critical care management of COVID 19 (RESPIRATORY SUPPORT)

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SCB MCH CTC.
Admit in Hospital when..

- Tachypnea (RR > 24/min)
- SpO₂ < 94% on room air (PaO₂/FiO₂ < 300)
- Signs of hypoperfusion
  - Low BP, altered mentation
- Risk of severe disease
  - Age > 60
  - DM, HTN, immunocompromised
  - Chronic lung/cardiac/renal/hepatic disease

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Criteria for ICU admission

Ventilation support
Vasopressor need
Worsening of mental status
MODS (Multi Organ Dysfunction Syndrome)

Poor prognosis

Age
Lymphopenia
High NLR
Raised LDH
Raised D-Dimer
Raised Ferritin
Respiratory Principles of management of ARDS in COVID-19

1. Early recognition
2. Initiation of ventilatory support
3. Treating the underlying cause
4. Monitor-record-interpret-respond
5. Delivering quality care.
Early recognition - ARDS

**Onset**
- New or worsening respiratory symptoms within one week of known clinical insult.

**Chest imaging**
- Bilateral opacities, not fully explained by effusions, lobar or lung collapse, or nodules.

**Origin of oedema**
- Respiratory failure not fully explained by cardiac failure or fluid overload.
COVID 19: Disease Severity

81% Non-Severe Disease

19% Hypoxic Resp. failure

14% Severe: O2 Therapy

9% ICU Ventilation

Critically ill COVID Patients

- 67% ARDS
- 56% Mechanical Ventilation

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# L and H Types Pneumonia

<table>
<thead>
<tr>
<th>L TYPE</th>
<th>H TYPE</th>
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<tbody>
<tr>
<td>Low Elastance</td>
<td>High Elastance</td>
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<tr>
<td>High Compliance</td>
<td>Low compliance</td>
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<tr>
<td>Low VQ Ratio</td>
<td>High right to left shunt</td>
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<tr>
<td>Low lung weight</td>
<td>High lung weight</td>
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<tr>
<td>Low lung recruitability</td>
<td>High lung recruitability</td>
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</table>
Severe SARS-CoV-2 infections: practical considerations and management strategy for intensivists

**Intensive Care Med (2020) 46:579–582**

<table>
<thead>
<tr>
<th>First Week</th>
<th>Second Week</th>
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<tbody>
<tr>
<td><strong>Setting</strong></td>
<td><strong>WARD</strong></td>
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<tr>
<td><strong>Repeate Sampling of the Nasopharynx and Tracheal Aspirates If Intubated by RT-PCR For COVID-19</strong></td>
<td>Initial Important viral shedding</td>
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<tr>
<td><strong>Oxygen Therapy and Mechanical Ventilation</strong></td>
<td>NO</td>
</tr>
<tr>
<td><strong>Organ Failure</strong></td>
<td>Typical signs according to current publications</td>
</tr>
</tbody>
</table>

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Oxygen Therapy

- Majority of patient required O₂ therapy \{Day 5-6\}

When to start O₂?
- \textbf{Suggest} starting \(O₂\) therapy when \(\text{SpO}_2 < 92\%\)
- \textbf{Recommend} starting \(O₂\) therapy when \(\text{SpO}_2 < 90\%\)

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SPO2 Targets?

- Recommend SPO2 no higher than 96%
- Target \( \text{SpO}_2 = 92-96\% \)

**WHO**

- Initial resuscitation target: \( \text{SpO}_2 > 94\% \)
- Once Patient is stable:
  - Target = \( \text{SpO}_2 > 90\% \)
  - Pregnant Patient = \( \text{SpO}_2 \geq 92 - 95\% \)

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Requirements for O₂ therapy for COVID ICU

- Pulse oximeters
- Functioning oxygen systems
- Oxygen cylinders for back up
- Disposable, single-use, oxygen-delivering interfaces
  - (nasal cannula,
    simple face mask
    venturi mask
    mask with reservoir bag).

Non invasive ventilator/HFNC

- Helmet interface
- Scavenging systems
- Etco2 monitoring
  - ABG machine
Oxygen Therapy

- Conventional, Single use, oxygen-delivering interfaces
  - Nasal cannula
  - Nasal prongs
  - Simple face mask &
  - Mask with reservoir bag

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Nasal cannula (prongs):
Amount of oxygen delivered

- Fio2 (Fraction Inspired Oxygen)
- Low flow 24-44%
  - 1L/Min = 24%
  - 2L/Min = 28%
  - 3L/Min = 32%
  - 4L/Min = 36%
  - 5L/Min = 40%
  - 6L/Min = 44%
The simple Oxygen mask

- Metal piece conforms to shape of nose
- Exhalation ports
- From oxygen source
- Strap
Delivers 35% to 60% oxygen.
A flow rate of 6 to 10 liters per minute.

It has vents on its sides which allow room air to leak in at many places, thereby diluting the source oxygen.
Oxygen mask with reservoir bag
......The Non Re-Breather Mask
The Non Re- Breather Mask

• This mask provides the highest concentration of oxygen (95-100%) at a flow rate 6-15 L/min.

• It is similar to the partial re-breather mask except two one-way valves prevent conservation of exhaled air.

• The bag has an oxygen reservoir
The Non Re-Breather Mask

- **Advantages**
  - Delivers the highest possible oxygen concentration
  - Suitable for pt breathing spontaneous with sever hypoxemia
The Non Re-Breather Mask

- **Disadvantages**
  - Impractical for long term Therapy
  - Malfunction can cause CO2 buildup
  - Suffocation
  - Expensive
  - Uncomfortable
“Venturi” Device with mask
Venturi System Varieties
Management of hypoxemic respiratory failure & ARDS

- Standard oxygen therapy (flow rates of 10-15 ltr / min.)
  - FiO2 (0.60 to 0.95)
  - High-flow nasal catheter oxygenation
  - Non-invasive ventilation
  - Low risk of air borne transmission
  - Close monitoring
Management

- Immediate initiation of oxygen/ventilatory support

- Options
  - High flow nasal cannula (HFNC) oxygen systems (limited availability)
  - Non invasive ventilation (NIV) (ideally through a critical care ventilator)
  - Invasive mechanical ventilation (IMV) (after endotracheal intubation) – *maybe required in a large majority*

- Supportive treatment
- Strategies for severe/refractory hypoxemia
Acute hypoxemic respiratory failure despite conventional oxygen therapy

- HFNC
- NIPPV
- Intubation

• WHO!
HFNC
High flow nasal cannula (HFNC)

May consider in selected patients if -
- awake, cooperative with normal haemodynamics
- without urgent need for intubation
- ($\text{PaCO}_2 < 45 \text{ mmHg}$).

- $40\%$ or greater patients may still require intubation and mechanical ventilation

If no clinical improvement in 1-2 hours,
DO NOT delay intubation.

*High potential for virus aerosolization therefore PPE accordingly*
Recent publications suggest that newer HFNO and NIV systems with good interface fitting do not create widespread dispersion of exhaled air and therefore should be associated with low risk of airborne transmission.
Failure of Conventional Oxygen Therapy

- **Suggest** HFNC if ↓\( \text{SpO}_2 \) on conventional \( \text{O}_2 \) therapy

- **Suggest** HFNC over NIPPV

 HFNC: Decrease risk of intubation
NIPPV: Increase risk to HCP
HFNC: Patient Comfort

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Risk to HCP

- HFNC does not seem to increase disease transmission

HFNC = Conventional O₂

(Contamination risk)

*SARS: HCP exposed to HFNC not at increase risk

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NIPPV in COVID

- **Suggest** a trial of NIPPV if HFNC is not available
- **WHO!**
NIPPV in COVID

Vs.

Face Mask

Helmet

- Insufficient data for any recommendation
- Safety and efficacy of helmet with COVID is not known?

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Non-invasive ventilation (NIV)

- Continuous positive airway pressure (CPAP) or bi-level positive airway pressure (BiPAP) delivered via a tight-fitting full face mask.
- As high concentration for oxygen may be required, to be used in ARDS only with a critical care ventilator

- Like HFNC, can be tried in selected patients. In case of failure of improvement within 1-2 hours, immediate endotracheal intubation and initiation for mechanical ventilation.

*High potential for virus aerosolization therefore PPE accordingly*
Non Invasive Ventilation

Continuous Positive Airway Pressure (CPAP) **Or**

Bi-level Positive Airway Pressure (BiPAP) delivered via a tight fitting mask.

- Not generally recommended for treatment of patients with ARDS as it may preclude achieving low tidal volumes and adequate PEEP level

If used, apply **airborne precautions**.
Ensure Safe NIV

- Increased **risk** to Health Care Worker
- Increased **failure rate** in non-cardiogenic etiology patients
- **Large** tidal volume
- Facial skin breakdown
- Delayed intubation
  - Do not wait for more than **1 hour**

Close monitoring is a must!!
Non-invasive ventilation (NIV)

- NIV can also be delivered through a helmet interface with a possibility of lesser aerosolization (no consensus although on its superiority in patients with COVID-19)

- NIV and HFNC should be used in ARDS, only under close monitoring with physicians experienced with management of patients with hypoxemic respiratory failure

- NIV and HFNC may be used as a temporizing measure until IMV is initiated.

In sick COVID-19 patients with severe respiratory distress and impending signs of respiratory arrest/fatigue, it is advisable to directly proceed to endotracheal intubation and initiation of mechanical ventilation.
Maximum exhaled air dispersion

- Maximum exhaled air dispersion via different oxygen administration and ventilatory support strategies: (in a negative pressure room, with human simulator at an inclination of 45°)
  - Method
    - Maximum exhaled air dispersion distance (in cm)
    - Oxygen via NC (5L/min) 100
    - Oxygen via simple face-mask (4L/min) 40
    - Oxygen via Venturi mask (FiO2 40%) 33
    - Oxygen via non rebreathing mask 12 L/min <10
Maximum exhaled air dispersion

- CPAP via oro-nasal mask (20cm of H2O) - Negligible
- HFNC (60L/min) - 17 (62cm sideways leakage if not tightly fixed)
- NIV via full face mask (IPAP 18cm/EPAP 5cm H2O) - 92
- NIV via helmet without tight air cushion - 27
- NIV via helmet with tight air cushion (IPAP 20cm/EPAP 10cm H2O) - Negligible air dispersion
Safety when using HFNC /NIV

• Mask over HFNC?
• Viral filters are essential to limit transmission.
  – If a ventilator is being used with a two-tube system:
    • Filters may be placed in-line with the exhalation port.
  – If a BiPAP machine is being with a one-tube system
    • Filter may be attached directly to the mask.
• Helmet masks might theoretically have an advantage here.

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COVID Patient with SPO₂ < 92%

Conventional O₂ therapy with target of SPO₂ 92-96%

Failure of conventional O₂ therapy

- Worsening oxygenation (\( \text{PaO}_2 / \text{FiO}_2 \leq 300 \))
- Hypercapnia
- Acidosis
- High work of breathing
- Mental status

HFNC available
- Consider HFNC

Monitor Closely
- Consider ROX index
- Worsening Respi. Status

Unable to maintain SpO₂ > 90% with an FiO₂ ≥ 0.60

HFNC not available
- Consider NIPPV

Monitor Closely
- Worsening Respi. Status

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Schema for Noninvasive Support

**Low flow nasal cannula**
- Typically set at 1-6 liters/minute.

**High flow nasal cannula**
- Titrate FiO2 based on patient’s saturation. If FiO2 requirement escalating (e.g. over ~80%) consider awake pronation or CPAP trial.
- Consider limiting flow rate below ~40 L/min to reduce aerosolization.
- N95 mask & aerosol precautions.

**CPAP**
- Titrate CPAP up as tolerated (in more severe hypoxemia might target ~15-18 cm)
- Viral filter.
- N95 mask & aerosol precautions.
- (Helmet interface likely ideal if available).

**Awake pronation plus (High Flow Nasal Cannula or CPAP)**
- If tolerated, awake patient may lie in a prone position (ideally for 12-18 hr/day).
- Limited to cooperative patients. May be useful if access to ventilator is limited.

**Invasive mechanical ventilation**
- Target tidal volumes of ~6 cc/kg.
- Permissive hypercapnia may be useful to allow for lung-protective settings.
- May use conventional lung-protective ventilation strategies or APRV.

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Awake Prone Positioning with Non-invasive Support

- Self Prone positioning:
  - with convectional oxygen therapy
  - Can be combined with other noninvasive support (HFNC & NIV).
- Requires cooperative patient with intact mentation.
- Same Physiological principle.
- Can avoid intubation
- Could be useful in situations where access to invasive ventilation is limited.

These instructions are for patients who have been advised to undertake ‘Conscious Proning’.

Please try to not spend a lot of time lying flat on your back. Lying on your stomach and in different positions will help your body to get air into all areas of your lungs.

It is recommended to change your position every 30 minutes to 2 hours rotating as below. Please note sitting up is better than lying on your back:

1. 30 minutes – 2 hours: lying fully prone on your stomach (bed flat)
2. 30 minutes – 2 hours: lying on your right side (bed flat)
3. 30 minutes – 2 hours: sitting up (30-60 degrees) by adjusting head of the bed
4. 30 minutes – 2 hours: lying on your left side (bed flat)
5. Then back to position 1 and continue to repeat the cycle.

INDICATION OF INTUBATION IN COVID PNEUMONIA

Respiratory distress (not tachypnea only)

Severe hypoxia (paO2 < 60 or Spo2 < 88% with > 10-12LO2/min).

Increased CO2 retention

Drowsy patient – low breathing rate and poor cough

Hemodynamic instability with moderate hypoxia (noradrenaline)
How to intubate these patients?

- Decide more electively than not…
- Full PPE – most important
- Check suction, airway equipments, IV fluids, monitors, drugs, IV line and ventilator
- A hydrophobic filter between mask and AMBU/Circuit.
- Experienced person for intubation
- Minimise number of persons inside room
- Pre oxygenation with 100% OXYGEN
- Rapid Sequence Intubation with opioid and suxamethonium/ Rocuronium
- Avoid bag mask ventilation
Invasive mechanical ventilation (IMV) with Lung Protective ventilation (LPV)

Figure 1. Mechanical ventilator for positive pressure ventilation

Nasogastric tube goes through the patient’s nose and into stomach

Mechanical ventilator blows air, or air with increased oxygen, through tubes into the patient’s airways

Nasal mask which warms and moistens the air

Endotracheal tube goes through the patient’s mouth and into the trachea

Exhaled air flowing away from the patient

Air flowing to the patient

Filter

Nursing Standard. doi: 10.7748/nrs.2021.35.02.1232
Modes of delivery of IMV

- **Endotracheal tube (preferred)**
- Nasotracheal tube
- Laryngeal mask (short-term, emergency)
- Tracheostomy (emergency airway, or long-term ventilation)

- Requires sedation, appropriate equipment and trained staff
Airway management in ICU

- Pre-oxygenate with closed circuit
- Avoid AMBU bag-mask ventilation
- **Rapid sequence induction**
  - Etomidate/propofol and scholine/rocuronium
- Most experienced operator
  - **Anesthesiologist** in each shift
- **Use video-laryngoscopy**
  - ↑ First attempt and ↑ over-all intubation success rate

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COVID: Mechanical Ventilation

• Critically ill ARDS = 67% presents with ARDS
• ARDS Classification: {Berlin definition}
  – Mild ARDS = $200 < \frac{PaO_2}{FiO_2} \leq 300 \text{ mmHg}$
  – Moderate ARDS = $100 < \frac{PaO_2}{FiO_2} \leq 200 \text{ mmHg}$
  – Severe ARDS = $\frac{PaO_2}{FiO_2} \leq 100 \text{ mmHg}$

When $PaO_2$ is not available, $SpO_2/FiO_2 \leq 315$ suggests ARDS
Initiate ventilatory support

Follow checklist for rapid sequence induction.

Anticipation and preparation are keys:

- do not delay procedure as patients with ARDS can desaturate quickly when oxygen is removed
- Monitor & respond to haemodynamic instability
- Properly titrate induction anaesthetics

Pre-oxygenate with 100% FiO2 for 5 minutes
Lung Protective Ventilation (LPV) reduces

- Ventilator-induced lung injury
- Barotrauma (e.g. pneumothorax)
- Volutrauma - Excessive strain
- Atelectrauma
- Biotrauma
- Oxygen toxicity
Management of hypoxemic respiratory failure & ARDS

Ventilation strategy in ARDS:

<table>
<thead>
<tr>
<th>Table 23.4 Protocol for Lung Protective Ventilation in ARDS</th>
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</thead>
<tbody>
<tr>
<td>I. 1st Stage</td>
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<tr>
<td>II. 2nd Stage</td>
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<tr>
<td>III. 3rd Stage</td>
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<tr>
<td>IV. Optimal Goals</td>
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</tbody>
</table>

Adapted from the protocol developed by the ARDS Network, available at [www.ardsnet.org](http://www.ardsnet.org).\(^\d\) Predicted body weight is the weight associated with normal lung volumes.
Lung Protective Ventilation

- Minimization of alveolar overdistension

- Minimization of rapid alveolar opening and collapse

- Ventilatory strategies aimed at preventing the aggravation of lung injury
Initiation of Mechanical Ventilation

- Endotracheal Intubation
- Aerosol precautions
- Intubation teams

- Pre-oxygenate with 100% FiO2 for 5 minutes
  - Bag valve mask
  - NIV
  - Highflow system.

  - Usual mode Volume controlled ventilation - ACMV (Assist Control Mode)
**Lung Protective Ventilation – How?**

<table>
<thead>
<tr>
<th>Target</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target tidal volume</td>
<td>6 mL/kg in adult and children - ideal body weight</td>
</tr>
<tr>
<td>Target plateau airway pressure (Pplat)</td>
<td>≤ 30 cmH2O</td>
</tr>
<tr>
<td>Target SpO2</td>
<td>88–93%</td>
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</tbody>
</table>
Initial settings and monitoring

- Set TV 6–8/kg predicted body weight.
- Set RR to approximate minute ventilation (MV).
- Set inspiratory flow rate above patient demand – commonly > 50-60 L/min.
- Set FiO2 at 1.00, titrate down.
- Set PEEP 5–10 cm H2O or higher and then adjust.

- Monitoring
  - SpO2 and ventilator parameters and ventilator waveforms continuously
  - pH, PaO2, PaCO2 as needed using ABG
Achieving the targets

- If TV is at 6 mL/kg and Pplat remains > 30 cm H2O then reduce TV by 1 mL/kg gradually, to a minimum 4 mL/kg:
  - at the same time, increase RR to maintain MV
  - allow for permissive hypercapnia
  - monitor and treat asynchrony

- Minute ventilation = Tidal Volume X Respiratory rate
  - Therefore, reduction in VT to be compensated by increase in RR
  - Low tidal volumes will lead to increase PaCO2 but that is acceptable
Permissive hypercapnia

- Mortality benefits of LPV outweigh risk of moderate respiratory acidosis
- No benefit to normalizing pH and PaCO2

- If pH 7.15–7.30:
  - increase RR until pH > 7.30 or PaCO2 < 25 (maximum 35)
  - decrease dead space by: decreasing I:E ratio, shortening the tube/flex connector

- If pH < 7.15 after above:
  - give buffer therapy intravenously (e.g. sodium bicarbonate)
  - TV may be increased in 1 mL/kg steps until pH > 7.15
  - if necessary, Pplat target of 30 may be temporarily exceeded
Oxygenation goals using PEEP-FiO2

- Titrate the FiO2 to the lowest value that maintains target SpO2 88–93%
- Set corresponding PEEP
- Higher PEEP for moderate-severe ARDS

### Lower PEEP/higher FiO2

<table>
<thead>
<tr>
<th>FiO2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.4</th>
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<th>0.5</th>
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<tbody>
<tr>
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<td>5</td>
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<table>
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<td>14</td>
<td>16</td>
<td>18</td>
<td>18-24</td>
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</table>

### Higher PEEP/lower FiO2

<table>
<thead>
<tr>
<th>FiO2</th>
<th>0.3</th>
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<th>0.3</th>
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<td>10</td>
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<table>
<thead>
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<th>0.9</th>
<th>1.0</th>
<th>1.0</th>
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<tbody>
<tr>
<td>PEEP</td>
<td>18</td>
<td>20</td>
<td>22</td>
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<td>24</td>
</tr>
</tbody>
</table>
HIGH PEEP

Hypotension due to decreased venous return to right heart.

Over-distension of normal alveoli and possible ventilator-induced lung injury and increase in dead space ventilation.

Titrate the FiO$_2$ to the lowest value that maintains target SpO$_2$ 88-93%.
Maximal PEEP levels to be determined on individual basis, range between 10-15 cm H$_2$O

Use caution with higher PEEP levels in children.
Monitoring in LPV

Monitor SpO₂ continuously.

Monitor pH, PaO₂, PaCO₂ using blood gas analyser
- should be available in all ICUs.

Monitor ventilator parameters regularly:
- **Pplat and compliance** at least every 4 hours, and after changes in PEEP or TV
- **intrinsic PEEP and I:E ratio** after changes in respiratory rate
- **ventilator waveforms** for asynchrony..
Severe ARDS

ARDS

Mild/Moderate

LPV + Fluid restriction

Severe

LPV + Fluid restriction + Prone position

If LPV Target not met, consider

Higher PEEP

Recruitment

Extra Corporeal Membrane Oxygenation
NMBA

• **Suggest** using intermittent boluses NMBA over continuous NMBA infusion, *(to facilitate protective lung ventilation)*

• **Suggest** continuous NMBA infusion for < 48 hrs:
  – Persistent ventilator dyssynchrony
  – Need for ongoing deep sedation
  – Prone ventilation
  – Persistently high plateau pressures,
Care of COVID patient on Mechanical Ventilation: Suctioning

- Close suction only
- As and when required
- **Not hourly** basis
- PPE precautions if using open suction
Other precautions

- Avoid disconnecting the patient from the ventilator to prevent lung collapse and worsen hypoxemia
- **Use closed suctioning**
- Clamp tube when disconnection required
- Minimize unnecessary transport
Avoid aerosol

- MDI preferred over **nebulization**
- Use **HMEF** – change when soiled or 5-7 days
- Change circuit only when soiled (not routinely)
- Avoid circuit disconnections
- Before unavoidable circuit disconnections
  - Clamp ETT and put ventilator on stand by
- **Closed suction catheter system**
Care of patient on Mechanical Ventilation

- **Nebulization**
  - Avoid routine nebulization (only when it's absolutely necessary)
    Clamp ETT with artery forceps or umbilical cord clamp → disconnect circuit → attach nebulization kit → connect
    (repeat in reverse way after nebulization)

- **Bronchoscopy**
  - only when it's absolutely indicated
Prone Ventilation

- Suggest prone ventilation for 12-14 hrs.
- Decrease Mortality
Prone Ventilation

- Increases ventilation in dorsal part of lungs
- Improves VQ mismatch
- 6-12 hours usually, can extend up to 24 hours if necessary

Contraindications:
- Shock
- Hypoxia not responding
- Dialysis
- Abdominal distension
Respiratory Nursing Care

Prone for 16 / 24 hours - Turning teams are a success

- Awake prone / Self prone
- Care scheduling during semi recumbent position
- Skin care – One hour bony prominence massage
  - Medical devices check for skin injury
- Swollen lips care
- Ice for inflammation

Cautious feeding through nasogastric or nasoduodenal tube
Complications of proning

- Transient hemodynamic instability
- Brachial plexus injury
- Skin injury due to pressure & medical devices
- Facial oedema
- Swollen lips & tongue
- Lines & tubes displacement
- Aspiration
Recruitment Maneuvers

• If patients are hypoxemic despite optimized vent settings: Suggest RMIs.

• Recommend against Staircase RMIs.

• WHO!
ECMO

- **Suggest** using venovenous (VV) ECMO if available:
  - Refractory hypoxemia despite optimizing ventilation
  - Use of rescue therapies, and proning
- Referring the patient to an ECMO center
- **Economical & Ethical issues**
ECMO (Extracorporeal membrane oxygenation)
Formal guidelines: management of acute respiratory distress syndrome

Pplat < 30 cmH₂O

Vt 6 ml/kg of PBW

PEEP > 5 cmH₂O

Reassessment

P/F < 80

Discuss VV-ECMO

P/F < 150

Neuromuscular blockers
Prone positioning

High level of PEEP if improves oxygenation

ARDS

Confirmed ARDS

Initiation of invasive mechanical ventilation with sedation in ICU

Tidal volume about 6 ml/kg of PBW
Plateau pressure < 30 cmH₂O
PEEP > 5 cmH₂O
Check for hypercapnia

Tidal volume (Vt) about 6 ml/kg of PBW in the absence of severe metabolic acidosis
Systematic screening for ARDS diagnosis criteria

Reassessment of ventilator settings and of the management strategy at least every 24h

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Pain management and sedation for IMV

- Implement a protocolized management approach to pain, agitation and delirium (PAD) to improve patient outcomes.
- Regularly assess patients using standardized, reproducible scales (i.e. VAS, RASS, CAM-ICU).

- First, treat pain (with opioids and non-opioids) to minimize the harmful effects of sedatives.

- Then treat anxiety using non-benzodiazepines sedatives (when possible) and target light sedation in most patients.
- Use non-pharmacologic interventions to prevent delirium.
Management of hypoxemic respiratory failure & ARDS

In patients with moderate to severe ARDS (PaO2/FiO2<150), neuromuscular blockade by continuous infusion should not be routinely used.

Avoid disconnecting the patient from the ventilator, which results in loss of PEEP and atelectasis.
Disaster Ventilation Strategy

- Splinting Ventilators
- Outpatient-design BiPAP machines for intubated patients
- Oxylator resuscitator / Votran automatic resuscitator
Disaster Ventilation Strategy

There is no one-size fits all solution.

• Splitting ventilators: Could be used for extremely ill patients (intubated, on deep sedation).
• BiPAP machines attached to ET tubes: Could be used for patients who are close to weaning off ventilation.
• Automatic resuscitator: Might be used for patients intubated for non-pulmonary reasons (patients with normal lungs).
Liberation from Mechanical Ventilator

Mechanically Ventilated Patient

Readiness testing for Weaning

Qualifies For Weaning

Weaning Trial

Clinical Criteria
Weaning Predictors
Integrated Indices

*SBT: low PS vs. T-piece
Weaning Trial?

Weaning Trial

- Weaning Success
- Decision For Extubation
  - Extubation
- Weaning Failure
  - Etiology of Failure?
    - Correct
  - Follow a Weaning Strategy

Identifying V Success

AIIMS, New Delhi
Extubation

**Exubation Guideline**
- Patient off respiratory support or support to be offered non invasively?
  - Yes
  - Reason to suspect upper airway inadequacy?
    - No
    - Airway Protection adequate?
      - Yes
      - Extubate +/- noninvasive support
      - No
      - Wait and Reassess upper airway function
    - Yes
      - Empty Stomach & Cuff deflation trial
      - Weaning guideline
  - No
    - Weaning guideline
Precautions during Extubation

- Plan for gentle extubation
- Avoid open tracheal suction during extubation
- History < 2 weeks: take all precautions
- History > 2 weeks may be treated as non COVID
  (Consider Viral load)
### Prevention of complications

- These interventions are based on Surviving Sepsis or other guidelines

<table>
<thead>
<tr>
<th>Anticipated outcome</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce days of invasive mechanical ventilation</td>
<td>Weaning protocols</td>
</tr>
<tr>
<td>Minimise continuous or intermittent sedation</td>
<td>Minimise continuous or intermittent sedation</td>
</tr>
<tr>
<td>Reduce incidence of ventilator associated pneumonia</td>
<td>Oral intubation is preferable to nasal intubation</td>
</tr>
<tr>
<td></td>
<td>Semi-recumbent position (head of bed elevation 30-45°)</td>
</tr>
<tr>
<td></td>
<td>New ventilator circuit for each patient</td>
</tr>
<tr>
<td></td>
<td>Change heat moisture exchanger every 5-7 days.</td>
</tr>
</tbody>
</table>
Prevention of complications

- These interventions are based on Surviving Sepsis or other guidelines

Anticipated outcome:

- Reduce incidence of venous thromboembolism
- Reduce incidence of catheter related bloodstream infection

Interventions:

- Use pharmacological prophylaxis (low molecular-weight heparin 5000 IU BD)
- Mechanical prophylaxis (intermittent pneumatic compression devices)
- Daily reminder to remove catheter if no longer needed
Prevention of complications

- These interventions are based on Surviving Sepsis or other guidelines

**Anticipated outcome:**
- Reduce incidence of pressure
- Reduce incidence of stress ulcers and gastrointestinal bleeding
- Reduce incidence of ICU related weakness

**Interventions:**
- Turn patient every two hours
- Early enteral nutrition (within 24–48 hours of admission)
- Administer histamine-2 receptor blockers or proton-pump inhibitors
- Actively mobilize the patient early in the course of illness
Psychosocial spiritual nursing care

- Smile!

- Communicate, communicate, communicate!!

- Connect with loved ones through a device - tab, mobile etc: works wonders.

- Address pain, agitation & delirium

- Ensure sleep and rest with scheduling
ICU preparation

- COVID designated area
- Designated donning area
- Safe cleaning & disinfection
- N95 respirators
- Safe doffing space
- High Efficiency Particulate Air Filter (HEPA) filter

Negative pressure rooms with minimum 12 air changes/hr OR 160 L/sec/patient
## Rational Use of PPE in ICU

<table>
<thead>
<tr>
<th>S.No</th>
<th>Setting</th>
<th>Activity</th>
<th>Risk</th>
<th>Recommended PPE</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ICU</td>
<td>Critical Care Management</td>
<td>High Risk</td>
<td>Full complement of PPE</td>
<td>Aerosol generating activities performed</td>
</tr>
<tr>
<td>2</td>
<td>ICU</td>
<td>Dead body packing</td>
<td>High Risk</td>
<td>Full complement of PPE</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ICU</td>
<td>Dead body transport to mortuary</td>
<td>Low Risk</td>
<td>Triple layer medical mask Gloves</td>
<td></td>
</tr>
</tbody>
</table>
CONCLUSION

- Communicate early with patient and family.
- If possible families to be communicated using web based platforms like zoom or watsapp video calls inorder to restrict their movement to hospital.
- Communicate proactively with patients and families and provide emotional support and prognostic information
- Understand the patient’s values and preferences regarding life-sustaining interventions