

Heated High-Flow Nasal Cannula O₂ Therapy Update (HHFNC)



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Gail Slack	Bluewater Health - Sarnia
Laura Clarke	CMH - Cambridge
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Kerri Hannon	MNCYN - London
Kristine Fraser	MNCYN - London
Ryan Trudeau	LHSC - London
Alissa Howe-Poisson	CKHA - Chatham



What is HHFNC-O₂ Therapy?



Blends medical gas & delivers warmed, humidified oxygen at flowrates meeting or exceeding patient demand



Utilizes a specialized nasal cannula interface, which should not exceed 50% of the nares



Can deliver a precise level of oxygen



Provides optimal heat & humidity



May help patients in mild to moderate respiratory distress



Washes out anatomic dead space which clears expired air in the upper airways and promotes slow, deep breathing, resulting in decreased RR and WOB



Heated humidity prevents drying of airway mucosa and improves mucous clearance



Well tolerated & comfortable interface



Bridges a gap between low-flow oxygen and non-invasive ventilation (CPAP or BiPAP)

Literature Review



Uses of high-flow nasal cannula on the community paediatric ward and risk factors for deterioration

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Abstract

Background: High-flow nasal cannula (HFNC) is a form of noninvasive respiratory support used for paediatric acute respiratory illnesses. Past HFNC research has focused on its use in bronchiolitis and in intensive care units, but little is reported on its use in the community hospital setting. We aimed to investigate the paediatric population using HFNC, any adverse events, and risk factors for deterioration.

Methods: A retrospective chart review was performed on patients admitted to a community paediatric ward. Inclusion criteria were patients between 1 day and 17 years of age, admitted between



Multicentre, randomised trial to investigate early nasal high-flow thereapy in paediatric acute hypoxaemic respiratory failure: a protocol for a randomised controlled trial – a Paediatric Acute respiratory Intervention Study (PARIS 2)

Donna Franklin ^{1,2,3,4}, Deborah Shellshear^{4,5,6}, Franz E Babi ^{4,7,8,9}, Luregn J Schlapbach ^{1,2,6}, Ed Oakley^{4,7,8,9}, Meredith L Borland^{4,10,11}, Tobias Hoepfner^{4,10}, Shane George^{1,2,4,12}, Simon Craig^{4,13,14}, Jocelyn Neutze^{4,15,16}, Amanda Williams^{4,7,8}, Jason Acworth^{2,4,5}, Hamish McCay¹⁷, Alex Wallace¹⁷, Joerg Mattes^{18,19}, Vinay Gangathimn^{4,20}, Mark Wildman^{4,20}, John F Fraser^{21,22}, Susan Moloney²³, John Gavranich²⁴, John Waugh²⁵, Sue Hobbins²⁶, Rose Fahy²⁶, Simon Grew²⁷, Brenda Gannon²⁸, Kristen Gibbons^{1,3}, Stuart Dalziel^{4,16,29,30}, Andreas Schibler^{1,2,3,4,6} on behalf of PARIS and PREDICT

To cite: Franklin D, Shellshear D, Babi FE, *et al.* Multicentre, randomised trial to investigate early nasal high-flow therapy in paediatric acute hypoxaemic respiratory failure:

ABSTRACT

Introduction: Acute hypoxaemic respiratory failure (AHRF) in children is the most frequent reason for non-elective hospital admission. During the initial phase

Strengths and limitations of this study

► This study is a pragmatic approach to test the efficacy of early nasal high-flow therapy in paediatric acute hypoxaemic respiratory failure.

Initiating HHFNC-O₂ Therapy

Infant with ongoing respiratory distress (TAL score* greater than 5) and hypoxia SpO₂ less than or equal to 92% despite low flow greater than age defined recommendations or FiO₂ (via venturi mask) greater than 40%

MRP consults RRT/RN for HHFNC-O₂ Therapy

MRP and RRT/RN review Indications/Contraindications
Evaluate HR, RR, BP, WOB and SpO₂

Initiate HR, RR, SpO₂ monitoring

Initiate flow rate based on Table 1.0 & FiO₂ to keep SpO₂ greater than or equal to 92% or target

Post HHFNC-O₂ initiation assessment within 30 minutes
Reassess HR, RR, BP, WOB & SpO₂

Patient Improving?

Yes
Reassess 2 and 4 hours or sooner after initiation

RRT/RN to follow Q4H & PRN while on HHFNC-O₂

No
Escalate respiratory support as per hospital policy and/or
Activate CritiCall: 1-800-668-4357 (HELP)

Low Flow Nasal Cannula
Ultra-Low Flow: Can use ultra-low flowmeter to deliver 25 mL/min to 200 mL/min of FiO₂ for newborns or infants less than 1 yr (if available)
Low-Flow: Use standard oxygen flowmeter (15 L/min) to deliver FiO₂
Max O₂ Flow Rates for Nasal Cannula

- 1 L/min for newborns to maximum of 2 L/min for infants less than 1yr
- 4 L/min for child greater than 1 yr
- Consider starting HHFNC-O₂ Therapy for flow rates ≥ 3 L/min

Table 1.0: Initiating HHFNC-O₂ therapy:

Weight	Starting Flow Rates
0-15kg	2L/kg/min
16-30kg	35Lpm
31-50kg	40Lpm
>50kg	50Lpm

Establish FiO₂ based on ordered SpO₂ target range

Modified TAL Score					
Score	Respiratory Rate (breaths/min)		Wheezing/Crackles	O ₂ Saturation (room air)	Accessory Muscle Use
	Age less than 6 months	Age 6 months and older			
0	Less than or equal to 40	Less than or equal to 30	None	Greater than or equal to 95%	None (no chest in-drawing)
1	41-55	31-45	Expiration only	92-94%	+ Presence of mild intercostal in-drawing
2	56-70	46-60	Expiration and inspiration with stethoscope only	90-91%	++ Moderate amount of intercostal in-drawing
3	Greater than or equal to 71	Greater than or equal to 61	Expiration and inspiration without stethoscope	Less than or equal to 89%	+++ Moderate or marked intercostal in-drawing, with presence of head bobbing or tracheal tug
Mild 0-5		Moderate 6-10		Severe 11-12	

Note: If infant is on oxygen they are scored a "3" for O₂ saturation.

Weaning HHFNC-O₂ Therapy

FiO₂ less than 40% and SpO₂ greater than 92%

HR, RR, WOB stable (TAL score less than 6)?

Yes

No

Wean O₂ first to less than 30% to maintain SpO₂ greater than 92%

Maintain on current parameters and reassess in 4 hours or sooner

Wean flow by:
<15kg: 0.5 L/min/kg Q4H until 1L/min/kg
>15kg: 5-10 Lpm Q4H until 15 Lpm

HR, RR, WOB stable (TAL score less than 6)?

Yes

No

Trial off HHFNC-O₂ Therapy or to prescribed Home Oxygen Level

Trial off standard oxygen therapy to keep SpO₂ greater than 92% or target SpO₂

Remove HHFNC-O₂ Therapy Equipment after 12 hours

Return to previously stable HHFNC-O₂ Therapy settings

Attempt to wean again after 12 hours back on HHFNC-O₂ Therapy

- SIGNS OF CLINICAL STABILIZATION**
- Work of breathing improved (reduction in TAL score)
 - Maintain SpO₂ within target range with FiO₂ less than 40%
- SIGNS OF NO IMPROVEMENT or CLINICAL DETERIORATION**
- FiO₂ requirement greater than 40%
 - Flow requirement greater than 2 L/min/kg
 - Worsening TAL score
 - HR, RR, BP, WOB and O₂ requirements remain unchanged or deteriorating at the 1- hour and/or at any time while on HHFNC
 - Other signs of clinical deterioration such as apneas, bradycardias, deteriorating level of consciousness, poor peripheral perfusion (delayed capillary refill, cool extremities, weak pulses, etc.)
 - Worsening blood gases

ABBREVIATIONS



- SpO₂ – oxygen saturation
FiO₂ – fraction of inspired oxygen
MRP – most responsible person
RRT – registered respiratory therapist
RN – registered nurse
HHFNC-O₂ – heated high flow nasal cannula oxygen
HR – heart rate
RR – respiratory rate
BP – blood pressure
WOB – work of breathing
Q4H – every four hours
PRN – pro re nata (as needed)

*Centres may choose to use another distress scoring tool for bronchiolitis used by their institution.



Initiating HHFNC-O₂ Therapy

Infant with ongoing respiratory distress
(TAL score* greater than 5) and
hypoxia SpO₂ less than or equal to 92%
despite low flow greater than age
defined recommendations or FiO₂ (via
venturi mask) greater than 40%



Case Review

Clinical Vignette

You are called to the Emergency Department to assess a 4 month old infant who was brought in by parents with a 3 day history of fever, rhinorrhea and nasal congestion. Today, parents stated baby is more sleepy, not feeding well and has increased breathing difficulties. The baby has an unremarkable perinatal history.

Vitals & Respiratory Assessment

- HR 185, RR 70, BP 75/50, T 39.0°C, SpO₂ 86% on room air
- Infant has nasal flaring, expiratory & inspiratory wheezing upon auscultation, moderate intercostal & subcostal retractions
- CRT 4 seconds, pale pink, warm extremities



PLAN

Case Review

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PLAN

Start infant on low-flow (table)
&
Complete a full assessment

Low Flow Nasal Cannula

Ultra-Low Flow: Can use ultra-low flowmeter to deliver 25 mLs/min to 200 mLs/min of FiO₂ for newborns or infants less than 1 yr (if available)

Low-Flow: Use standard oxygen flowmeter (15 L/min) to deliver FiO₂

Max O₂ Flow Rates for Nasal Cannula

- 1 L/min for newborns to **maximum** of 2 L/min for infants less than 1yr
- 4 L/min for child greater than 1 yr
- Consider starting HHFNC-O₂ Therapy for flow rates \geq 3 L/min

Modified TAL Score

	Respiratory Rate (breaths/min)				
Score	Age less than 6 months	Age 6 months and older	Wheezing/Crackles	O ₂ Saturation (room air)	Accessory Muscle Use
0	Less than or equal to 40	Less than or equal to 30	None	Greater than or equal to 95%	None (no chest in-drawing)
1	41-55	31-45	Expiration only	92-94%	+ Presence of mild intercostal in-drawing
2	56-70	46-60	Expiration and inspiration with stethoscope only	90-91%	++ Moderate amount of intercostal in-drawing
3	Greater than or equal to 71	Greater than or equal to 61	Expiration and inspiration without stethoscope	Less than or equal to 89%	+++Moderate or marked intercostal in-drawing, with presence of head bobbing or tracheal tug
Mild 0-5			Moderate 6-10		Severe 11-12

Note: If infant is on oxygen they are scored a "3" for O₂ saturation.

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Calculating the TAL Score

HR
185

RR
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BP
75/50

T
39.0°C

SpO₂
86%
room air

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Calculating the TAL Score

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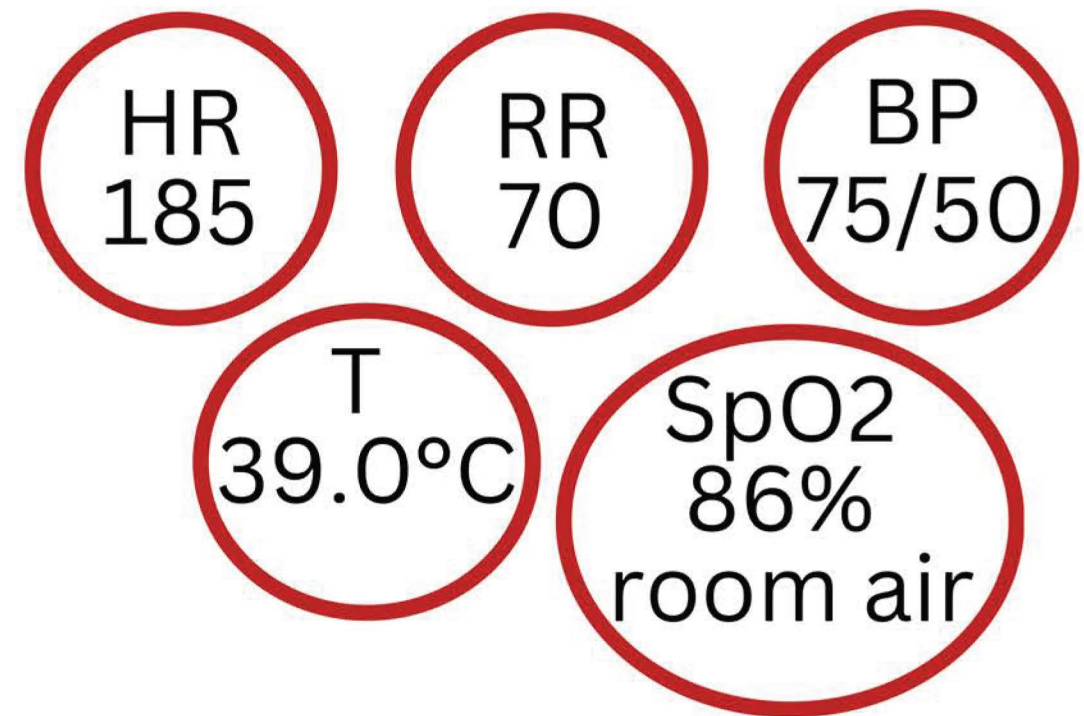
SpO2
86%
room air

Assessment showed:

- Nasal flaring
- Expiratory & inspiratory wheezing upon auscultation
- moderate intercostal & subcostal retractions
- CRT 4 seconds

Modified TAL Score					
	Respiratory Rate (breaths/min)				
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Mild 0-5			Moderate 6-10		Severe 11-12
Note: If infant is on oxygen they are scored a "3" for O ₂ saturation.					

Calculating the TAL Score



Assessment showed:

- Nasal flaring
- Expiratory & inspiratory wheezing upon auscultation
- moderate intercostal & subcostal retractions
- CRT 4 seconds

TAL Score = 9

Next Steps

MRP Consults RRT/RN for HHFNC-O₂ Therapy

MRP and RRT/RN review Indications/Contraindications

Evaluate HR, RR, BP, WOB and SpO₂

Initiate HR, RR, SpO₂ monitoring

Initiate flow rate based on Table 1.0 & FiO₂ to keep SpO₂ greater than or equal to 92% or target

Post HHFNC-O₂ initiation assessment within 30 minutes

Reassess HR, RR, BP, WOB & SpO₂

Ontario – West Region Algorithm for Use of Heated High Flow Nasal Cannula Oxygen Therapy
October 15, 2023

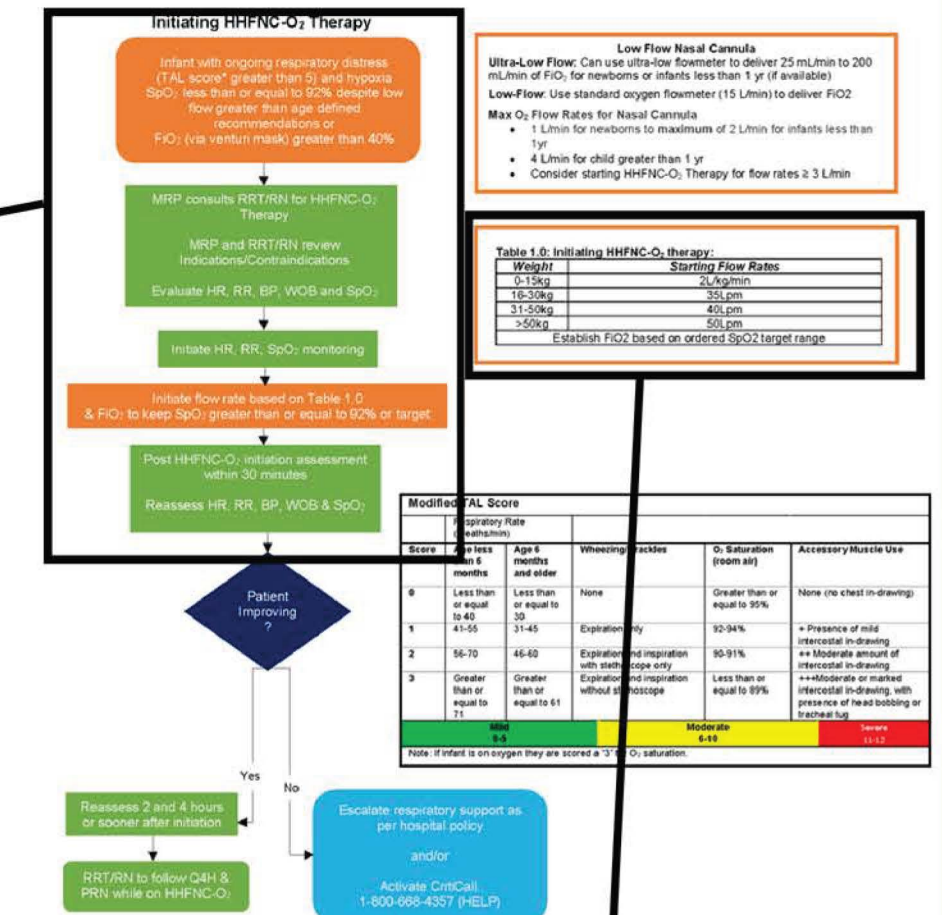
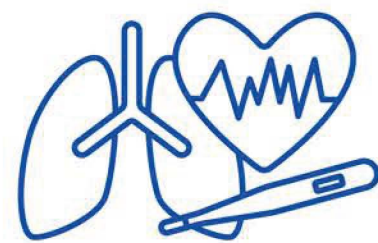


Table 1.0: Initiating HHFNC-O₂ therapy:

Weight	Starting Flow Rates
0-15kg	2L/kg/min
16-30kg	35Lpm
31-50kg	40Lpm
>50kg	50Lpm
Establish FiO2 based on ordered SpO2 target range	



Case Review: Reassessment



Placed infant on 2L/kg of high-flow based on respiratory assessment and TAL score (9) and reassessed 30 minutes later:

HR
180

RR
65

BP
80/55

T
38.5°C

SpO₂ 91%
on 45%

Is Patient
Improving?

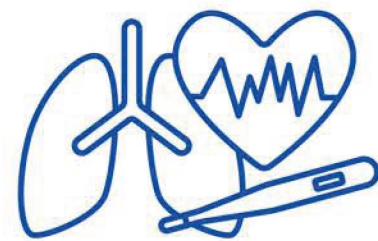
SIGNS OF CLINICAL STABILIZATION

- Work of breathing improved (reduction in TAL score)
- Maintain SpO₂ within target range with FiO₂ less than 40%

SIGNS OF NO IMPROVEMENT or CLINICAL DETERIORATION

- FiO₂ requirement greater than 40%
- Flow requirement greater than 2 L/min/kg
 - Worsening TAL score
- HR, RR, BP, WOB and O₂ requirements remain unchanged or deteriorating at the 1- hour and/or at any time while on HHFNC
- Other signs of clinical deterioration such as apneas, bradycardias, deteriorating level of consciousness, poor peripheral perfusion (delayed capillary refill, cool extremities, weak pulses, etc.)
- Worsening blood gases





Case Review: Reassessment



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HR
180

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BP
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T
38.5°C

SpO₂ 91%
on 45%

Is Patient
Improving?

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Escalate respiratory support as per
hospital policy
and/or
Activate CritiCall:
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MRP consults RRT/IRN for HHFNC-O₂ Therapy

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Initiate HR, RR, SpO₂ monitoring

Initiate flow rate based on Table 1.0 & FIO₂ to keep SpO₂ greater than or equal to 92% or target

Post HHFNC-O₂ initiation assessment within 30 minutes

Reassess HR, RR, BP, WOB & SpO₂



Yes

Reassess 2 and 4 hours or sooner after initiation

RRT/IRN to follow Q4H & PRN while on HHFNC-O₂

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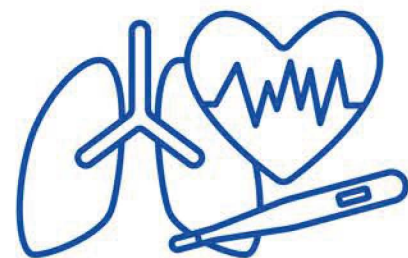
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Table 1.0: Initiating HHFNC-O₂ therapy:

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Establish FIO₂ based on ordered SpO₂ target range

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3	Greater than or equal to 86	Expiration and inspiration without stethoscope	Less than or equal to 89%	• Severe or marked intercostal in-drawing, with presence of head bobbing or tracheal tug
Note: If infant is on oxygen they are scored a '3' for O ₂ saturation.				



Case Review: Reassessment



Placed infant on 2L/kg of high-flow based on respiratory assessment and TAL score (9) and reassessed 30 minutes later:

HR
165

RR
55

BP
90/55

T
38.5°C

SpO₂ 95%
on 35%

Is Patient
Improving?

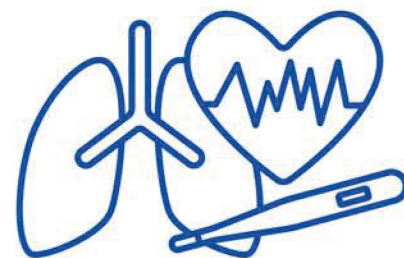
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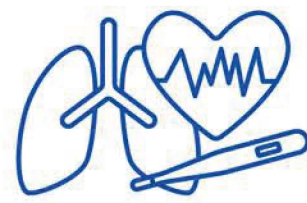
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Mild 0-1 Moderate 2-3 Severe 4-5					

Note: If infant is on oxygen they are scored a "3" for O₂ saturation.



Case Review: Reassessment



Infant has been on high-flow for 8 hours.

HR
145

RR
45

BP
92/53

T 37

SpO₂ 96%
on 30%

Is Patient
Improving?

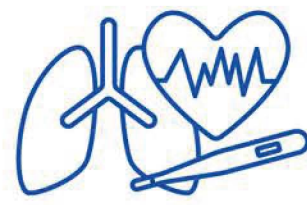
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Is Patient
Improving?

YES

Consider de-escalation

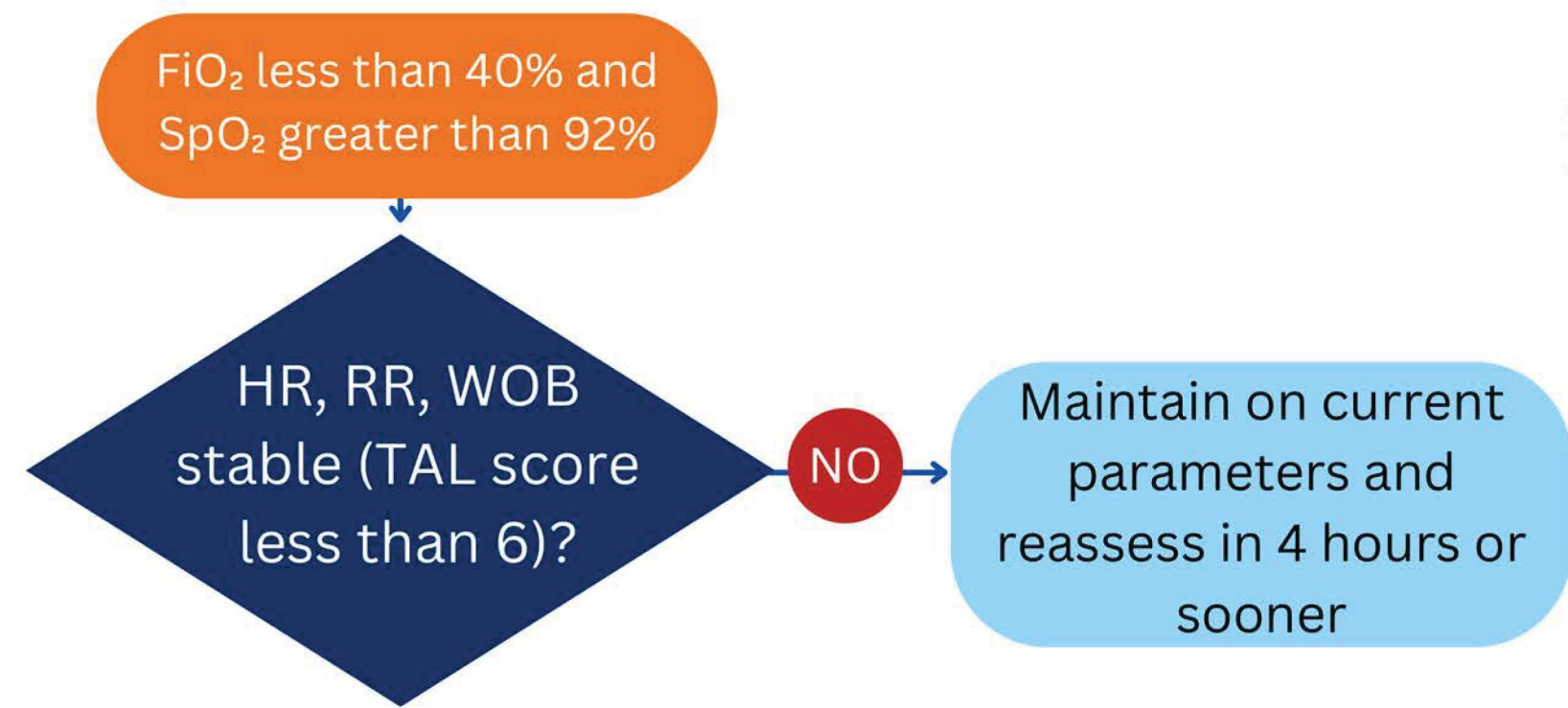
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- Work of breathing improved (reduction in TAL score)
- Maintain SpO₂ within target range with FiO₂ less than 40%

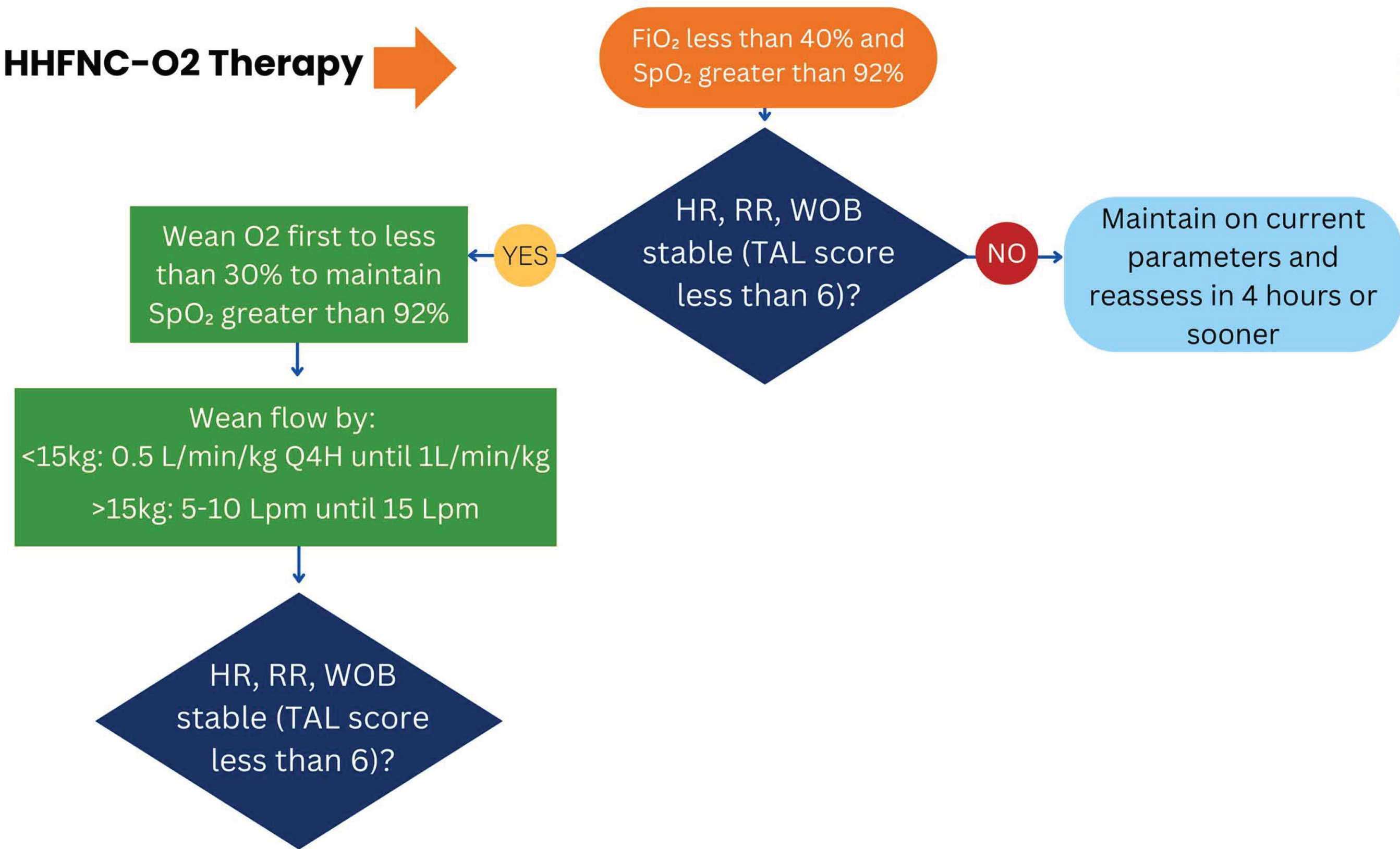
SIGNS OF NO IMPROVEMENT or CLINICAL DETERIORATION

- FiO₂ requirement greater than 40%
- Flow requirement greater than 2 L/min/kg
 - Worsening TAL score
- HR, RR, BP, WOB and O₂ requirements remain unchanged or deteriorating at the 1- hour and/or at any time while on HHFNC
- Other signs of clinical deterioration such as apneas, bradycardias, deteriorating level of consciousness, poor peripheral perfusion (delayed capillary refill, cool extremities, weak pulses, etc.)
- Worsening blood gases

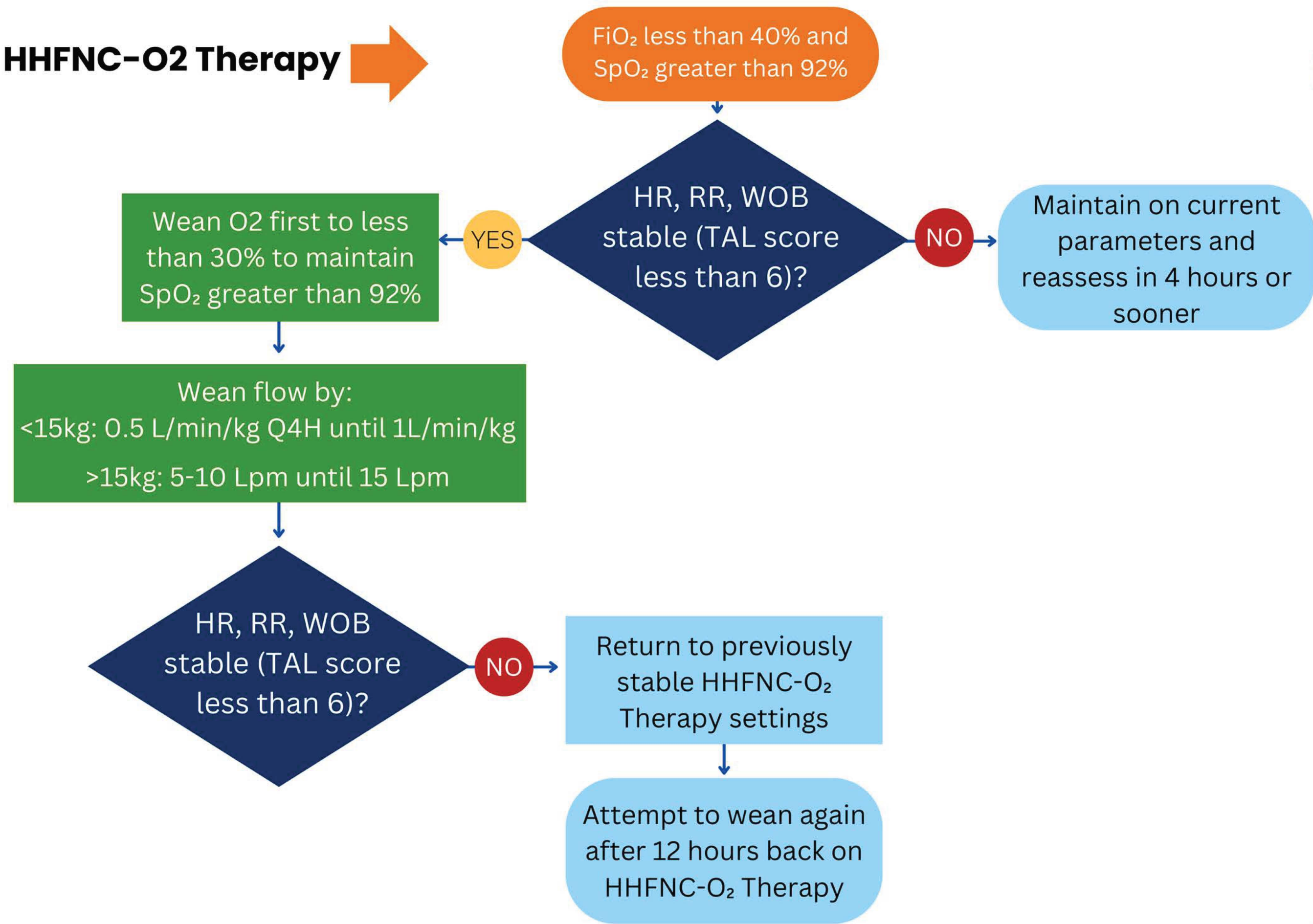
Weaning off HHFNC-O₂ Therapy



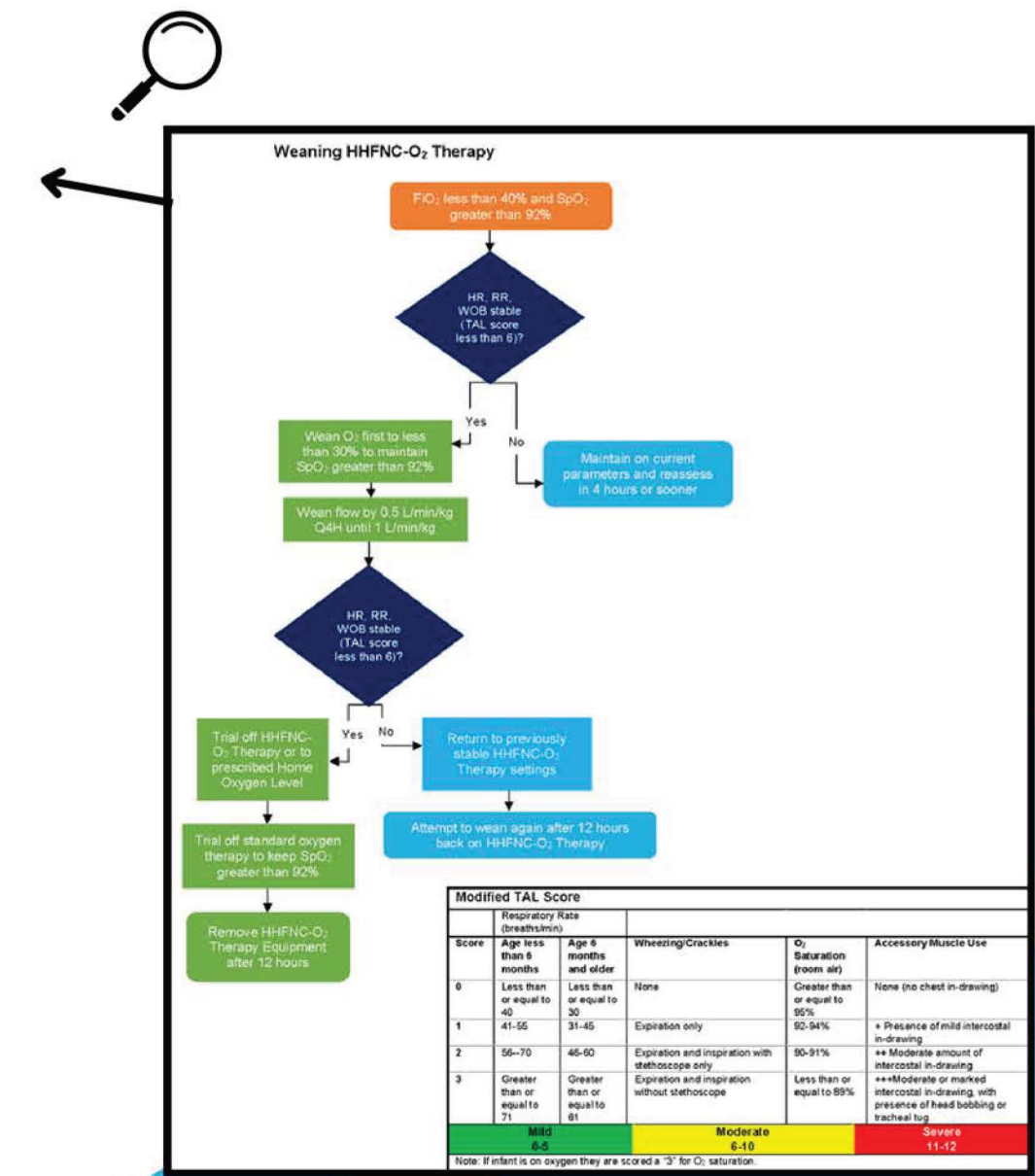
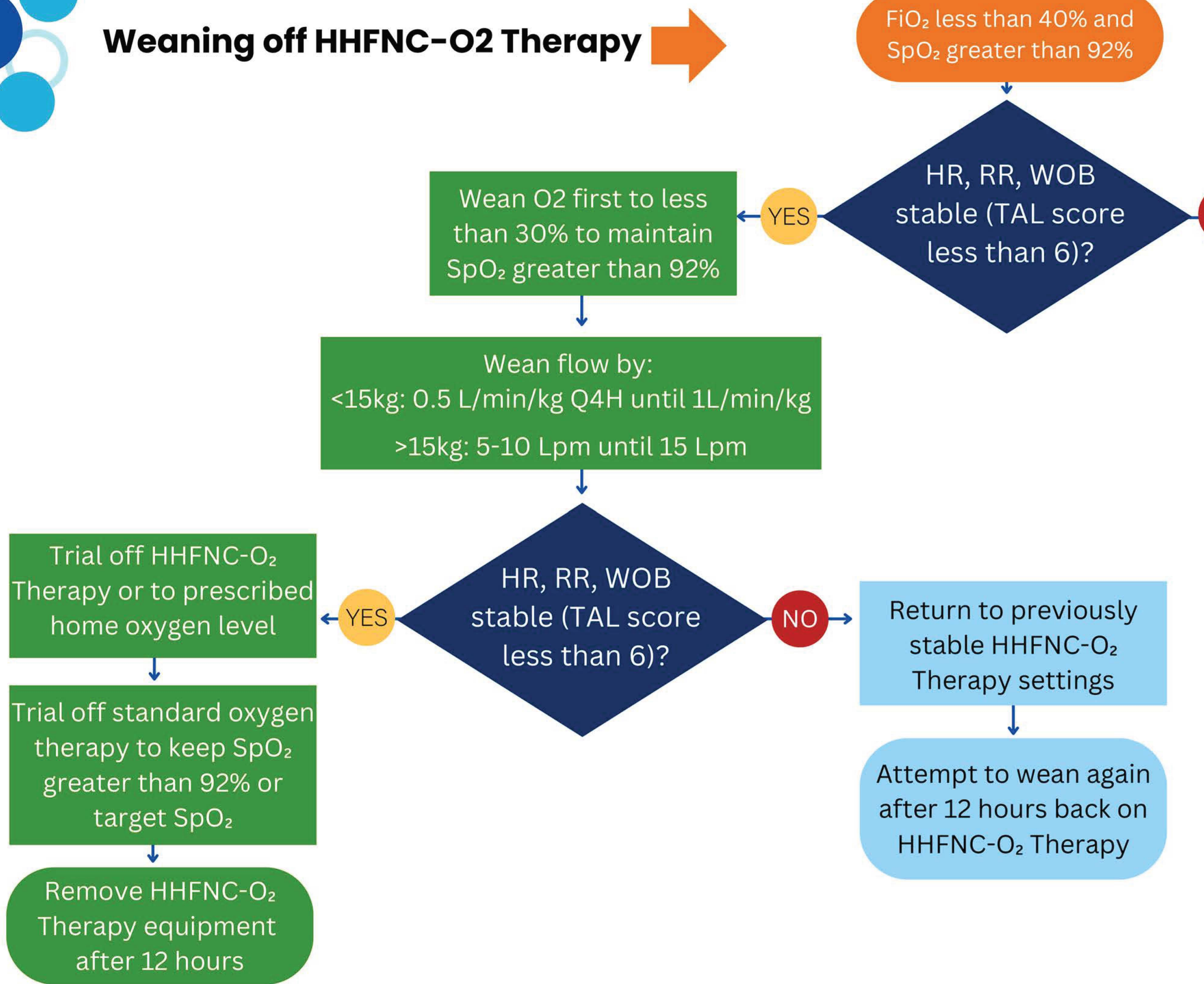
Weaning off HHFNC-O₂ Therapy



Weaning off HHFNC-O₂ Therapy



Weaning off HHFNC-O₂ Therapy



Nursing Considerations



Routine assessments - respiratory, vital signs and skin integrity minimum Q4H



FiO₂ - titrate within ordered SpO₂ parameters



Move oxygen saturation probe to a new location q4h as probes can leave skin irritation and burns



Skin Care - Pay close attention to the nasal septum and upper lip area, monitoring for skin irritation and breakdown (prongs should not rub against nasal septum)



Suctioning: remove one side of the prongs from wiggle pad and suction nostril

- Patient may desaturate with suctioning, requiring an increase of FiO₂ for handling periods
- Place prong back on wiggle pad and repeat on the other side



Do not cover circuit tubing with any towels or blankets



Review the
TAL Score
&
Know when
to call for help



Questions?

T h a n k y o u !

