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Specialty guides for patient management during the coronavirus pandemic

Guidance for the role and use of non-invasive respiratory support in adult patients with COVID-19 (confirmed or suspected)

6 April 2020, Version 3

1. Summary

This guidance should be used to advise clinicians on the appropriate use of continuous positive airway pressure (CPAP), non-invasive ventilation (NIV, here referring to bilevel positive airway pressure, BIPAP) and high flow nasal oxygen (HFNO, such as OptiflowTM) in patients with confirmed or suspected COVID-19. Published evidence, clinical guidelines and personal communications with colleagues in China and Italy have informed this document.

The guideline is not designed to be prescriptive but to provide a useful aid to use alongside clinical judgement. It can be adjusted to suit individual clinical environments. Decisions relating to the escalation of ventilatory support (whether as a trial of treatment, as a ceiling of care, or as a possible bridge to ongoing invasive ventilation) need to be made early and by experienced clinical decision makers.

Key recommendations as of 3 April 2020

- We recognise that all guidance issued around best practice in the management of patients with COVID-19 is based on low levels of evidence (case series, small observational studies or expert opinion). We therefore strongly support the development and delivery of high quality, multi-centre, pragmatic and rapidly reported clinical trials, which will help build a stronger evidence base for treating future patients. Clinicians are encouraged to support recruitment to trials if they are available in their organisation.

- Please consider drug interactions when instituting low-dose sedation to aid tolerance of CPAP/NIV. For example, lopinavir-ritonavir is being evaluated in clinical trials in COVID-19 patients and can substantially increase the bioavailability (and therefore potency) of benzodiazepines, particularly midazolam.

- We strongly advocate early discussions seeking to ascertain ceilings of treatment at presentation in all patients, to avoid inappropriate escalation of ventilatory support. https://www.nice.org.uk/guidance/ng159

- The use of HFNO is not advocated in COVID-19 patients based on lack of efficacy, oxygen use and infection spread.

- NIV with BiPAP is usually not needed in those with otherwise normal lungs; compliance is usually maintained in COVID-19 patients. However, excessive work of breathing is a possible indicator for intubation. The use of NIV (BiPAP) should be reserved for those with hypercapnic acute on chronic ventilatory failure.

- CPAP is the preferred form of non-invasive ventilatory support in the management of the hypoxaemic COVID-19 patient. Its use does not replace invasive mechanical ventilation (IMV), but early application may provide a bridge to IMV.

- Assess the response to CPAP in a monitored environment within 30 to 60 minutes, with regular review as clinically indicated thereafter. Where there is no adequate response, where clinical decline continues, or where patient tolerance limits use, early intubation and mechanical ventilation should be sought where appropriate.

- Hoods and masks can be distressing for patients, and the use of low doses of agents to improve comfort and tolerance can be considered. Opioids, in appropriate and judicious doses, may help reduce the sensation of breathlessness and also limit very high tidal volumes and respiratory rates – which are thought likely to be driving ongoing patient-induced lung injury (PILI).

- Cohorting of these patients can be considered, but it is essential that strict care is taken with other hygiene precautions. The risk of infection to staff when using such modalities are not thought to be high with appropriate use of personal protective equipment (PPE) according to the latest Public Health England PPE guidance.

- Unless there are reasons to suspect CO_2 retention, arterial lines/blood gases are not needed, and patients can be monitored using continuous peripheral arterial oxygen saturation (SpO_2) with an appropriate level of nursing support: Adult critical care novel coronavirus (COVID-19 staffing framework.

2. Clinical advice as of 3 April 2020

We recognise that the clinical advice will flex and change as new evidence emerges. Please note that this guidance will be reviewed and updated weekly.

Indications for NIV (CPAP for hypoxaemic respiratory failure; BiPAP for hypercapnic acute on chronic respiratory failure):

- as a ceiling of treatment
- trial to avoid intubation
- to facilitate extubation.

2.1. Early discussions around ceilings of care – supporting patients and their families

Not all patients will benefit from critical care admission. It is strongly advocated that treatment escalation plans and limits of care are decided early. Cross-disciplinary engagement (which must involve critical care clinicians) are necessary where the benefits of such escalation are unclear or likely to be contested. Acute care, elderly care and palliative care teams may all be engaged, especially for patients who fall into a group where mortality rates are currently high.

The NICE rapid guideline for critical care advises the use of the clinical frailty score to guide clinical decision-making and discussions around ceilings of treatment with patients and families. Ensure a treatment escalation plan is in place, and where possible enlist the help of palliative care teams.

2.2. Location and settings of care

2.2.1. It is recommended that CPAP is delivered in a negative pressure room with air exchanges greater than the regulatory threshold (10 cycles per hour) with/without a lobby. However, it is recognised that availability may be limited.

2.2.2. If a negative pressure room is not available, a neutral pressure room with air cycling is preferable, or (if not) a simple side-room. Thereafter, cohorting in a closed bay should take place in preference to a closed ward.

2.2.3. 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. The use of a mobile emergency rapid intubation team (MERIT) is suggested.

2.2.4. Wherever non-invasive ventilatory support is used, a clear plan must be in place to determine the threshold for failure and escalation to intubation and invasive mechanical ventilation if appropriate.

2.3. Tolerability and use of adjuvant pharmacology

2.3.1. Clinicians must be aware that the resolution of pneumonitis is over a week and the use of CPAP for this length of time will be challenging for the patient.

2.3.2. Helmet CPAP and mask CPAP can be distressing for patients, and the use of low doses of agents to improve comfort and tolerance can be considered, albeit this will need to be in a monitored critical care environment.

2.3.3. Opioids, in appropriate and judicious doses, may help reduce the sensation of breathlessness and limit very high tidal volumes.

2.3.4. Benzodiazepines can be used to moderate anxiety but may interact with other drugs, including some which are being evaluated as treatments for COVID-19 in clinical trials (eg lopinavir-ritonavir) – therefore check for interactions before instituting treatment.

2.3.5. Sedative and opioid agents should only be administered under the supervision of suitably trained and experienced physicians.

2.3.6. CPAP should not be used in those with agitation and confusion but may be considered as the ceiling of treatment in some patients.

3. Use and device settings

3.1. CPAP is the primary mode of non-invasive respiratory support for hypoxaemic COVID-19 patients. Suggested initial settings are 10 cmH_2O + 60% oxygen.

3.2. The key to successful use of CPAP/NIV is patient tolerance. Different delivery devices can be used to suit individual patient needs. Small doses of benzodiazepine or opioid can be considered to facilitate this.

3.3. High-flow face masks with non-rebreathe reservoir bags should be considered as a modality to give short breaks to patients from CPAP.

3.4. If NIV is being considered for hypercapnic acute on chronic respiratory failure this should be initiated and reviewed by suitably experienced emergency department, respiratory, anaesthetic or critical care physicians. Suggested initial settings are PS 8-10 cmH_20 + PEEP 5-10 cmH_2O + 60% oxygen, targeting SpO_2 of 88 – 92%. See Appendix: Technical aspects.

4. Monitoring and SpO_2 targets

4.1. Once CPAP/NIV has been begun, clinical progress should initially be reviewed hourly (or more frequently, where clinically indicated) to determine whether there is improvement or deterioration. Frequency of assessment can be reduced if the patient remains stable.

4.2. Monitoring should focus on the regular measurement of respiratory rate, work of breathing, oxygen saturation and heart rate.

4.3. The use of arterial blood gas monitoring will be assessed on an individual basis and should be provided if $PaCO_2$ is elevated at presentation. Otherwise, the use of simple peripheral arterial oxygen saturation (SpO_2) monitoring is advocated.

4.4. Generally, aim for SpO_2 92-96% or 88-92% for patients with chronic or acute on chronic type II respiratory failure

4.5. An SpO_2 target of 90-93% is acceptable in patients with visible continuous pulse oximetry in an appropriately monitored care environment with trained staff to monitor for clinical deterioration.

5. Targets and exemplar plan

5.1. Where compatible with the treatment escalation plan, there should be a low threshold for intubation where there is clinical decline (which may include a rising oxygen requirement, consistently or rapidly declining SpO_2, consistently or rapidly increasing respiratory rate and increased work of breathing). This should trigger immediate assessment for intubation and mechanical ventilation if deemed appropriate.

5.2. Consider increasing CPAP support: ie CPAP 12-15 cmH_2O + 60-100% oxygen if needed.

5.3. If condition remains stable or is improving, continue CPAP/NIV with regular clinical assessment.

5.4. A trial of weaning CPAP/NIV to conventional oxygen therapy can be considered when oxygen concentration < 40%.

Table: Adult escalation plan following initial assessment and treatment for patients in hospital

Category	Clinical Status	Suggested action
Green	RR ≥ 20bpm with SpO_2≤94%	Administer O_2 <40% by face mask. If SpO_2 rises to >94%, observe and monitor
Yellow	RR ≥ 20bpm with SpO_2≤94% on FiO_2 ≥40%	Start 15L/min O_2 via non-rebreathe mask *Senior clinical review to consider:* If orientated and able to tolerate well-fitted non-vented face mask, trial CPAP 10cmH_2O with FiO_2 0.6 If further escalation appropriate, consider increasing CPAP 12-15 cmH_2O + 60-100% oxygen if needed If not, IMV if in accordance with TEP
Red	RR ≥ 20bpm with SpO_2≤94% on 15L/min O_2 via non-rebreathe mask and/or patient unable to tolerate CPAP mask, obtunded/ disorientated, rising FiO_2 needs, significant clinical decline	Urgent critical care review and prepare for intubation if in accordance with TEP

Abbreviations: RR = respiratory rate; SpO_2 = oxygen saturation; CPAP = continuous positive airways pressure; FiO_2 = fraction of inspired oxygen, IMV = invasive mechanical ventilation, TEP = treatment escalation plan.

NB:

- **Escalation may be guided by clinical acumen, work of breathing/high tidal volumes and respiratory rates (which may drive PILI). Note that respiratory rate may be low, but tidal volumes harmfully high.**

- After CPAP is applied, the patient should be reviewed over 30 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 no decline occurs, with careful monitoring continuing thereafter.

6. Personal protective equipment

The risks of infection to staff when using such modalities are not thought to be high if patients are managed with staff wearing appropriate respiratory PPE in accordance with Public Health England PPE guidance. Cohorting these patients can be considered, but it is essential that very strict care is taken with other hygiene precautions and consideration given to likely O_2 flow requirements. Respiratory PPE is single-layer PPE with gown, gloves, goggles/visor and fit-checked or fit-tested FFP3 mask.

Choice of CPAP interface with respect to PPE

There is a risk of exhaled droplet dispersion from all three non-invasive respiratory support modalities, but it is likely to be very low. The risk decreases with distance from the patient-device interface. Respiratory PPE should be worn in accordance with PHE guidance. It is suggested that clinicians use a system they are familiar with and which results in optimal patient tolerance. For CPAP, the three recommended interfaces are:

- **1st choice** – a full-face non-vented mask with expiratory viral filter; a good mask seal is important for face masks, to minimise droplet dispersion and maximise effectiveness
- **2nd choice** – a helmet with air cushion for CPAP
- **3rd choice** – a helmet without air cushion for CPAP
- **4th choice** – a standard face mask.

If using a mask system, it is advised to humidify the gas flow. Helmet systems do not require humidification. An HME/viral (heat and moisture exchange) filter should be fitted to all exhaust systems to reduce droplet spread. Taping these in position will limit the chance of unplanned disconnection. This can be done, even with single limb circuits, by introducing the HME proximal to the expiratory valve. The HME should not become waterlogged, as flow will be at a high rate and unidirectional, but care should be taken to watch for this and change the HME if waterlogging is detected.

7. Review schedule of this guidance

Given the dynamic nature of new clinical experience being shared, this document will be reviewed by an expert group weekly and updated accordingly where indicated.

8. Resources

8.1. Clinical frailty score (CFS)

This online learning module providing learners with a comprehensive understanding of frailty and how to accurately determine a person's CFS score based on their specific circumstances:

https://rise.articulate.com/share/deb4rT02lvONbq4AfcMNRUudcd6QMts3#/

Appendix: Technical aspects

Masks

- Well-fitting oronasal face masks, masks over the whole face, or helmets should produce the least droplet dissemination.
- Vented masks could worsen contamination of the environment.
- Any patient on acute NIV should be managed with a non-vented mask and an 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.

Filters

- A viral/bacterial filter should be placed in the circuit between the mask and the oxygen and exhalation ports to ensure that if the oxygen tubing becomes dislodged accidentally, the filter will stop exhaled breaths escaping via the ports. (Figure 1 below).
- This viral/bacterial filter can replace any filter at the machine end of the circuit.
- 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.)
- An external humidifier must not be used.
- Blocked filters can be mistaken for clinical deterioration; this issue is remedied by changing filters.

Oxygen

- Oxygen can be entrained into the circuit, and this should be done at the patient end (Figure 1 below).

For patients already managed under home ventilation services who are admitted to hospital with suspected or confirmed coronavirus infection

- 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 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.

Figure 1: Example of acute NIV set-up with non-vented mask and viral filter