Best Practice Guidance for Non-invasive Continuous Positive Airway Pressure (CPAP) for Children under 2 year within Acute Paediatric Admissions

A South London and South East of England approach

Introduction:

This guideline has been updated to support clinical colleagues in South Thames Paediatric Network (STPN) with the use of Non-invasive Continuous Positive Airway Pressure (CPAP) for Children under 2 year within acute Paediatric admissions. This excludes the use of CPAP within Neonatal units who will use equipment and approaches familiar and appropriate to their clinical environment and practice.

The guideline is designed to allow for rapid recognition of a child that would benefit from CPAP and provide succinct information as to the best practice for commencing therapy in a child experiencing acute respiratory distress. It does not replace the clinical knowledge, expertise and judgement of clinicians at the bedside. The guideline does not describe the use of Non-invasive ventilation (NIV) beyond CPAP although clinical units with the skills and ability to provide care beyond CPAP should use local guidance.

The Contents for the Guideline are as follows:

Main document
Appendices
Team credits and References

Change History:

Date	Change details, since approval:	Approved by:	Document Version:
Oct 2021	First version	Clinical Director STPN, Marilyn McDougall	1.0
Dec 2024	Updated – extended to age 2 years, expanded essential care considerations including use of chloral hydrate, updated intra-hospital transfers flowchart, updated equipment and interfaces, learning resources, teaching simulations, troubleshooting, and team credits	Clinical Director STPN, Ryan Watkins	2.0

January 2025

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NON-INVASIVE CPAP IN CHILDREN UNDER 2 YEARS WITHIN ACUTE PAEDIATRIC ADMISSIONS

PATIENT AND THERAPY SELECTION

Choosing CPAP or HHHFT- CPAP delivers better PEEP but HHHFT is often better tolerated. Decision should be made by senior clinical team with consideration of underlying condition and severity, time to set up, equipment availability, skill availability and patient tolerance to therapy. Consider CPAP first-line in pre-term infants and infants under 6 weeks of age

INDICATIONS

- Bronchiolitis with moderate to severe respiratory distress
- Other possible indications may include lower respiratory tract infections and viral induced wheeze, but must be discussed with Paediatric Consultant and/or STRS, particularly when considering to use in patients with underlying cardiac disease
- Unresponsive to HHHFT, and no red-flags / contraindications
- Apnoeas, which are short-lived and infrequent
- Hypoxia (Sats < 90%) despite nasal / facial oxygen therapy
- Respiratory acidosis (pCO_2 > 6.5kPA without pre-existing lung disease, rising pCO_2, and/or pH < 7.30 if parallel clinical assessment signifies a need. *Favorable outcomes have been seen if CPAP is commenced at pH 7.25, although clinicians should be aware of potentially higher rates of CPAP failure if intervention is delayed.*

Regardless of the gas, decision for non-invasive respiratory support should be based on clinical condition.

CONTRA-INDICATIONS

- Respiratory arrest or peri-arrest state indicate need for imminent intubation and ventilation
- Recurrent or prolonged apnoea(s)
- Severe cardiovascular instability
- Upper airway obstruction
- Craniofacial abnormalities / choanal atresia
- Inability to protect the airway / GCS < 8
- Undrained pneumothorax / pneumomediastinum
- Trauma / basal skull fracture / facial surgery
- Continuous vomiting / recent upper GI surgery

CAUTIONS

- Abdominal distention
- Recent abdominal surgery
- Previous vomiting

PATIENT AND EQUIPMENT MANAGEMENT

ESSENTIAL CARE CONSIDERATIONS (ECCs) – review prior to and during therapy

FIRST LINE – CONSERVATIVE MEASURES

- **Optimise positioning** – head elevation 30°, ensure neutral open airway position, hips flexed 90° to "offload" core musculature
- **Optimise comfort** – regular analgesia / antipyretics, temperature control, swaddling, dummy/thumb sucking, nappy cares, parental contact/skin to skin, music / white noise, rocking / patting, aspirating stomach air, Minimal handling / cluster cares
- Consider chest physiotherapy and secretion clearance if indicated, particularly if reduced cough / neuromuscular disorder
- Psychosocial support for family and manage expectations with plans of escalation / de-escalation based on clinical response

SECOND LINE - CONSIDER ORAL SEDATION (if no apnoeas or significant underlying cardiac disease)

Chloral hydrate: < 6 kg = 10 mg/kg 6 hrly PRN
> 6 kg = 30 – 50 mg/kg 6 hrly PRN

HYDRATION & FEEDING - Consider feeding based on risk, severity and underlying disease:

- **Severe respiratory distress, RR > 70/min** – NBM with IV fluids, consider trophic feeds
- **Moderate respiratory distress, RR < 70/min** - Consider continuous NG milk or ORS (oral rehydration solution) at 80ml/kg/day

MONITORING AND NURSING CARE

- Nurse on 1:2 ratio (1:3 with 2 ward level patients)
- Presence of red flags require Nursing ratio 1:1 until resolved
- 2 hourly mouth & nose care, including pressure areas, seal & eye checks
- 4 hourly NG/OGT aspiration
- Chest X-ray for all children
- Continuous ECG and sats
- Minimal 1 hourly obs and increased frequency according to PEWS escalation
- 1 hourly documentation of FiO_2, Flow L/min, PEEP, humidification water and temp, and tubing for water

EQUIPMENT

- Paediatric Arrest and/or Airway trolley
- Bag Valve Mask (bedside)
- Piped Medical Gases
- Suction
- Central monitoring if available

TRANSFER

Intra-Hospital - avoid where possible until a period of stability maintained without CPAP - **Appendix**

Inter-Hospital - Discuss with STRS

COMMENCING CPAP

1. Select interface, CPAP device, humidification and settings

PEEP 5-7cmH20 (commence at 4-5 if tolerance poor)
FiO_2 at maximum setting (unless contraindicated).

2. Nasogastric tube

Aspirate stomach contents including air.
Leave NG on free drainage and regularly aspirate to alleviate pressure from air in stomach until patient considered ready to re-establish feeding.

3. Patient preparation

Assess need for suction
Nappy cares and other comfort measures
Place headgear at the back of the head
Other comfort measures and skin preparation

4. Commence CPAP using 2 person technique

1st person - turn on device and apply interface

2nd person- apply flow by oxygen until interface applied and secure headgear once therapy tolerance and clinical condition established

Please note: If secured too tight this will increase risk of intolerance, vagal stimulation and pressure damage.

5. Close observation for tolerance and stability in 1st 10-15 mins

6a. If patient tolerates CPAP, review at regular intervals (Minimum hourly)

- Titration of FiO2 to oxygen saturations of 90% (or alternative patient range)
- Need to escalate treatment
- Readiness to feed
- Readiness to wean PEEP (When FiO_2 < 0.40)

6b. If patient FAILS to tolerate CPAP

- Senior review
- Consider switching to high-flow or low-flow
- Consider escalation to intubation, see red-flags below

RED FLAGS FOR IMMEDIATE ESCALATION

- **Apnoeic or bradycardic episodes**
- **Increasing respiratory distress after CPAP started**
- **Clinical exhaustion (with respiratory insufficiency)**
- **FiO2 > 0.60**
- **PEWS indicates immediate escalation to 2222**

IMMEDIATE ESCALATION

- **Increase FiO2 to max**
- **Call 2222**
- **Prepare for intubation**
- **Liaise with STRS retrieval team or on site L3 PCC**
- **Communicate with family**

NOTE: Children with underlying neuro-muscular weakness may not be able to increase respiratory effort – escalate treatment according to effect (hypoxia, hypercapnia, bradycardia, prolonged CRT, reduced consciousness)

APPENDICES

(A) SAFER PATIENT INTRA-HOSPITAL TRANSFERS
(B) CPAP EQUIPMENT, INSTRUCTIONS, AND COMMON INTERFACES
(C) LEARNING RESOURCES TO HELP UNITS ESTABLISH CPAP
(D) TEACHING SIMULATION 1 & 2
(E) ACUTE CPAP TROUBLESHOOTING
(F) TEAM CREDITS & REFERENCES

(A) SAFER PATIENT INTRA-HOSPITAL TRANSFERS

CYP REQUIRES HEATED HUMIDIFIED HIGH FLOW THERAPY (HHHFT) OR CPAP AND REQUIRES INTRA-HOSPITAL TRANSFER
(E.G. EMERGENCY DEPARTMENT TO WARD, or BETWEEN AREAS ON WARD) ***Note: for inter-hospital transfer, call Retrieval Service for advice***

STEP 1 – ASSESS RISK – Assessment by Senior Clinician to establish risk of deterioration during transfer

LOW RISK	MEDIUM RISK	HIGH RISK
Mild-Moderate respiratory distress Some recessions and/or use of accessory muscles	**Moderate respiratory distress** Moderate recessions and/or use of accessory muscles	**Severe respiratory distress** Prominent recessions and marked use of accessory muscles
Maintaining oxygen saturations > 92% with FiO_2 requirement < 0.39 with face mask oxygen or 2 Litres Nasal Cannula Oxygen	**Maintaining oxygen saturations** > 92% with FiO_2 requirement 0.40 – 0.59	**Saturations <92% on Oxygen** and/or FiO_2 requirement > 0.60 Apnoea and/or bradycardic episodes Clinically tiring High / Emergency PEWS

STEP 2 – IS RELIABLE HHHFT / CPAP TRANSFER EQUIPMENT AVAILABLE?

YES – commence therapy prior to transfer

Should be transferred by a Nurse trained in Paediatric Basic Life support (BLS)
Should be transferred by a competent Health Care Professional and a Nurse trained in Paediatric ILS
Should be transferred by a Paediatric Airway Competent Health Care Professional and a nurse trained in Paediatric ILS.

STEP 3 – TRANSFER

NO – ensure risk assessed as above and follow as below

DO NOT commence on HHHFT / CPAP prior to transfer. **Ensure therapy can commence immediately on arrival at destination**	**Should be transferred by a Paediatric Airway Competent Health Care Professional and a nurse trained in Paediatric ILS.** Oxygen delivery method during transfer should be 15L via Non Re-breath oxygen mask unless competent in delivering PEEP via mask and Ayres T-piece. Keep NBM, NG on free drainage, consider oxygen requirement to ensure adequate supply for entire journey. Consider static trial period to establish tolerance and stability. **HHHFT should be recommenced immediately on arrival at destination**
If transfer CAN occur within 30 minutes, DO NOT commence on HHHFT / CPAP prior to transfer. **Ensure therapy can commence immediately on arrival at destination.** Should be transferred by a Airway Competent Health Care Professional and a Nurse trained in Paediatric ILS **If transfer CANNOT occur within 30 minutes**, treat as per **HIGH RISK group →**	

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Ensure Oxygen, Non Re-breath Mask and Bag-Valve-Mask (BVM) to hand for all transfers

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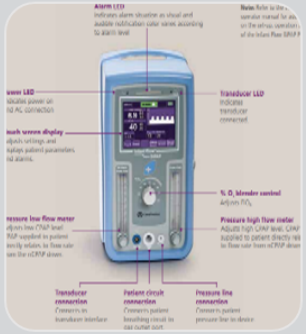
(B) CPAP EQUIPMENT, INSTRUCTIONS, AND COMMON INTERFACES



Infant Flow SiPAP

Bubble CPAP (Fisher & Paykel)

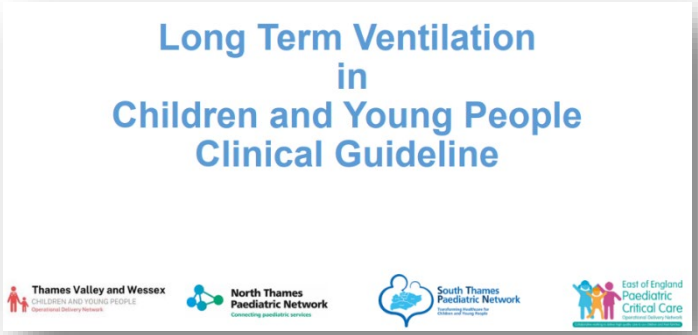
Trilogy EVO

Trilogy 100

Trilogy EV300

Hamilton-T1

For information on CPAP use for children requiring Long Term Ventilation, please see separate clinical guideline



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Interface selection process

First step: Recognise

Clinical indication for NIV identified

Second step: availability in the current setting

Availability of interfaces in the unit	Appropriate interface for the patient

Third: Chose which interface

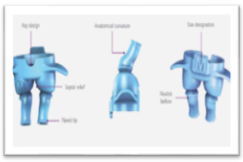
Nasal interface	Oronasal/ face interface
Indicated for patients who require frequent suctioning or do not settle without a dummy. Also choice for patients who are prone to vomiting	For patients where a large leak is expected from the mouth or that need a reliable pressure is needed to ensure the success of the therapy .

Tips for optimal fitting

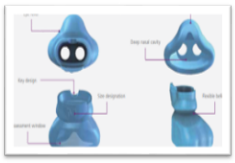
- 2 person technique ideally when fitting a mask
- Fit mask first, with no tubing attached
- Ensure head gear straps are not too tight or loose
- Once mask fitted, connect tubing and then start ventilation
- Check for leaks anywhere around the interface by feeling with your hands for air escaping

Different masks and fitting

For infant flow SiPAP



Infant flow LP prongs



Infant flow LP mask

Available in multiple sizes- from XS to XL

Sizing guide for masks vs prongs for infant flow SiPAP

Headgears and bonnets

Infant flow SiPAP fixation devices:
wrap headgear and bonnet

Bubble CPAP interfaces- Flexitrunk

Nasal mask compatible with multiple CPAP machines

Respireo Soft baby (3-12kg) and child (12-25kg). Suitable from birth (multiple sizes).
Nasal mask, vented and non vented options.
Comes with headgear

Nasal mask compatible with multiple CPAP machines

Respironics PN841
Nasal mask
Available in 3 cushion sizes, for patients > 10kg

Different masks and fitting

Face mask compatible with multiple CPAP machines

Paediatric 'Cirri' Full Face Mask Non vented
Four sizes available (from 0 – 8 years)

Total Face mask compatible with multiple CPAP machines

FitMax total Face Mask, vented and non vented options
Two sizes available

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(C) LEARNING RESOURCES TO HELP UNITS ESTABLISH CPAP

INITIAL SET-UP:

- Contact the manufacturer for MDT training sessions (in-person/ virtually) & online resources.
- Departmental Power Point teaching session (also used as regular refresher – junior doctor changeover/new staff induction periods)
- Create CPAP resources folder on departmental shared drives. To include: manufacturer QR codes/links to set up, prescription pro-forma etc.
- Establish competency document and how this will be managed/signed off.

AD-HOC:

- Practice Educators/Senior Team to provide regular bite-size teaching on the ward. Themes such as: putting together circuit from scratch, applying masks to different size mannequins, pressure ulcer assessments, machine maintenance/changing filters etc.
- Attach laminated hard copies of STPN guideline to CPAP machines.
- Create laminated step-by-step photo guide of CPAP equipment set-up that can be attached to CPAP machines for reference (these can be used as resource for bite-size teaching session).
- If happy to, Practice Educators/Senior team can produce a short film demonstrating CPAP set-up on a mannequin. This can be shared with the team via email, saved in resources folder and used on any relevant paediatric training days.
- Include CPAP set-up and review of available resources in future preceptorship sessions, or as part of induction for all new starters.
- Include CPAP as part of mini and big simulations. Mini sims to include much the same as bite-size teaching, allowing individuals to initiate/manage independently and with less guidance. Big sim to allow natural escalation to CPAP and support staff in getting used to preparing CPAP in advance and measure mask size/apply mask in an emergency setting.

PHYSICAL COMMENCEMENT OF CPAP ON THE WARD:

- Patient selection and staffing (competency/familiarity) key for first patient success.
- Revisit and signpost staff to existing learning resources and offer opportunity to practice securing mask on mannequin if time.
- CPAP prescription pro-forma to be readily available and reviewed by all staff in commencement process.
- Ensure NIC and medical lead both experienced and happy to support staff as required.

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(D) TEACHING SIMULATION 1

Teaching Simulation - Respiratory Failure – Bronchiolitis

Clinical Setting and History

S: 6 weeks old baby Azra is brought to AE. She has cold and poor feeding since 2 days. Today mother noticed that she is breathing fast and is not able to complete her bottles even 50%. She is having on and off short dusky episodes.

B: Azra is born preterm 32 weeks gestation and required respiratory support at birth with Vapotherm, LISA, and nasal cannula oxygen till 37weeks. She was discharged from Special care just last week with home oxygen for 100cc.

A: The triage nurse has assessed the Azra. She has significant work of breathing. Sats are 90% on nasal cannula home oxygen cylinder on 100cc. HR is 160/m, RR is 70/m. CRT<2secs, BP 77/55. Nurse notice baby has a brief apnoeic episode during the triage which is self-correcting.

R: Urgent Paediatric review has been requested.

Additional Instructor information:

Practitioner assesses the patient:

- A- Intact, crying
- B- Bilateral wheeze, severe respiratory distress, sats improved to 94% after starting NRB mask. Short frequent self corrected apneas noted.
- C- Circulation- CRT < 2secs, HR 176/m, BP 92/53.
- D- Glucose 5.5, pupils equal, normal posture
- E- no rash, no bruises. Temp 37.1c

Diagnosis of Bronchiolitis made. Team to start the baby On CPAP.

Keep baby Nil by mouth and start IV Fluids.

Additonal points to be demonstrated as appropriate:

- Setting up CPAP
- Summon experienced senior assistance
- Frequent reassessments of ABCDE
- Referral to definitive management
- Appropriate care/designated team member for family members.
- Demonstrate strategies to help settle whilst establishing CPAP
- Escalation of care explained to parents

Discussion Points and Expected interventions:

- Differentiation between compensated and decompensated clinical status
- Assessment of severity of respiratory distress
- Importance of minimal handling
- Keep baby Nil by Mouth, increase oxygen supply, either NRB mask/ Optiflow, N/OGT - aspirate gastric contents, optimize positioning, suction if any secretions.

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TEACHING SIMULATION 2

Teaching Simulation- Respiratory Failure – CPAP failure - need for Intubation.

Clinical Setting and History

S: A 7 month old baby Oliver is admitted to the willow ward with history of 5 days of cough, cold, poor feeding, increased work of breathing since 3 days.

B: Oliver is diagnosed with RSV and metapneumovirus positive bronchiolitis and is on CPAP since 1 day of admission with PEEP of 5 and FIo2 30%. CXR shows bilateral extensive haziness. Bloods are unremarkable. Baby is on Coamoxiclav IV, with NBM, and on 2/3rd maintenance IV fluids with 5% dextrose and 0.9% NACL.

A: The nurse looking after the baby is struggling to take observations as baby is extremely unsettled. After a while she records following observations-

HR is 180/m, RR is 77/m, Sats 88% on Fio2 30%, BP 96/60. She increased the Fio2 to 40%. She swaddles the baby and comforts her with a dummy. She calls the nurse in charge.

R: Urgent Nurse in charge and Paediatric review has been requested.

Additional Instructor information:

Participant senior nurse- Baby has significant work of breathing, sats still 89% inspite Fio2 40%. Baby appears exhausted and lethargic. Obs as above. Gives suction- plenty of secretions, decompresses stomach.

Practitioner assesses the patient-

- A- Baby is lethargic, Responding to pain only, moans to pain, withdraws to pain
- B- Bilateral wheeze, severe respiratory distress, RR 77/min, sats88%, baby appears exhausted.
- C- Circulation- CRT < 2secs, HR 180/m, BP 77/53.
- D- Dextrose 7.1, pupils equal, normal posture. AVPU = P
- E- No rash, no bruises. Temp 36.9c

Additional points to be demonstrated as appropriate:

- Summon experienced senior assistance
- Frequent reassessments of ABCDE
- Referral for definitive management ie intubation
- Appropriate care / designated team member for family members and explanation to family.
- If becomes apneic- start bag and mask, consider intubation.

Discussion Points and Expected interventions:

- Differentiation between compensated and decompensated clinical status
- Assessment of severity of respiratory distress
- Importance of minimal handling
- Nurse in charge to give suction, decompress the stomach.
- Doctor to check the equipment, anticipation of need of intubation, informs parents.
- Consultant to be informed, anaesthetic review urgent, inform STRS

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(E) ACUTE CPAP TROUBLESHOOTING

WHICH INTERFACE TO USE?

- This will be dependent on the size of the child's face. Nasal CPAP prongs should fit snugly without causing blanching of the nostrils. Nasal/oronasal masks should sit on the bridge of the nose without sitting over eyes. Consider full face masks if available.
- Most interfaces will have a sizing guide that can be used at bedside to avoid opening masks unnecessarily and reducing waste

SHOULD THERE BE A LEAK?

- Yes. The majority of acute CPAP will be delivered via a single limb, leak circuits where there should always be a leak. The CPAP pressure is programmed and the machine alters the flow depending on the leak.
- The acceptable leak value will be machine/patient dependant – look to previous values for guidance. If the leak is too high then the target CPAP pressure may not be reached. If a VT (tidal volume reading) is available then looking at changes to this will also help determine whether the level of leak is acceptable or needs improving.

HOW CAN I IMPROVE THE LEAK?

- Gentle manipulation of the interface/head gear to ensure everything is midline. Gently feel around the edges of the interface to detect any obvious air leaks. Pressure should never be allowed to blow into the patient's eyes due to risk of corneal abrasions.
- If using a mask, ensure this isn't too tight, it should 'float' on face as pulling it tighter may actually worsen the leak & increase risk of pressure damage to face.
- Consider an orogastric rather than nasogastric tube, particularly for smaller infants.

WHAT IF PATIENT TOLERANCE IS AN ISSUE?

- Try comfort measures prior to pharmaceutical sedation. For younger children, swaddling or containment holding/cuddles, dummies/dummy dips if appropriate (& no prior issues with unsafe swallow), familiar toys & caregiver support. Ensure analgesia is given regularly where appropriate & that enteral feeding is adequate to help the child settle without contributing to an increase in their work of breathing.
- Chloral hydrate can be given with caution & careful monitoring, preferably during the start of CPAP therapy to allow stabilisation.

CAN I GIVE INLINE NEBULISERS?

- Yes. This is a safe & efficient way of delivering nebulisers. Aerogen nebuliser chambers can be added into the CPAP circuit using a t-piece adaptor on the dry side of the humidifier chamber. Check that the chamber is misting on starting the neb, and that it fully completes (dependent on neb volume, but ≈ 5 minutes).

HOW OFTEN SHOULD I DO MASK CARES?

- 4-6 hourly. Release interface pressure briefly or change the interface. Consider using duoderm on all areas of the face where the mask will sit, or be close to. Assume there will be some mask movement & be generous with width of barrier dressing.
- When doing mask cares, assess skin integrity & document interface changes.

WHAT ABOUT FEEDS?

- Once a child is settled on CPAP and not showing signs of needing imminent further escalation, continuous NG feeds can be started at a conservative volume. These can be further increased at clinician's discretion once more stable or to help with tolerance.
- Feeds should be via NG or gastrostomy (if present), not orally even if the chosen CPAP interface is a nasal mask, leaving the mouth free. Oral feeding whilst on CPAP would be a significant risk for aspiration.

WHAT IS 'RAIN OUT'?

- Within a heated, humidified circuit, condensation will build up due to the difference in room air temperature. It is imperative that this 'rain out' is allowed to drain back into the humidifier chamber so as not to flush into the patient interface

ANY TOP TIPS?

- Cluster cares & interventions. Sicker infants may respond to suction, cares etc with apnoeas, bradycardias and/or desaturations. Be prepared for this, both with equipment & alerting nearby staff to planned interventions.
- Keep families informed & ensure they are supported. Where possible, provide opportunities to still have cuddles in line with clustering cares. Encourage caregivers to participate in their child's cares as they feel able.

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(F) TEAM CREDITS

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