CPAP (continuous positive airway pressure) NIV (non-invasive ventilation) Provision during COVID-19 Pandemic

Purpose of the Guideline

The purpose of this guideline is to provide clinical staff with information regarding the use of non-invasive ventilation in the medical management of patients with suspected or confirmed COVID-19 with identified clinical symptoms.

This guideline has been developed using the current national guidance provided from BTS (March 2020).

Please refer to the clinical guideline CG-10386-1: Initial management of patients with suspected or confirmed COVID-19 for full investigations and clinical treatment.

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NB: NIV refers to non-invasive ventilation, which could mean either CPAP or BiPAP. The number of patients requiring NIV will often need CPAP due to the likelihood of type I respiratory failure, however, BiPAP should be considered for those patients with type II respiratory failure.

1. Background

Current data for hospitalised cases show that coronavirus (COVID-19) infection causes acute pneumonitis in approximately 10-20% of patients and can lead to ARDS-like syndrome with severe hypoxaemia. A large proportion of patients with type 1 respiratory failure (RF) require invasive mechanical ventilation.
2. Rationale

The number of COVID-19 patients is expected to increase dramatically in the coming weeks and may exceed the capacity of ITU beds, available invasive ventilators and staff trained in looking after invasively ventilated patients. Using CPAP early on in the course of COVID pneumonitis could potentially reduce the number of patients requiring mechanical ventilation. Based on experience from other centres patients with COVID pneumonitis have compliant lungs; they do not require high inspiratory pressure and respond well to PEEP and prone ventilation which indicates that small airway closure and atelectasis are the primary problem. CPAP can improve oxygenation and reduce the work of breathing by recruiting atelectatic lung regions. However, there are no data to confirm the role of CPAP in COVID pneumonitis and there are also concerns that prolonged CPAP use could increase the risk of complications around intubation and worsen outcomes of subsequently mechanically ventilated patients.

Therefore, CPAP should be used for carefully selected patients and in clinical areas where respiratory status of these patients and their response to CPAP can be closely monitored.

NICE guidance (2020) recommends the use of CPAP within the confines of the critical care unit in the first instance. However, it is less preferable, though potentially unavoidable as cases increase, to cohort patients outside HDU/ICU. But if so, immediate intubation and transfer to ICU must be possible (if compatible with treatment escalation plan).

It is essential to assess the response to CPAP delivered in the appropriate environment within 30-60 minutes of initiating, with regular comprehensive reviews as clinically indicated (minimum of twice daily from medical team). The nurse will need to remain with the patient until first ABG is recorded and reviewed by medical team.

Advice can be sought from the respiratory physician on duty (in hours) is recommended.

Where there is no adequate response, where clinical decline continues, or where the patients tolerance is limited early intubation and mechanical ventilation should be considered with the support of the ICU team. If this is deemed by the team not to be appropriate a review of the patient’s ongoing care must be undertaken and the EPARS decision recorded and communicated accordingly.

Appropriate skill mix will be essential to ensure a prompt review by an ICU specialist and, if appropriate, rapid intubation of deteriorating patients.

There will be a group of patients where CPAP will be a ceiling of care. This should be clearly documented within the EPARS and communicated to the team caring for the patients.

3. Patients suitable for this pathway

1. Suspected or confirmed COVID-19 pneumonitis
2. Moderate to high oxygen requirements (patients with low oxygen requirements should be monitored and considered for CPAP in case of deterioration) and following first line treatments, with clinical review for effectiveness
3. No haemodynamic compromise (systolic BP>90mmHg)
4. No contraindication to using CPAP (e.g. pneumothorax, low consciousness level, unable to tolerate face mask, vomiting)
5. Patients with minimal co-morbidities and no more than one organ failure

If invasive mechanical ventilation (IMV) has been identified as appropriate for a patient, then this method is advised to be used in preference to NIV.

NB: Refer to clinical guideline CG-10386-1and ICU pathway.
4. Patient location
   - Initially to be placed in ICU (as per NICE guidance) dependent upon levels of activity and acuity in relation to COVID 19
   - Patients on NIV should be managed according to the appropriate infection prevention and control (IPC) recommendations from Public Health England (PHE). See with reference to Aerosol generating procedures (AGP).
   - Patients on NIV should be managed in side-rooms (negative or neutral pressure) whenever possible
   - Air exchanges in side-rooms should be checked and adhere to standard IPC guidelines (open windows)
   - When such a time arises (i.e. When the number of patients requiring NIV exceeds the capacity in the ICU) patients on NIV may be managed in a cohort bay where all cohorted patients have confirmed coronavirus infection (i.e. larger volume of patients).
   - In the above situation patients with suspected coronavirus infection should be placed in a separate bay or side rooms until proven positive
   - Factors to take into account include: access to toilet facilities/ thoroughfare for other patients/relatives/staff/ air flow and air exchanges/ mixed sex breaching to be accepted in circumstances of stretched capacity
   - The designated location for the cohort NIV area will be Ward F7 in the first instance. Initially within the four side rooms, then bays 4 and 5 when this resource has been used.
   - It should be acknowledged that further capacity may be required if activity and acuity increases, however, we will be limited by the availability of appropriately trained staff and NIV devices (up to 14 units capacity)
   - Non COVID patients will continue to have NIV for COPD exacerbations in F8 as per trust protocols for now (this may change if F8 converts to a COVID ward)
   - The emergency department can initiate NIV if absolutely necessary following first line treatments. However, it must be stressed, that this should only be commenced if it is required for life saving reasons. Emphasis should be on expedient transfer of the patient to the allocated location. This will ensure that patients are not delayed in ED. If NIV has to be commenced in the ED, it is important to open the rear exit door of the RAT area to ensure adequate ventilation and reduction of viral load.

**NB:** It is recognised that the provision of NIV to acutely unwell patients requires the support of appropriately skilled and competent staff. In order to maximise our provision of this resource, ward F7 has been identified due to its location of joining the current respiratory ward and follows on from the process already in place for the provision of NIV to a single COVID affected area that has already been utilised since the initial necessity.

5. High flow nasal oxygen (HFNO)
   - NIV is preferred over high flow nasal oxygen (HFNO)
   - HFNO consumes higher volumes of oxygen and generates a larger volume of aerosols therefore may pose a higher risk for the transmission of infection compared to NIV (especially if NIV is used with full-face or helmet masks, or with double-limbed circuits ± filters over expiratory vents/ports)
   - It has been agreed that HFNO (AIRVO or OPTIFLOW) will not be used within the organisation during the COVID 19 pandemic.

6. Use of nebulisers in suspected/ confirmed COVID-19 infection
   - Advice published from Public Health England / British Thoracic Society which states that nebulisation does not create an aerosol of patient-derived viral particles and therefore does not represent an aerosol generating procedure. As such standard PPE with a surgical facemask is appropriate for patients receiving nebulisers.
   - We recommend that both in primary care and in the hospital setting, nebulised treatment should be used whenever it is clinically indicated (most commonly for treatment of Bronchospasm in those with pre-existing lung disease e.g. asthma / COPD.)
7. Masks
- Well-fitting oronasal/full face or total face masks.
- Use only a non-vented mask with a filter over the exhalation port in the circuit.
- Ensure that the ventilator mode employed supports the use of non-vented masks and exhalation ports.
- Sequence of actions: NIV mask on → ventilator on; ventilator off → NIV mask off.

8. Filters
- A viral/bacterial filter (Intersurgical clear- therm 3 HMEF reference 1541000) should be placed in the circuit between the mask and the exhalation port (see appendices 2).
- The filter at the end of the circuit (machine end) can remain in situ.
- Viral/bacterial filters should ideally be changed every 24 hours or sooner. (There is a risk that they will become wet from exhaled gas and this may increase resistance to flow.)
- Change of the viral/bacterial filters will activate an alert on e-Care. This can be set up by using Powerchart, selecting request and care plans and adding in NIPPY filter change. The user should sign the request, this will then result in the order being set up to appear as a reminder in care compass every 24 hours after initial request.
- Blocked filters can be mistaken for clinical deterioration; this issue is remedied by changing filters.
- An external humidifier must not be used.

9. Oxygen
- Oxygen can be entrained into the circuit and this should be done at the patient end (see appendices 2) or via a T piece placed between the CPAP device and the tubing.

10. Nebulizer usage with NIV
- It may be necessary to entrain nebulized medications within the NIV circuit whilst the patient receives on-going pressure support. If this is necessary please follow the guidance in appendices 3 for the correct set-up.
- Ensure that the nebulizer canister directly connects to the non-vented mask via the T-piece within the kit.
- Do not place the viral filter between the mask and nebulizer canister as this will prevent administration of the drug and will block the filter.
- Ensure that a nebulizer compressor is used or oxygen, dependent upon the patient’s oxygen demands.
- Further oxygen can be entrained if necessary to maintain the target SpO2 range.
- Ensure that the nebulizer canister is in the correct horizontal plain so that it can function effectively.

11. CPAP/NIV devices
- Use portable devices (i.e. NIPPY S, NIPPY 3, NIPPY 4) can be used to deliver CPAP. Ensure that the CPAP device is set in a fixed pressure mode.
- Note that the above devices do not have an air-oxygen blender. FiO2 delivered to the patient will depend on the CPAP level, entrained oxygen flow, respiratory rate, mask leaks and will also vary slightly between the devices. As a general rule, FiO2 will decrease the higher the CPAP level.
- High/low flow alarms can be set on NIPPY ventilators when in CPAP mode. Careful monitoring for circuit disconnection and an exhalation filter blockage is required.
- See appendices 4 and 5 for the correct set up and usage of the NIV machines for the provision of CPAP.
12. Patients already managed under home ventilation services who are admitted to hospital with suspected or confirmed coronavirus infection

- Patients should be encouraged to bring their CPAP machine to hospital
- Do not apply home CPAP unless discussed with respiratory/medical teams
- If CPAP is used for obesity hypoventilation syndrome (OSA, obesity plus respiratory failure), then this is an indication to use CPAP, change to new mask and circuit
- Check if their usual mask is a vented or non-vented mask. – Vented masks should be changed for a non-vented mask and an exhalation port put into the circuit.
- A viral/bacterial filter should be placed in between the mask and the exhalation port in exactly the same way as for acute NIV.
- For any patient who has a humidifier in the community, the humidifier should be removed from the circuit.
- Patients remaining at home should continue with their usual method of ventilation.
- Contact home ventilation service for further advice as needed
- For those patients that use their own CPAP for sleep apnoea: if they are admitted for another reason (i.e. Fever, GI problems), assess if the CPAP is absolutely necessary whilst in hospital (sometimes these patients don’t use this device reliably at home, and may be able to manage without). If it is deemed necessary for these patients, ideally using their own machines is preferable with the addition of the non-vented mask and filter (as above). However, if there any concerns over the effectiveness or cleanliness of their own machine, utilise a machine within the organisation instead.

13. Staffing and training

- Staff looking after patients using NIV must ensure that they wear the identified PPE at all times (PPE FFP3)
- The ratio of nurses to NIV patients should be as follows (where possible):
  - RN with appropriate NIV skills/ training to three patients on NIV and
  - Another member of staff to assist with treatments/ care (NA/ student/ OSCE nurse)
  OR
  - RN working within acute area and
  - Another member of staff with appropriate NIV skills/ training (i.e. Physio)
- Training will be offered where possible for the staff working in this area, along with competencies assessment
- The critical care outreach team will provide support (where possible) as is usual process

14. Commencing and reviewing COVID-19 patients on NIV

- After NIV is applied, the patient should be reviewed at 30 to sixty minutes to detect failed response or further decline. If the patient responds, close observation and monitoring must continue for a further six hours to ensure that no decline occurs. Careful monitoring thereafter must continue. However, if the patient does not respond or is not tolerating the device, early ICU opinion should be sought for ongoing treatment with intubation and ventilation. If this is deemed by the team not to be appropriate a review of the patients ongoing care must be undertaken and the EPARS decision recorded and communicated accordingly
- These patients will be reviewed in their respective wards by the teams on the wards by the following methods:
  - One hour after NIV commencement or after first ABG (whichever is first)
  - Every ward round (patient must be seen by the consultant on duty)
  - At least twice per day by the doctors or more frequently if the patient’s condition dictates
  - Patients on the cohort ward on CPAP must be handed over to the on call medical team out of hours inclusive of being on the ‘sick list’
- The respiratory consultants will be available to provide advice when needed to help with specialist input. If they are not available, refer to the ICU consultant on call
• Once a decision is made to initiate NIV please get in touch with a member of the critical care outreach team for assistance
• The medical teams must ensure that they discuss these patients with the ICU consultant daily to ensure good communication and appropriate treatment plans
• Any patient for intubation will need close support and liaison with the intensive care team. Please see the CPAP/NIV diagram for reference to the Papworth clinical decisions unit available on 01223 638638 for patient appropriate to refer to Papworth.

15. Ceilings of care decisions and EPARS
NICE strongly advocate the early discussions seeking to establish ceilings on presentation of the patient so as to avoid inappropriate ventilator support [https://www.nice.org.uk/guidance/ng159](https://www.nice.org.uk/guidance/ng159)

• An escalation plan (EPARS) must be completed and documented before initiating NIV.
• Refer to EPARS process flowchart for COVID-19 patients
• Ceilings of care need review every 24 hours, with emphasis on progress if relevant.

References:
BTS (March 2020).

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Appendices 1: Flow chart for NIV treatment choices

NB: At present patients requiring CPAP should be transferred to ICU for this provision as per NICE guidance (3rd April 2010). This decision will be reviewed regularly and the process below will be followed when CPAP patients are cohorts in an area outside of ICU/HDU.

Establish EPARS - Decision about CPR status and whether for escalation to ICU within first 4 hours of admission
(Note frailty score and Discussion with senior clinicians ED/medical/ICU)

Suspected/confirmed COVID with respiratory failure (oxygen aiming 95% or 88-91% in those at risk of hypoxia - avoid high flow nasal oxygen, avoid humidification)
Please notify the Critical Care Outreach to support the decision making process and initiation of treatment if indicated.

eg. ≤92% on 4L/min (note rapid onset hypoxia), respiratory rate >30, respiratory distress

For escalation to ICU?

No

Palliation
Consider oxygen, just in case medications and palliative care involvement

Yes

Ward Based care
Oxygen (not HFNO, no humidification), can consider CPAP or NIV in type II RF

For discussion with WSH ICU and Consider calling Papworth Hospital Clinical Decision Cell Consultant on 01223 638 638

Can consider CPAP in patients with severe hypoxia (eg.<SpO2 <92% on 60% or more)
CPAP to be delivered in side rooms with non vented mask, filters (see picture below)
Start on CPAP 10cmH2O + 60% O2
Titrates up as required (consider NIV in type II respiratory failure)
Appendices 2: NIV Set-up with Non-vented Mask and Viral Filter

NIV Set-up with Non-vented Mask and Viral Filter for all patients During COVID-19

To be used with all patients requiring NIV (BiPAP & CPAP)
Mask should be put on before starting NIV machine
Contact Outreach for advice and support

- Non-vented Mask
  - Anti-asphyxiation valve (shuts off on expiration)

- Bacterial / Viral HME Filter
  - (Ref 1541000)
  - Change every 24 hours or sooner if wet / visibly contaminated

- Oxygen Entrainer
  - Add in necessary O₂ to maintain the target SpO₂ range if required

- NIV Tubing (use either)
  - Integrated Exhalation Port
  - Ensure that this is not occluded

- NIV Tubing (use either)
  - HME Filter to be changed if contaminated
Appendices 3: NIV with Entrained Nebulizer

NIV Set-up with entrained Nebulizer via Non-vented Mask and Viral Filter for all patients During COVID-19

Non-vented Mask
Anti-asphyxiation valve
(shuts off on expiration)

NIV Tubing (use either)
Integrated Exhalation Port
Ensure that this is not occluded

Nebulizer Chamber and T Piece
Ensure that the chamber is connected to a nebulizer compressor or oxygen if necessary for SpO2 maintenance

Bacterial / Viral HME Filter (Ref 1541000)
Change every 24 hours or sooner if wet / visibly contaminated

To be used with all patients requiring NIV (BiPAP & CPAP) with nebulized drug entrainment

The nebulizer canister **must** be directly attached to the non-vented mask followed by the filter – if this is inverted the drug will be absorbed by the filter

Ensure that O2 is utilised for nebulizer entrainment if required for SpO2 maintenance / consider further supplemental O2 if required

Ensure that the canister is in a horizontal position to facilitate effective nebulization

Contact Outreach for advice and support
Appendices 4: (NIPPY ST4)

**Getting Started**
1. - Press the Start/Stop button on the top panel

2. - Select Mode menu

3. - Select Mode (use + and – button to move on menu, followed by SET when chosen mode highlighted):
   - Pressure Support = BiPAP
   - CPAP

4. - Press confirm

5. - To Adjust pressures:
   - Use highlighted button to select pressure
   - Adjust with + and – button to change values

6. - When settings confirmed, put patient’s mask on

7. - Press the Start/Stop and release when the bar is filled

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**Stopping NIV**

1. - Press the Start/Stop and release when the bar is filled

2. - Press Yes

3. - Take Patient’s mask off
Appendices 5: (NIPPY ST)

**Getting Started**

Turn on and adjust setting away from patient

1 - Press the on/off button

2 - Select Mode:
   - Press “Mode”
   - Use + and – to highlight CPAP or Pressure Support (BiPAP)
   - Press “Set”

**Stopping NIV**

1 - Press On/Off button and confirm it by pressing and holding the On/Off button again until machine turns off

3 - Adjust pressures:
   - Press “IPAP” or “EPAP” button
   - Adjust values by pressing + and – button
   - Press “Set”

4 - Turn machine off (setting will be saved)

5 - Taken machine to patient and put mask on

6 - Turn machine on

2 - Remove patient’s mask