GUIDELINE FOR THE USE OF HIGH FLOW NASAL CANNULA OXYGEN THERAPY (OPTIFLOW OR AIRVO) IN CHILDREN WITH BRONCHIOLITIS OR AN ACUTE RESPIRATORY ILLNESS.

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

Introduction

High flow nasal cannula oxygen enables delivery of heated and humidified air/oxygen blend at flow rates which are higher than a patient's inspiratory flow. It has been shown that oxygen can be delivered more effectively than low-flow oxygen therapy or face mask high-flow oxygen. High flow oxygen washes out end-expiratory oxygen-depleted gas, resulting in more oxygen inhalation in the next breath and less carbon dioxide rebreathing. The heating and humidification of inspired gases during nasal cannula high flow therapy improves patient comfort by reducing the sensation of respiratory distress and mouth dryness.

Studies have shown that a reduction in the need for invasive ventilation in infants with bronchiolitis and in children with acute respiratory insufficiency following introduction of high flow nasal cannula oxygen therapy.

There are 2 systems for delivering high flow nasal cannula oxygen. Fisher & Paykel's Optiflow sytem and Fisher & Paykel's AIRVO 2. Optiflow can deliver up to 25litres/min, whereas AIRVO is capable of delivering up to 70litres/min.

This guideline is for use by the following staff groups:

The decision to commence nasal cannula high flow oxygen must be made by experienced paediatric medical and nursing staff. The member of nursing staff allocated responsibility for the patient must have received training on using Optiflow/AIRVO to ensure the nurse is competent in setting up and operating the system and able to provide safe, effective, evidence based care.

Lead Clinician(s)

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Approved by Paediatrics Guideline Review Meeting on:	9th February 2024
Review Date: This is the most current document and should be used until a revised version is available	9th February 2027

Key amendments to this guideline

Date	Amendment	Approved by:
19th Nov 2020	Document extended for 1 year	Dr J West/ Paediatric QIM
26th March 2021	Document reviewed and approved for 3 years	Clare Onyon/ Paediatric Guideline Review Meeting
9th Feb 24	Escalation of care added. Minor amendments	Paediatric Guideline Review Meeting

Guideline for the use of high flow nasal cannula oxygen therapy (Optiflow) in children with bronchiolitis or an acute respiratory illness.

Introduction

High flow nasal cannula (HFNC) oxygen enables delivery of high inspired gas flows of air/oxygen blend. This has become an increasingly utilised modality for the management of patients with respiratory compromise in Bronchiolitis alongside CPAP. There is evidence that it provides some level of continuous positive airway pressure while also providing pressure saturated humidified air. This may reduce the need for invasive respiratory support thus potentially lowering costs, with clinical advantages and fewer adverse effects.[1]

HNFC provides "a revolutionary bridge between low flow oxygen therapy and CPAP therapy and will reduce the requirement for CPAP and intubation in some clinical scenarios"[2]

How does high flow nasal cannula oxygen work?

High flow nasal cannula oxygen has been shown to improve the efficiency of ventilation and reduce the work of breathing by:

1. Washout of nasopharyngeal deadspace leading to improved alveolar ventilation.
2. Reduction in the inspiratory resistance associated with the nasopharynx.
3. Reduces the damage to the upper airway mucosa and improves lung compliance by supplying adequately warmed and humidified gas.
4. Reduces work of breathing – enables more oxygen inhalation and less carbon dioxide rebreathing.
5. Provides a degree of positive airway pressure thus assisting in keeping the child's airways open and improving ventilation.

Advantages of high flow oxygen therapy:

There are a number of advantages of using high flow nasal cannula oxygen therapy, these include:

1. Provides more comfort for the patient than low-flow oxygen therapy as the gases are heated and humidified.
2. Provides greater access to the patient than head box oxygen therapy.
3. Can help prevent the need for CPAP (continuous positive airway pressure)
4. It is better tolerated by the patient than CPAP as the system does not require creation of a seal.

Indications for high-flow nasal cannula oxygen therapy:

A child with an increased respiratory rate, signs of respiratory distress and/or increased oxygen requirement may benefit from high flow therapy. A child's requirement for increased

respiratory support can be measured objectively using the respiratory component of the Paediatric Early Warning Score (PEWS) alongside oxygen saturations of <92%.

A registrar or consultant should review the patient prior to commencing High flow therapy.

Contraindications for Optiflow/ AIRVO therapy:

1. Recurrent apnoea
2. Pneumothorax, Pneumomediastinum
3. Multi-organ compromise (particularly intra-abdominal)
4. Nasal obstruction or upper airway anomalies
5. Maxillo-facial or chest trauma or base of skull fracture
6. Inhalation of a foreign body
7. Consider if appropriate with respiratory acidosis with pH <7.25 or more appropriate to proceed directly to intubation and ventilation

Complications / side effects of Optiflow/ AIRVO:

1. Abdominal distension
2. Air leaks (pneumothorax or pneumomediastinum have been described in 2 case reports involving 4 children)
3. Mucosal injury / nasal bleeding (the rates are lower than reported for CPAP)
4. Failure of therapy (need for intubation / ventilation)

Initiation of Optiflow/ AIRVO:

1. Ensure patient and/or parent/carer are informed of plan of care and have had benefits and side effects of high flow explained.
2. A blood gas is recommended and a chest x-ray should be considered
3. Ensure child is appropriately monitored with continuous ECG and oxygen saturation monitoring
4. Child should ideally be nursed in a HDU room with hourly observations recorded.
5. Select appropriate sized nasal prongs. These should only occlude up to 50% of the nares, where 2 sizes could be suitable choose the smaller size.
6. There are 5 sizes of nasal cannulae available:
7. -Set the initial oxygen concentration at 40% aiming for oxygen saturations of 92-95%.
   -If after 5 minutes oxygen saturations remain less than 92% increase oxygen concentration to 50% (unless otherwise indicated by registrar/consultant or intensive care team).
   -If oxygen saturations are greater than 95% in 40% oxygen then wean oxygen concentration to maintain saturations between 92% and 95%. ***(check with consultants for plan)***

8. **Set the initial flow rate:**
   - i. **Infants (up to 12 months) 2L/kg/min**
   - ii. **Over 1 year 1-2L/kg/min**

Caution should be exercised using rates over 2L/min/kg in children and an increase over this rate should be discussed with the middle grade or consultant on call. The maximum flow rate is determined by the size of the nasal cannulae used:

YELLOW (neonatal):	maximum flow rate 8L/min
PURPLE (infant):	maximum flow rate 20L/min
GREEN (paediatric):	maximum flow rate 25L/min
ORANGE (small adult):	maximum flow rate 50L/min
BLUE (medium adult):	maximum flow rate 60L/min

Attaching the Nasal cannulae:

1. Prepare the skin, ensuring the face is clean and dry. Consider using sorbaderm to protect cheeks.
2. Connect the cannula to the neonatal Optiflow tubing. Place close to the prongs to ensure that there is gas flow.
3. Remove the first backing tabs from the wigglepads on the nasal cannula, leaving the second backing tabs in place.
4. Hold the ends of the wigglepads and apply slight tension to the cannula.
5. Position the prongs as far into the nares as possible so that the cannula bridge rests just underneath the septum.
6. Position horizontally across the face and stick wigglepads onto the cheeks.
7. Remove the second backing tabs and stick the remainder of the pads onto the cheeks. Ensure the wigglepads are well adhered to the face.
8. If a nasogastric tube is required this can be attached on top of the tubing there is a slight ridge where this can rest and tegaderm can be used to attach in place.

Consider repeating a blood gas 2 hours after starting optiflow / AIRVO (there is some evidence that if children remain acidotic they are more likely to deteriorate later)

Management of a child receiving Optiflow/AIRVO:

1. There should be continuous ECG and oxygen saturation monitoring
2. Children requiring maximum suggested flow rates for their age/weight should be cared for in a HDU room.
3. The child should be reviewed at least daily by registrar or consultant
4. There should be consideration of the need for further investigation and repeat blood gases.
5. A nasogastric tube should be passed to help reduce gastric distension. Initially feeds should be stopped and Intravenous fluids commenced. Enteral feeds may be introduced if the child's clinical condition dictates.
6. Weaning Optiflow therapy should be considered at each review.

Escalation of care:

The definition of high dependency care on optiflow/ airvo is a
Requirement of >2L/kg flow AND / OR oxygen requirement >40%

If oxygen saturations are less than 92% in 50% and/or the respiratory component of the PEW score (respiratory rate, oxygen saturations and respiratory distress) is 3 or more whilst a child is receiving Optiflow /airvo therapy, ask medical staff for urgent review and discuss/inform KIDS team.

If a child is on the maximum flow for age/weight and has oxygen saturations less than 92% in 50% oxygen and respiratory component of PEWS remains 3 or above then they are likely to require non-invasive or invasive ventilator support. Medical staff should review urgently, anaesthetists should be made aware and patient should be discussed with KIDS.

Weaning Optiflow / AIRVO:

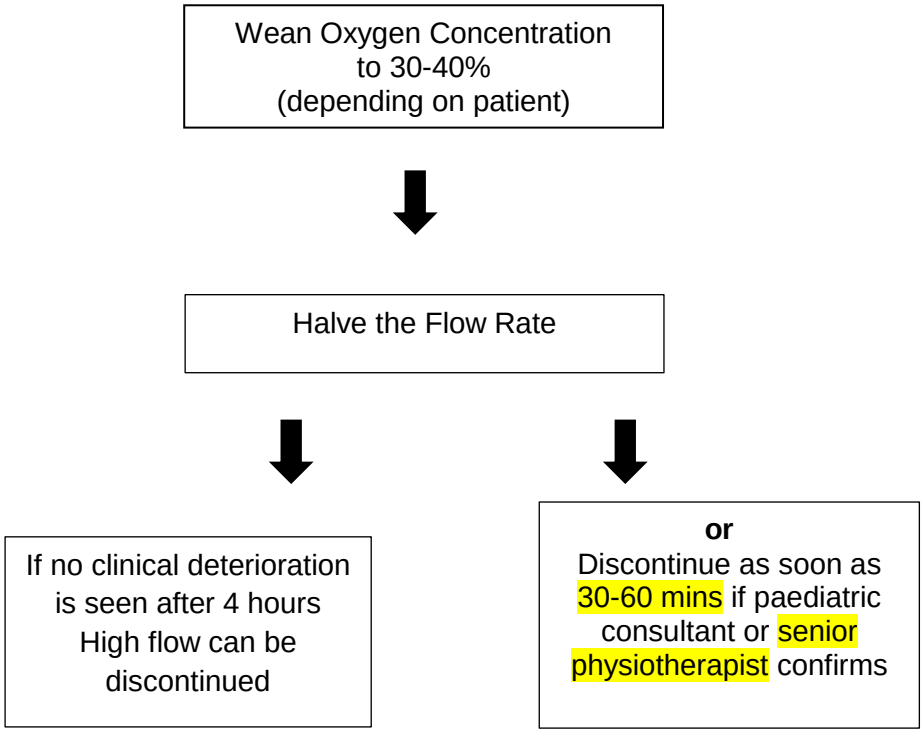
There should be a period of clinical stability and stable settings prior to weaning. Weaning should be initiated by a senior member of the medical or physiotherapy team and the *individualised plan should be documented in the medical notes*.

Initially wean oxygen concentration until 30 - 40% (usually by 10% increments)

Weaning flow rate should begin when the oxygen concentration is around 30% and the respiratory section of the PEWS score is less than 3. There is no need to wait for the oxygen requirement to come down to air or near 21% before weaning the flow rate.

How to wean off high flow:

- There is limited evidence for weaning regimes and there is wide variation in practice
- Recommended plan for most patients:



Restart at weaning flow rate if stopping high flow is not tolerated

Nursing care of patient receiving Optiflow/AIRVO:

1. Observe the nasal cannula at least hourly to ensure they are in the correct position
2. Observe the nose and face for evidence or pressure sores
3. Perform and record hourly heart rate, respiratory rate and effort, and oxygen saturations and concentration. PEWS also needs to be documented hourly. BP and temperature should be recorded at least 4 hourly or as condition dictates. Flow rate of air, oxygen concentration and humidification temperature should also be recorded.
4. Check and record water temperature hourly ensuring that not too much water has drained into the water chamber. Replace the sterile water bag every 24 hours.
5. Check that optiflow tubing is warm.
6. Change tubing and cannula every 7 days, if wigglepads lose their attachment to skin these can be replaced separately to the nasal cannula. Do not change nasal cannula more frequently than every 7 days unless absolutely necessary.
7. Patients should have minimal handling as this can be more effective than therapies.

Delivery of nebuliser medication using Optiflow / AIRVO

There are no studies looking at medication delivery via nebuliser or MDI whilst using high flow. High flow oxygen should be used with caution in patients with asthma.

For the smaller size nasal cannulae (purple, green) an attachment is available to enable a nebuliser to be attached to the circuit, although there is limited evidence for its use.

The manufacturer does not recommend any change in the high flow rate when a nebuliser is being delivered over the top of the nasal cannulae. Some guidance (New South Wales Government Guidelines) recommends that the flow should be reduced to 4L/min during the administration of a nebuliser or MDI and spacer (to ensure that there is some entrainment of the air from the nebuliser or spacer). This should be considered. MDI and spacer may be preferable to minimise the time taken for administration. If there is any deterioration during the delivery of the nebuliser or inhaler the high flow rate should be resumed to its previous level and alternative means considered (such as IV salbutamol).

Cleaning the equipment after use:

1. Dispose of the patient circuit, humidifier dome and oxygen tubing in appropriate clinical waste bin.
2. Wash machine as per trust guidelines.
3. Store in allocated space, with easy access for next use.

4. DO NOT DISPOSE OF THE HEATER WIRES.

Monitoring Tool

This should include realistic goals, timeframes and measurable outcomes.

How will monitoring be carried out?

Who will monitor compliance with the guideline?

Page/ Section of Key Document	Key control:	Checks to be carried out to confirm compliance with the policy:	How often the check will be carried out:	Responsible for carrying out the check:	Results of check reported to: *(Responsible for also ensuring actions are developed to address any areas of non-compliance)*	Frequency of reporting:
	WHAT?	**HOW?**	**WHEN?**	**WHO?**	**WHERE?**	**WHEN?**
	Monitor to ensure all patients receiving high flow therapy are receiving high dependency care.	Audit of HDU patients to ensure all children receiving Optiflow/Airvo therapy are receiving high dependency care.	12 times per year	HDU Lead Nurse	Ward Matron, Ward Managers, Clinical Medical Director for Paediatrics.	12 times per year.
	Ensure guideline is being followed.	Audit a selection of patients receiving high flow therapy to ensure that the guideline is being followed.	4 times per year	HDU Lead Nurse	Ward Matron, Ward Managers, Clinical Medical Director for Paediatrics.	4 times per year.

References:

- **Best Practice Guidance For Using Heated Humidified High Flow Therapy in Children and Young People: An East of England Approach (March 2020) Accessed via https://www.networks.nhs.uk/nhs-networks/east-of-england-paediatric-critical-care**
- **Bristol Royal Hospital for Children, 2015. Optiflow – high flow nasal cannula cannula oxygen therapy (AIRVO 2/Neonatal Optiflow),**
- **Frat, J.P., Thille, A.W., Mercat, A., Girault, C., Ragot, S., Perbet, S., Prat, G., Boulain, T., Morawiec, E., Cottereau, A. and Devaquet, J., 2015. High-flow oxygen through nasal cannula in acute hypoxemic respiratory failure. *New England Journal of Medicine,* 372(23), pp.2185-2196.**
- **Hutchings, F.A., Hilliard, T.N. and Davis, P.J., 2014. Heated humidified high-flow nasal cannula therapy in children. *Archives of disease in childhood*, pp.archdischild-2014.**
- **McKiernan, C., Chua, L.C., Visintainer, P.F. and Allen, H., 2010. High flow nasal cannulae therapy in infants with bronchiolitis. *The Journal of pediatrics*, 156(4), pp.634-638.**
- **Mikalsen, I.B., Davis, P. and Øymar, K., 2016. High flow nasal cannula in children: a literature review. Scandinavian Journal of Trauma, *Resuscitation and Emergency Medicine*, 24(1), p.93.**
- **NICE guideline, 2015. Bronchiolitis in children: diagnosis and management**
- **Wessex PCCN guidelines for the use of nasal humidified high flow oxygen in children. Accessed via** www.pier.uhs.nhs.uk/Media/.../**High-flow**-oxygen-full-text.pdf
- **New South Wales government, 2016. Humidified high flow cannula oxygen guideline for metropolitan paediatric wards and EDs. Accessed via http://www1.health.nsw.gov.au/pds/ActivePDSDocuments/GL2016_004.pdf**

Contribution List

This key document has been circulated to the following individuals for consultation;

Designation

This key document has been circulated to the chair(s) of the following committee's / groups for comments;

Committee

Supporting Document 1 - Equality Impact Assessment Tool

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

		Yes/No	Comments
1.	**Does the policy/guidance affect one group less or more favourably than another on the basis of:**		
	• Race	No	
	• Ethnic origins (including gypsies and travellers)	No	
	• Nationality	No	
	• Gender	No	
	• Culture	No	
	• Religion or belief	No	
	• Sexual orientation including lesbian, gay and bisexual people	No	
	• Age	No	
2.	**Is there any evidence that some groups are affected differently?**	No	
3.	**If you have identified potential discrimination, are any exceptions valid, legal and/or justifiable?**	No	
4.	**Is the impact of the policy/guidance likely to be negative?**	No	
5.	**If so can the impact be avoided?**	N/A	
6.	**What alternatives are there to achieving the policy/guidance without the impact?**	N/A	
7.	**Can we reduce the impact by taking different action?**	N/A	

If you have identified a potential discriminatory impact of this key document, please refer it to Human Resources, together with any suggestions as to the action required to avoid/reduce this impact.

For advice in respect of answering the above questions, please contact Human Resources.

Supporting Document 2 – Financial Impact Assessment

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

	Title of document:	**Yes/No**
1.	Does the implementation of this document require any additional Capital resources	No
2.	Does the implementation of this document require additional revenue	No
3.	Does the implementation of this document require additional manpower	No
4.	Does the implementation of this document release any manpower costs through a change in practice	No
5.	Are there additional staff training costs associated with implementing this document which cannot be delivered through current training programmes or allocated training times for staff	No
	Other comments:	

If the response to any of the above is yes, please complete a business case and which is signed by your Finance Manager and Directorate Manager for consideration by the Accountable Director before progressing to the relevant committee for approval.