

# Covid-19 – Ventilation strategy

This document details a standardised approach to mechanical ventilation in patients with suspected or proven Covid-19 pneumonitis with severe respiratory failure within Intensive Care at Worcestershire Acute Hospitals NHS Trust.

It maybe modified during the course of the pandemic in the light of new evidence.

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## 1 **Clinical presentation of Covid-19**

- Initial fever and cough in majority
- Nausea / vomiting and diarrhoea rare.
- Hypoxia with CXR changes of bilateral interstitial pneumonia. Asymmetry raises concerns about bacterial super infection.
- In severe cases, a progressive type 1 respiratory failure (20% of all cases)
- 25-30% of cases in group d may need referral to ICU (see WHAT Referral flow chart ver8 and COVID-19 decision support tool and form NICE/NIHR March 2020)

## 2 **Identification of patients requiring referral to ICU**

See WHAT referral flow chart version 9 – 7/4/20

## 3 **Admission to ICU**

- The final decision to admit to ICU will be made by a Consultant in Intensive Care Medicine
- Presumed or confirmed Covid-19 patients requiring intubation will be transferred to one of the stabilisation side rooms if possible. All staff involved in the stabilisation process will wear full PPE. **Intubation procedure ideally in ICU side rooms 15/16(WRH) 1/8 (Alex) – see [WorcesterICU.com](http://WorcesterICU.com) website guidelines**
- If a patient is not stable enough to transfer prior to intubation then this must occur at the patient's current location. Intubation guideline must be followed and all staff involved must wear full PPE.
- Once intubated and ventilated with a closed circuit and viral filter, Covid-19 patients can be moved from the stabilisation side room and will be cohorted as far as is possible within critical care areas. It is likely the boundaries of these areas will change over time.
- Patients **will not be admitted** to ICU for non-invasive respiratory support (see WHAT COVID and NIV guideline 03/04/20)

#### 4 **Site specific capacity to provide mechanical ventilation:**

- Worcester
  - Intensive Care Unit has **15** bed spaces equipped with:
    - 9 Evita Infinity V500 ventilators
    - 4 Savina 300 Drager ventilators
    - 1 Phillips Trillogy NIV ventilators
    - 1 Oxylog portable ventilator
    - 1 Babypac portable paediatric ventilator
  - Emergency Department equipped with:
    - 4 Oxylog portable ventilators
    - 1 Flow-I anaesthetic machine
- Redditch
  - Intensive Care Unit has **8** bed spaces equipped with:
    - 5 Evita Infinity V500 ventilators
    - 3 Drager Evita XL ventilators
    - 1 Phillips Trillogy NIV ventilators
  - Emergency Department equipped with:
    - 2 Oxylog portable ventilator
    - 1 Flow-I Anaesthetic machine
- Anaesthetic Machines countywide:
  - **53.** Precise numbers available for ventilation of Covid-19 patients will depend on unknown requirements for ongoing provision of emergency anaesthesia.
- In storage (ready to deploy)
  - 4 x Carina ventilators
  - 1 x Oxylog ventilator

## 5 Initial ventilation strategy (on ICU or anaesthetic machines only)

### AIM FOR PaO<sub>2</sub> $\geq$ 8KPa at lowest possible FiO<sub>2</sub>

- In the majority of patients, principles of ventilation will include:
  - Ventilation with tidal volume of 6-8mls/kg ideal body weight (IBW) and Resp Rate  $>20$ /min, I:E of 1:2
  - PEEP strategy –initially of 8cmH<sub>2</sub>O
  - If PaO<sub>2</sub>  $<$  8KPa then incremental step wise (2-3cm) increase in PEEP to 15cmH<sub>2</sub>O with maintenance of Pplat  $<30$
  - Aim for normocapnia and a pH  $>7.2$  by increasing Resp Rate up to 30/min and maintaining I:E ratio of 1:2
  - Consider escalation to APRV if PaO<sub>2</sub>  $<$  8KPa and pH  $>7.2$  despite above measures **OR**
  - Consider paralysis and full mechanical ventilation for 48hrs (maintain Pplat  $>30$  and driving pressure  $<15$ ) and inverse I:E ratios if pH  $>7.2$
  - Consider prone position ventilation if above measures fail
  - If pH  $<$  7.2 despite above measures consider ECCO<sub>2</sub>R
  - Relaxed fluid balance but aim for neutral overall balance at end day 3 post intubation
- ICU ventilators:
  - Initial mode of ventilation suggest SIMV-VC can change to VC-CMV in full mechanical ventilation
- Anaesthetic machine flow-I:
  - Initial mode of ventilation suggest PRVC with settings (i-iv) as above
- Early ECHO (TTE) to establish RV filling/dysfunction and Lung USS to exclude atelectasis and pleural effusions
- Consider recruitment into RECOVERY trial (see guidelines)
- Consider early use of ‘treatment dose’ LMW Heparin plus low dose aspirin unless contraindicated
- Strict PPE precautions with FFP3 mask for all aerosol-generating procedures: Intubation, nebulization, bronchoscopy, tracheal suction, tracheostomy insertion, proning, insertion of aeroneb.

**6 Ongoing ventilation strategy (consider at >72 hrs post ICU admission)**

Compliance may worsen and the disease becomes more akin to classic ARDS therefore

AIM for PaO<sub>2</sub>  $\geq$  8kPa at lowest possible FiO<sub>2</sub>

- On SIMV or VC-CMV - reduce tidal volume to 4-6ml/kg IBW
- Increase PEEP in increments of 2-3cm H<sub>2</sub>O towards 15cmH<sub>2</sub>O
- Maintain Pplat <30cmH<sub>2</sub>O and Driving pressure (Pplat-PEEP) of < 15
- Lung protective ventilation (Pplat <30 and driving pressure <15) may only be achieved with inverse I:E ratios
- Allow for Permissive hypercapnia as long as pH>7.2
- Consider changing to APRV in non-paralysed patients
- Uncertain benefit as to further prone ventilation
- Consider ECMO referral
- Consider ECCO<sub>2</sub>R

**7 APRV**

- a) Decision to initiate APRV made by Consultant Intensivist or experienced Anaesthetic / ICM registrar.
- b) Detailed instructions for initiating APRV are contained in 'guidelines for acute respiratory failure'. This document is available on the [WorcesterICU.com](http://WorcesterICU.com) website
- c) APRV to be delivered by the ICU ventilators preferably via Drager Evita Infinity 500 ventilators
- d) It might become necessary to move patients requiring APRV from outlying areas to the Intensive Care Units

**8 Prone position ventilation (consider early when P/F ratio < 16)**

- Patients in first 3 days may benefit from early proning for 12-16 hours, however improved PaO<sub>2</sub> may only be maintained for 4 hours after returning supine
- Should be considered in all patients with refractory type 1 respiratory failure despite strategies described in section 5.
- Decision to prone made by Consultant Intensivist or experienced anaesthetic / ICM registrar.
- Ensure all invasive procedures completed prior to turning to the prone position
- Patients may remain in the prone position for 12-16 hours before resuming the supine position.
- Patients may need repeat proning up to 7 times.
- Consider that paralysis may need to be maintained for longer than 48hrs – ensure adequate sedation at all times and use of midazolam infusions
- For procedural details on how to prone, please refer to the separate proning guideline.
- It is likely that proning teams will be established to focus on this procedure.

## 9 Additional considerations for all patients

- Fluid balance
  - Neutral fluid balance needs to be obtained by end of day 3 via:
    - a) Cautious use of IV fluids.  
Avoid IV maintenance fluid. Use fluid boluses as required (to minimise fluid overload), to maintain cardiovascular support and where there are signs of renal impairment (oliguria/rising urea and creatinine)
    - b) Establishing early enteral nutrition. (see NG feeding guidelines)  
Oral water where tolerated rather than IV fluids.  
Sando K and Sando Phos rather than IV K/PO4 replacement.
    - c) IV Frusemide prn or Co-amolordide/bumetamide NG where neutral balance cannot be achieved by day 3  
CVVH if renal failure and RRT indicated.
    - d) Norepinephrine to support MAP only after euvoemia achieved (e.g SVV < 12 on Vigileo-Flotrac)
- Prostacyclin nebs
  - Decision to use made by Consultant Intensivist.
  - Indicated for refractory respiratory failure with evidence of right ventricular strain
  - Delivery of prostacyclin to occur within the Intensive Care Units only.
  - Insertion of aeroneb is considered an aerosol generating procedure and the use of full PPE is indicated.
  - Refer to aeroneb guidelines on the critical care intranet.
  - Consider using 'wet' circuit
- Anticoagulation  
Early hypoxia without ventilatory compromise in the first 24-72hours after intubation maybe due to V/Q mismatch and pulmonary microthrombosis and loss of hypoxic pulmonary vasoconstriction. There is a theory that early use of aspirin with or without LMW heparins (treatment dose) could have a benefit. Consider only at ICU Consultant level and in absence of any contraindications.
- RECOVERY trial  
Details are available on [WorcesterICU.com](http://WorcesterICU.com) website. Consider early recruitment if practical and ethical considerations apply

- ECCO<sub>2</sub>R
  - Referral for ECMO must occur prior to initiation of ECCO<sub>2</sub>R.
  - The exception to this rule would occur if national guidance rationing access to ECMO were to be published.
  - Indicated for type 2 respiratory failure with hypercapnia **and** pH <7.2
  - Decision for ECCO<sub>2</sub>R to be made by two Consultant Intensivists
  - Procedure for ECCO<sub>2</sub>R is documented in policy 'Use of veno-venous extra corporeal carbon dioxide removal in the Critical Care Unit.' This document is available on the critical care intranet departmental page under 'Clinical Guidelines'
- Bronchoscopy
  - Routine bronchoscopy is not indicated. Bronchoscopy is an aerosol generating procedure and places staff at increased risk.
  - A proportion of Covid-19 patients may test negative from initial viral swabs. These patients often have positive tests from deep respiratory samples.
  - Deep suction samples should be taken as soon as possible after intubation via a closed suction circuit.
- Imaging
  - A CXR should be obtained after intubation, line insertion, NGT placement has occurred.
  - Routine CT chest scanning is not advised.
  - Patients might require CT scanning for reasons unrelated to Covid-19 – the decision to scan should be made by a Consultant Intensivist on an individual patient basis
  - Lung USS should be utilised to aid the diagnosis of pneumothorax, consolidation, extra vascular lung water and effusions.
  - Lung USS procedure can be found in the lung USS
  - guidelines on [WorcesterICU.com](http://WorcesterICU.com) website.

## **10 Referral for ECMO**

- In the absence of nationally available guidelines, ECMO referral should be considered for all patients with persistent respiratory failure despite the above measures.
- Decision to refer to Glenfield should be made at the level of Consultant Intensivist
- See ECMO referral pathway on [WorcesterICU.com](http://WorcesterICU.com) website

**11 Transfer:**

- The protocol for transfer within the hospital is detailed in policy 'Transfer in Covid-19'.

**12 Tracheostomy:**

- It is expected that many patients with severe Covid-19 will require a tracheostomy procedure to facilitate weaning from mechanical ventilation.
- The preferred technique for tracheostomy formation is percutaneous. There may be a small cohort of patients who require surgical tracheostomy.
- Tracheostomy formation is a high-risk aerosol generating procedure. Full PPE must be worn by all members of staff involved.
- Decision for tracheostomy to be made by a Consultant Intensivist
- There is no evidence currently to determine the optimal timing of tracheostomy. This decision will be at the discretion of the Consultant Intensivist

**13 Weaning**

- Indications that weaning should be considered:
  - Absence of pyrexia
  - Euvolaemia
  - PEEP < 12
  - FiO<sub>2</sub> < 50%

**14 Extubation**

Maybe part of palliation and end of life care (see separate guidelines)

If weaning is established as in 13, then extubation maybe associated with high risk of airway oedema and need for re-intubation

Check that inflammatory markers are falling.

Deflate cuff and perform a leak test, consider indirect laryngoscopy to visualize cords (ENT surgeon required) -full PPE must be worn throughout this process

Start Iv dexamethasone if evidence of airway oedema

Have one size smaller ETT at extubation (if rapid reintubation needed)

Consider Tracheostomy (with ENT surgeon present) if failed extubation