

High Flow Oxygen within the Paediatrics - Full Paediatric Clinical Guideline – Joint Derby and Burton

CH CLIN G 139/Sept 2021/v001.1

1. Introduction

To provide guidance on the use of high flow oxygen within UHDB

2. Scope

This guidance is intended for the safe and the correct use of high flow oxygen for patients around the UHDB trust

3. Main body of Guidelines

Background

High-flow nasal cannula therapy (HFNCT) is a form of respiratory support that is easily set up and is well tolerated by patients. The use of nasal cannula adapted to the infant's nares size to deliver heated and humidified gas at high flow rates has been associated with improvements in washout of nasopharyngeal dead space, lung mucociliary clearance, and oxygen delivery compared with other oxygen delivery systems.

HFNCT also creates positive pharyngeal pressure to reduce the work of breathing, which positions the device midway between classical oxygen delivery systems like the high-concentration face mask, and continuous positive airway pressure (CPAP) generators.

Use of High Flow- who might benefit?

In the paediatric literature the benefits of HFNCT have been reported only for moderate to severe acute viral bronchiolitis.

Experience with this device in other settings may broaden the paediatric indications to include weaning from invasive ventilation, cardiac support and acute asthma. As for any form of respiratory support, HFNCT initiation in patients requires close monitoring and regular reviews.

HFNCT is used for the same indications as the traditional method of CPAP:

Indications (not exhaustive)	Contraindications	Cautions
<ul style="list-style-type: none"> • High oxygen requirement with respiratory distress • Post extubation if clinically indicated 	<ul style="list-style-type: none"> • Nasal obstruction or craniofacial abnormalities • Trauma/surgery to nasopharynx • Recurrent apnoea • Respiratory arrest or peri-arrest state • Multiorgan compromise • Undrained pneumothorax • Respiratory acidosis pH < 7.25 	<ul style="list-style-type: none"> • Drained pneumothorax • Upper airway obstruction

When should it be started? (see flow chart)

ALL children should be review by ST4 doctor or above before starting HFNC.

The indication(s) for starting high flow and location of where starting needs to be clearly documented in the medical notes.

Assessment of severity needs to be made to decide on whether to start HFNCT.

Bronchiolitis severity can be categorised into 3: moderate, severe and life threatening disease. Similar parameters can be used for other medical reasons to use HFNCT.

Moderate disease

Sats < 92% in air + ↑HR, ↑RR, respiratory distress, poor feeding

Severe disease

FiO₂ > 0.5 to maintain Sats > 92%, ↑HR, ↑RR, severe recession, frequent apnoea's (>2/h) but not needing bagging

Life-threatening disease

Sats < 88% despite high flow oxygen, respiratory acidosis (ph<7.25) despite CPAP / BiPAP, marked recession, exhaustion, grunting, apnoea needing bagging or frequent with desaturations

Severity of bronchiolitis (from Leicester guideline)

All children need a blood gas as baseline before starting HNFC to look for respiratory acidosis but be aware that acidosis is a late sign of respiratory failure.

Assessment and documentation of any contraindications to its use (see previous table)

Where is HFNC delivered?

NB – delivery of oxygen via NFNC is an ‘aerosol generating procedure’ – ensure correct PPE is worn according to level of risk for COVID – for detail see <https://www.rcpch.ac.uk/resources/national-guidance-management-children-bronchiolitis-during-covid-19#appendix-1-%E2%80%93indications-and-contraindications-for-hfnco-in-children-and-young-people>

High flow should only be delivered within the Step Down bed on Dolphin or in high dependency bed in QHB or in Derby PCCU. Other areas may be considered during RSV surge, please see Appendix 1 for cohorting according to RSV / COVID status.

Please note the following requirements for each area:

Step down bed Dolphin ward or High dependency bed on QHB

1. Children with proven or suspected viral bronchiolitis only
2. PEWS > 4 or more but in < 0.4 oxygen (approx < 5 L/ minute)
3. Signs of moderate disease
2. Nursing staffing on Dolphin ward or QHB should be at least **1 nurse for 2 patients** (may need to be 1:3 if capacity requires).
 - o On dolphin ward this should be in the step down bed

Derby Paediatric Critical Care Unit.

- Conditions other than bronchiolitis, such as Asthma, pneumonia, cardiac failure who meet the criteria for High Flow are managed on PCCU only.
- Children with severe disease viral bronchiolitis or who require >0.4 oxygen to maintain oxygen saturations > 92%.
- Children with apnoeas / bradycardias
- Children on wards where there is no improvement in condition (see ongoing management) or concerns raised at medical or nursing review (needs documentation.
- The bleep holder and Derby Consultant on call should be made aware

Transfer from Burton to Derby PCCU / Transfer from CED to PCCU

Follow the current STOPP policy for transfer

Complications of HFNCT

Potential complications of HFNCT therapy to consider:

- Potential barotrauma leading to surgical emphysema / pneumothoraxes, especially if cannulae occupy more than 50% of the diameter of the nares.
- Gastric distention and diaphragmatic splinting
- Obstruction or irritation due to improper sizing of nasal cannulas

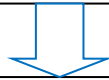
Initiation of High flow

Nursing staff to contact ST4 or above and review within 30 minutes

Consider need for further respiratory support and assess for diagnosis

Are there any contraindications to high flow?

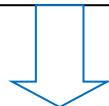
Doctor to document review indication including observations and PEWs



Decision made to start high flow

If < 0.4 FiO₂ plus viral bronchiolitis and enough nursing staff = step down/ HDU bed QHB

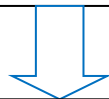
If other medical cause/ co-morbidities and/ or > 0.4 FiO₂ and/ or apnoeas = PCCU



Inform Bed manager of high flow use (both sites)

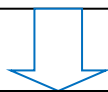
Use transfer policy as needed

Inform Resident or On Call Consultant Derby site - PCCU bed



Choose correct size cannula

Start at 40% FiO₂ and correct flow for weight and prong size



Nursing care

Observations at 0, 30 , 60 minutes then hourly
NG on free drainage- feeding after 4 hours if tolerated

Nasal and mouth care and review hourly

Fluid balance

Monitor the humidifier hourly



Medical review at 60 minutes

Documentation of review including signs of a response:

i) PEWS

ii) Heart rate: typically decreases within 60 minutes by 10-15% from baseline

iii) Reduction or stable FiO₂ requirement (< 0.4 on the ward)

iv) Improvement of work of breathing and RR

Ongoing management for those who have responded to HFNCT

Monitoring

- Continuous HR and SpO2 monitoring (ECG monitoring if on PCCU)
- Hourly PEWS, cannula position and gastric distention
- Fluid balance
- NG on free drainage and start feeding if stable at 4 hours including 4 hourly Nasogastric aspirates

Bedside care

- Check nasal prong position hourly (at minimum)
- Perform oral and nasal care to prevent crusting
- NOA suction as clinically indicated
- Check humidifier water level hourly
- Minimal handling with head elevation

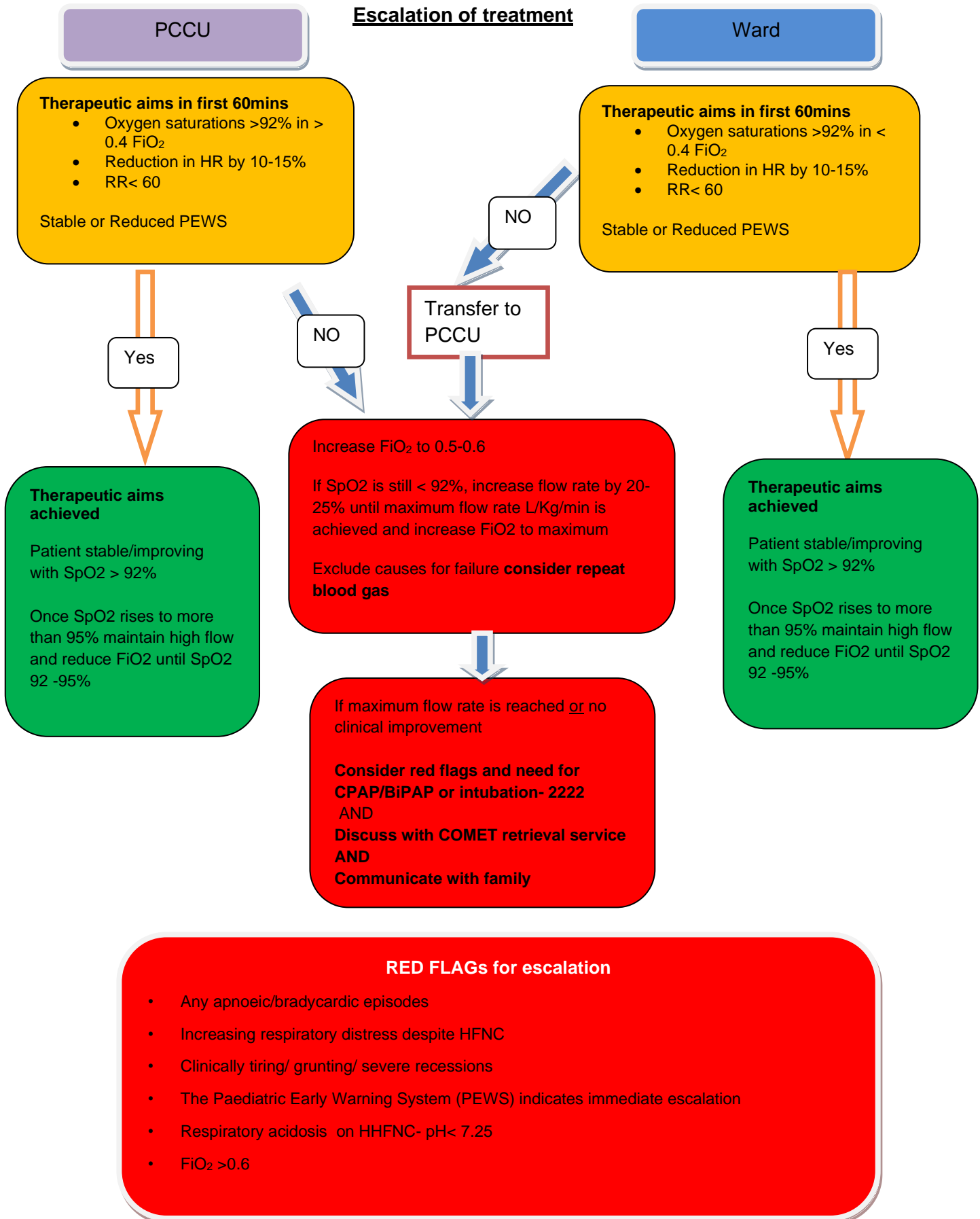
Feeding

- Review at 4-6 hours if stable to feed
- Most will need NG feeding, introduce slowly and consider small bolus initially at 2/3 full feeds
- If not tolerating or increased RR (red or amber risks) then NMB and IV fluids at 2/3 rds maintenance

Weaning of high flow

- Start when stable on high flow and < 30-40% (green flow)
- Do not wean high flow if respiratory distress or 40-60% oxygen (orange flow)

Routine blood gases are **NOT** necessarily needed when on high flow but repeat if clinical concerns around deterioration



NO

Yes

If maximum flow rate is reached or no clinical improvement

Consider red flags and need for CPAP/BiPAP or intubation- 2222

AND

Discuss with COMET retrieval service

AND

Communicate with family

Yes

RED FLAGS for escalation

- Any apnoeic/bradycardic episodes
- Increasing respiratory distress despite HFNC
- Clinically tiring/ grunting/ severe recessions
- The Paediatric Early Warning System (PEWS) indicates immediate escalation
- Respiratory acidosis on HHFNC- pH < 7.25
- FiO₂ >0.6

Response to treatment of HFNCT

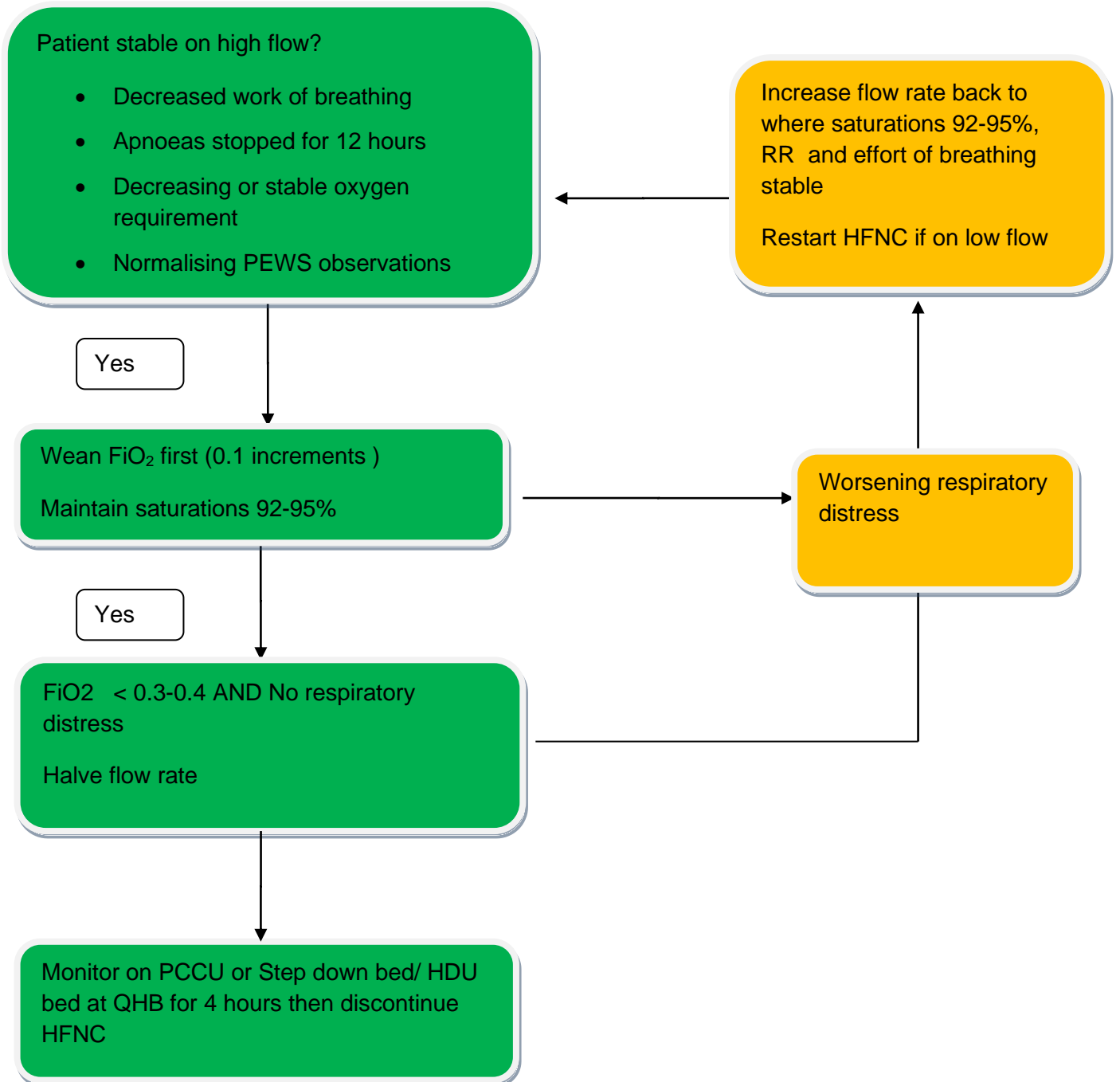
Sustained response to HFNC Nursing ratio 1:3 or 1:4 <2y	Response to HFNC Nursing ratio 1:2 or 1:3 if cohorted with 2 ward level patients	Unresponsive to treatment
Wean FiO ₂ to 0.3-0.4 (depending on patient)	Moderate respiratory distress continues <u>and/or</u> FiO₂>0.4-0.6	In the first hour Severe respiratory distress and / or FiO₂ >0.6
<p>THEN</p> <p>Halve the flow rate</p> <p>THEN</p> <p>If no clinical deterioration is seen after 4 hours, HFNC can be discontinued (or as soon as 1 hour if paediatric consultant confirms)</p> <p>THEN</p> <p>Restart at weaning flow rate if stopping HFNC is not tolerated – see 'Weaning HFNCT) section below</p>	<p>Re-assess essential monitoring/basic care continue on current HHHFT settings until ready to wean (move to green)</p> <p>THEN</p> <p>Continue to observe for any deterioration or red flags</p>	<p>•Re-assess - essential continuous monitoring/basic care</p> <p>•Ensure paediatric ST4+ has reviewed the patient</p> <p>•Consider discussion with the COMET service and anaesthetics</p> <p>•Discuss/review with the anaesthetic team</p> <p>•Closely observe for any red flags</p> <p>After 2nd hour or with any red flags:</p> <p>•Consider NIV or invasive mechanical ventilation (IMV)</p> <p>•Prepare patient, team and family for intubation</p>

Weaning can be considered when the patient's clinical condition is improving or stable as indicated by. :

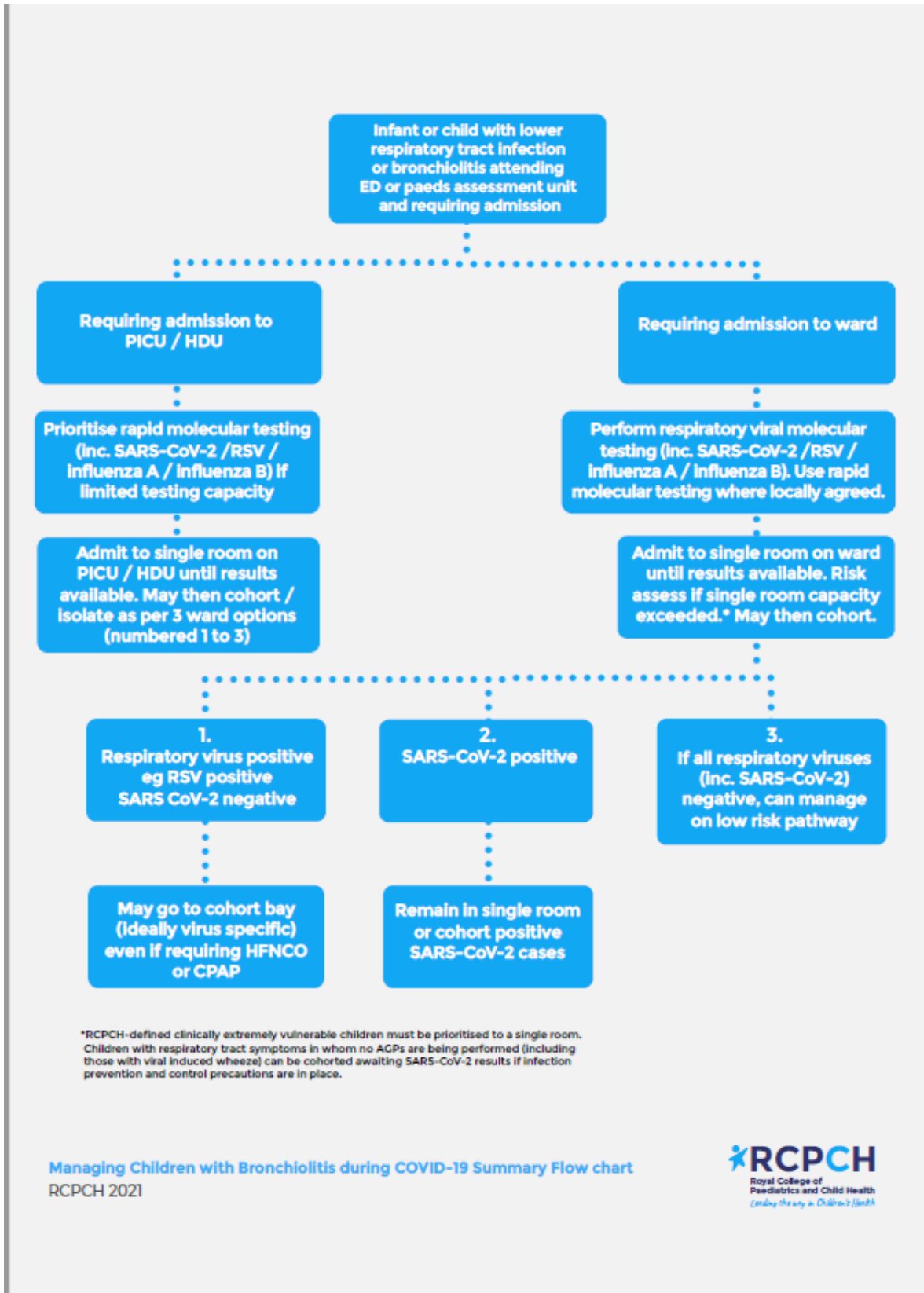
- Decreased work of breathing
- Apnoeas stopped for 12 hours
- Decreasing or stable oxygen requirement (< FiO₂ 0.4)
- Normalising PEWS observations
- Weaning should be initiated by a senior member of the medical team (ST4+ or Consultant) and the plan should be documented in the medical notes.
- FiO₂ should be reduced **before** flow
- Reduce FiO₂ to keep SpO₂ > 92%
- Only when FiO₂ is less than 40%, and the child is stable, can wean flow rate.

- Once < 0.4 FiO_2 , half flow rate
- Consider a slower wean in those with chronic lung disease or those had previous CPAP/intubation.
- Stop high flow if stable after 4 hours
- **If Increased RR, effort of breathing or drop in $\text{Fio}_2 < 92\%$ when weaning**
 - Determine if a cause for failure e.g. Secretions/ positioning
 - **If not** then increase flow back to weaning rate to where observations stable
 - Some neonates may require slow weaning of high flow especially in history of previous NCPAP/CLD.
 - Consider a slower wean when stable- **document this in the notes**

Weaning HFNCT



Appendix 1 – cohorting according to respiratory virus status (July 2021 RCPCH guidance)



Appendix 2 – delivery of HFNC

- Select appropriate sized nasal prong (ideally this should be \leq half diameter of nostril but can go up to 80% in small infants as long as fits comfortably)

In general

- Infants and children up to 10kg: OPT316 Infant (max flow 20L/min) or up to 12.5kg: OPT318 Paediatric cannula (max flow 25L/min)
- Children >10kg: Adult cannula size S OPT542, size M OPT544, size L OPT546

Nasal prong	Equipment Setting
Infant (OPT316)	AIRVO 2 in junior mode (purple butterfly)
Paediatric size (OPT318)	AIRVO 2 in junior mode (green bird)
Adult cannula size S (OPT542/4/6)	AIRVO2 in Adult mode

- Set up Airvo 2 ® system and Humidifier and attach Circuit tubing to humidifier

Remember, the junior mode has different limits settings to adult with a maximal temperature of 34 °C and a maximum flow of 25 l/m

SettingsSet up of the flow rate

- Start flow rate off at 6L/min and increase up to goal flow rate (see below) over a few minutes to allow patient to adjust to high flow
- High flow meter flow should be rounded down to nearest available flow (only certain flows available)

	Nasal prong size	Suggested flow rate	Max Flow (L/min)
< 10 Kg	Infant	2 L/kg/minute	20
> 10 kg	Paediatric	2 L per kg per minute for the first 10kg + 0.5L/kg/min for each kg above that (max flow 50 L/min)	25
	Adult		50

i.e. 16kg= 20L (2 x first 10kg) + 3L (0.5 x 6kg) = 23L/min;
40kg = 20L (2 x first 10kg) + 15L (0.5 x 30kg) = 35L/min

Setting FiO₂:

- Set target SpO₂ as > 92%
- Some may need lower target saturations, for example children with chronic lung disease or congenital heart disease.

- Start with 0.4FiO₂ and increase oxygen to 0.5 FiO₂ if saturations are < 92% after 5 minutes.
- If at 1 hour review , concerning symptoms or 0.5 FiO₂ and cant wean oxygen then needs transfer to PCCU
- Reduce FiO₂ in 0.1 increments to keep SpO₂ > 95 % (or target if different) to keep > 92%

References.

1. National guidance for the management of children with bronchiolitis and lower respiratory tract infections during COVID-19, RCPCH September 2020
2. Humidified High Flow Nasal Cannula Oxygen Therapy UHL Childrens Hospital Guideline , Leicester, October 2019
3. Plymouth Hospitals NHS Trust Policy: High Flow Nasal Cannula Oxygen Therapy in Children (Airvo 2 Device). January 2017
4. Dysart K, Miller TL, Wolfson MR, Shaffer TH. (2009) Research in high flow therapy: mechanisms of action. *Respiratory Medicine.*;103:1400-5.
5. Groves N & Tobin A. (2007). High flow nasal oxygen generates positive airway pressure in adult volunteers. *Australian Critical Care.* 20, 126—131
6. Spentzas T, Minarik M, Patters AB, Vinson B, Stidham G. Children with respiratory distress treated with high- flow nasal cannula. *J Intensive Care Med* 2009;24:323-8.
7. Schibler, A., Pham, T., Dunster, K., Foster, K., Barlow, A., Gibbons, K., and Hough, J. (2011) Reduced intubation rates for infants after introduction of high-flow nasal prong oxygen delivery. *Intensive Care Medicine.* May;37(5):847-52
8. McKiernan, C., Chua, L.C., Visintainer, P. and Allen, P. (2010) High Flow Nasal Cannulae Therapy in Infants with Bronchiolitis. *Journal of Pediatrics* 156:634-38
9. Ingvild B M, Peter D, Knut O (2016): High flow nasal cannula in children: a literature review. *Journal of Trauma, Resuscitation and Emergency Medicine:* 29-93
10. Wraight T, Ganu S (2015). High-flow nasal cannula use in a paediatric intensive care unit over 3 years. *Critical Care and Resuscitation:* 17(3):197-201.
11. <https://www.rcpch.ac.uk/resources/national-guidance-management-children-bronchiolitis-during-covid-19#appendix-1-%E2%80%93indications-and-contraindications-for-hfnco-in-children-and-young-people>
12. Example guidance on commencing and rapid weaning from HFNCO - Courtesy of North and South Thames Paediatric Networks and retrieval services embedded in RCPCH guidance (12)

4. Documentation Controls

Development of Guideline:	Dr E Starkey, updated July 2021 for RSV surge Dr V Cox
Consultation with:	Paediatric consultants and senior nursing staff
Approved By:	<i>Paediatric Business Unit Guidelines Group, Women and Children's Division 30/09/2021.</i> <i>Pending divisional approval, 10/2021</i>
Review Date:	September 2024 - Extended to Jan 2025
Key Contact:	Dr E Starkey, HDU lead Consultant