</b>
<b>BP</b>	<b>85/45 mmHg</b>

He is asleep and demonstrating mild intercostal indrawing. Their PEW and bronchiolitis scores are unchanged from 5-6.

His oxygen saturation goal is >88% when asleep.

***What would you do next?***

***Increase NP to keep SpO<sub>2</sub> > goal/order. Increase and assess, up to 2 LPM.***

***Consider all aspects of bundle – suctioning, repositioning***



Image Available From: Shutterstock.com

# Case Study # 1 Continued

Xavier is day 2 of his admission. You increase the oxygen flowrate on his N/P as high as **2 Lpm**. You wake the patient up and suction them via the nasopharynx with a suction catheter eliciting a cough.

His SpO<sub>2</sub> when awake is 89%-92%. *His WOB is worsening and so are his Bronchiolitis score and bedside PEWS.*

**HR 120 bpm**

**RR 62 BPM**

**SPO2 89-92%**

**BP 110/64 mmHg**

***What is your next step?***

# Case Study # 1 Continued

Your team decides to initiate HFNC. Xavier weighs 11 kg.

***What would be your starting settings?***

**HFNC: 34 C (pediatric mode); Flow 22 LPM; FiO<sub>2</sub> to keep SpO<sub>2</sub> > 90%.**

**HR 140 bpm**

**HR 138**

**RR 62 BPM**

**RR 54 BPM**

**SPO<sub>2</sub> 89-92%**

**SpO<sub>2</sub> 94% on 40% O<sub>2</sub>**

**BP 110/64 mmHg**

**BP 110/64 mmHg**

***What is your next step?***

***Continue to support on HFNC, titrating FiO<sub>2</sub> to SpO<sub>2</sub>.***

# Thank You







Online evaluation form will be sent after the session or scan the QR Code to complete now.

We appreciate your feedback.

<https://skconnect.typeform.com/to/jmP9E8IZ>