Non-Invasive Respiratory Strategies

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Outline

• Rationale for NIV
• Types of NIRS devices and infection control
• Indications for respiratory support: COVID-19
• HFNO/NIPPV (CPAP/BiPAP)
• Patient selection and special precautions
• Monitoring

• Weaning
• Troubleshooting
• Proning
• Uganda’s experience
Rationale for NIRS (HFNO/NIPPV)

• Can provide higher levels of respiratory support for patients with acute hypoxaemic respiratory failure despite supplemental oxygen flow (> 10–15 L/min via mask with reservoir).

• This includes the delivery of higher flow rates (up to 60 L/min), more consistent higher oxygen concentrations (FiO2 of 100%) and provision of positive pressure.

• HFNO and NIPPV may provide more comfort, well tolerated in appropriate patients.

• Use of HFNO and NIPPV should not delay intubation if there are emergent indications.

• Clinicians should choose between the devices on the basis of as availability, the supply of oxygen, their personal comfort and experience, and patient-specific factors (such as claustrophobia with CPAP masks, and nasal discomfort with HFNO).

• Maybe only available advanced respiratory support strategy in resource limited settings
Types of advanced non-invasive respiratory support devices

- High-flow nasal oxygen (HFNO)
- Continuous positive airway pressure (CPAP)
- Bi-level positive airway pressure (NIV)

Sources:
## Example of non-invasive respiratory support

<table>
<thead>
<tr>
<th>Device</th>
<th>Intended use</th>
<th>Modes</th>
<th>Supplemental Oxygen</th>
<th>Supplemental Oxygen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resmed/</td>
<td>Adult, Paediatric (patients</td>
<td>S, ST, T, PAC, iVAPS,</td>
<td>Up to 15 L/min</td>
<td>6</td>
</tr>
<tr>
<td>Lumis 150 VPAP ST-A</td>
<td>weighing more than 13 kg)</td>
<td>CPAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>YUWELL/</td>
<td>Adult, Paediatric (patients</td>
<td>S, ST, T, VGPS, CPAP</td>
<td>Up to 15 L/min</td>
<td>6</td>
</tr>
<tr>
<td>YH-830</td>
<td>weighing more than 30 kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F&amp;P/</td>
<td>Adult, Paediatric</td>
<td>Target temperature</td>
<td>Up to 60 L/min (Low</td>
<td>6</td>
</tr>
<tr>
<td>AIRVO2</td>
<td></td>
<td>settings: 37, 34, 31 ºC</td>
<td>pressure inlet)</td>
<td></td>
</tr>
<tr>
<td>MASIMO/</td>
<td>Adult, Paediatric</td>
<td>Target temperature</td>
<td>Up to 50 L/min (Low</td>
<td>6</td>
</tr>
<tr>
<td>TN1 softFlow 50</td>
<td></td>
<td>settings: 30 – 37 ºC</td>
<td>pressure inlet)</td>
<td></td>
</tr>
</tbody>
</table>

**HFNC**
The Boussignac continuous positive airway pressure (CPAP) is a small plastic cylinder that attaches to a face mask.

Arnaud W Thile et al. Respir Care 2011;56:1526-1532
Infection Prevention and Control

Use airborne precautions when treating patients with HFNO or NIV:

• PPE (including gown, gloves, eye protection) should be worn by health workers performing aerosol-generating procedures (AGP) and by health workers on duty in settings where AGP are regularly performed on patients with suspected or confirmed COVID-19.

• Place all cases in well ventilated single rooms if feasible.

• When single rooms are not available suspected, probable or confirmed COVID-19 patients should be cohorted in adequately ventilated areas with bed space at least 1 m apart.
Patient selection: appropriate patients for advanced non-invasive respiratory support

- Patients with acute hypoxaemic respiratory failure, not in need of emergent intubation AND:
  - AWAKE
  - COOPERATIVE
  - HAEMODYNAMICALLY STABLE.

Criteria for ARDS:
- Signs of severe or worsening respiratory distress.
- Hypoxaemia (SpO$_2$ < 90%) despite escalating oxygen therapy.
- SpO$_2$/FiO$_2$ < 315.
- Pulmonary oedema, cardiac failure or fluid overload not the primary cause.
- New bilateral opacities on chest imaging.

Do not delay intubation and invasive mechanical ventilation (IMV) if patient has urgent indications for airway management and invasive ventilation.
Monitoring patients on HFNO and NIPPV

- When initiating HFNO or NIPPV, use a **time-limited trial (i.e. 1 hour)**, to assess for clinical response:
  - A good response includes:
    - PATIENT COMFORT
    - REDUCED WORK OF BREATHING
    - REDUCED RESPIRATORY RATE (RR)
    - IMPROVED OXYGEN SATURATION BY PULSE OXIMETER
    - STABLE HAEMODYNAMICS
    - STABLE MENTAL STATUS.

**Note:** Patients with severe air hunger and very large spontaneous tidal volumes may need consideration for referral and earlier intubation and lung protective ventilation.


Characteristics of high-flow nasal cannula (HFNO)

• Delivered through a comfortable nasal cannula interface. May be better tolerated than NIPPV.

• Able to provide high airflow rates (up to 60 L/min in adult).

• FiO₂ is controlled through the total flow rate of gas administrated to the device. Therefore, its directly linked to the gas source and flowmeter control.

• Higher airflow rates can provide a low level of positive end expiratory pressure (PEEP).

• The airflow is warmed and humidified to prevent dryness.

• Provides washout of dead space in the upper airways which may improve ventilation.
Selecting the right size nasal cannula for HFNO

• General tips:
  • Select the best size of high-flow nasal cannula, according to manufacturer instructions.
  • Ensure correctly fitting nasal cannula for the patient.

• In children:
  • Interface size should not exceed 50% of the size of nares.
  • When the flow is above 25 L/min change to adult interface.
Initiating and titrating high-flow nasal oxygen (HFNO) in adults

Adults:

• INITIATE DEVICE AIRFLOW RATE AT 40 L/MIN FLOW (FOR ADULTS AND CHILDREN > 15 YEARS) AND OXYGEN FLOWMETER AT HIGHEST TO DELIVER 100% FIO₂.

• TITRATE THE FLOW UP OR DOWN TO TARGET CLINICAL RESPONSE (MAXIMUM IS 60 L/MIN):
  □ patient comfort
  □ improved work of breathing
  □ reduced RR
  □ Improved oxygen saturation
  □ stable haemodynamics and mental status.

• TO AVOID OVERUSE OF OXYGEN, TITRATE THE OXYGEN FLOWMETER (FIO₂) DOWN TO USE THE LOWEST FIO₂ NECESSARY TO ACHIEVE TARGET:
  – SpO₂ ≥ 90% for adults and children, 94% ≥ for pregnant patients and 94% ≥ for children with signs of multi-organ dysfunction.
Initiating and titrating high-flow nasal oxygen (HFNO) in children

• Select target airflow rate based on age and weight:
  • 0–10 KG --> 2 L/KG/MIN
  • 10–20 KG --> 1 L/KG/MIN
  • 20–40 KG --> 0.5–1.0 L/KG/MIN (MAX 30 L/MIN).

• Initiate airflow rate at 50% of target and FiO$_2$ at 60%.
• Increase flow gradually (every 5 minutes) to achieve good patient response and not to exceed target flow rate.
• Titrate the oxygen flowmeter (FiO$_2$) down to use the lowest FiO$_2$ necessary to achieve target SpO$_2$ ≥ 90%.
ROX Index

- Roca et al predicting need for intubation/HFNO failure.

\[
\text{ROX Index} = \frac{\text{SPO}_2/FIO}_2}{\text{Respiratory Rate}}
\]

Respiratory rate - O\text{X}ygenation

<table>
<thead>
<tr>
<th>ROX</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥4.88</td>
<td>Little risk of intubation</td>
</tr>
<tr>
<td>3.85-4.87</td>
<td>Close monitoring due to increased risk of intubation</td>
</tr>
<tr>
<td>2.85-3.84</td>
<td>Monitoring in the ICU if possible. Highly increased risk of intubation</td>
</tr>
<tr>
<td>&lt;2.85</td>
<td>Consider intubation</td>
</tr>
</tbody>
</table>

- High Flow Nasal Cannula
  - 2 Hours
  - 6 Hours
  - 12 Hours
  - ROX Index < 2.85
  - ROX Index < 3.85
  - ROX Index < 3.85
  - HFNC Failure
Characteristics of NIPPV

• DELIVERS POSITIVE PRESSURE VENTILATION, EITHER CPAP OR BIPAP, TO IMPROVE OXYGENATION, ELIMINATION OF CO₂, REDUCE THE WORK OF BREATHING.

• DELIVERED VIA A TIGHT-FITTING NASAL MASK, FACE (ORO-NASAL) MASK OR HELMET. A GOOD SEAL IS NECESSARY TO DELIVER THE DESIRED POSITIVE PRESSURE.

• RELIABLY TITRATES FIO₂ UP TO 100% WHEN CONNECTED TO HIGH PRESSURE OXYGEN SOURCE. OXYGEN IS BLENDED WITH ROOM AIR INSIDE THE MACHINE. SOME CPAP MACHINES, CAN WORK ON LOW PRESSURE OXYGEN FROM A CONCENTRATOR BUT MAXIMAL FIO₂ WILL BE LOWER.
Precautions to consider with NIPPV

Important **considerations that may lead to harms** include:

- **Delayed intubation** due inadequate monitoring and response.
- **Uncontrolled tidal volumes** leading to injurious transpulmonary pressures.
- **Skin breakdown** from pressure of mask on face.
- **Undernutrition** due to mask reducing capacity to tolerate oral intake. Careful assessment and consideration of feeding to achieve early enteral feeding within 24–48 hours of admission through nasogastric tube.

To minimize adverse effects, ensure NIPPV is used by trained staff in context of close monitoring and protocols about skin care, nutrition and adjustment of settings.
Comparing CPAP and BiPAP

**CPAP** provides a continuous level of positive end expiratory pressure (PEEP, cmH\(_2\)O). End expiratory pressure is used to improve hypoxaemia by recruiting collapsed alveoli.

**BiPAP** provides a level of inspiratory pressure, or iPAP; and separately, an expiratory pressure support (ePAP). The addition of iPAP reduces the work of breathing. \(\Delta P\), is the difference in pressure between iPAP and ePAP.
Select appropriate interface for NIPPV

- **Select interface type:** There are nasal masks, oro/nasal masks, full-face masks and helmets.
  - The choice between interface should be guided by clinician experience, availability, and patient comfort.
  - If the patient has claustrophobia or needs to expectorate often, choose a nasal mask.

- **Select the appropriate size:** Choose appropriate size to ensure correct fitting prior to starting therapy.

Carefully follow the manufacturer instructions on fitting to optimize comfort and tolerability and decrease leakage.
Initiating and titrating CPAP: Adult

- Start CPAP at 5 cm H$_2$O and FiO$_2$ 100%
- TITRATE UP BY 2–4 CM H$_2$O EVERY 5 MINUTES, AS NEEDED, TO GOOD CLINICAL RESPONSE, NOT TO EXCEED 12 CM H$_2$O.
- IN CONJUNCTION, REDUCE FiO$_2$ TO LOWEST SETTING NEEDED TO ACHIEVE TARGET SP$_{O2}$ ≥ 90%.
- MONITOR THE PATIENT'S RESPONSE BETWEEN ALL CHANGES.
- CAUTION WITH HIGHER PRESSURES AS THEY MAY LEAD TO OVERDISTENSION OF ALVEOLI AND LUNG INJURY AS WELL AS GASTRIC INSUFFLATION AND RISK OF ASPIRATION.
- CLINICAL RESPONSE INCLUDES:
  - patient comfortable
  - improved work of breathing
  - improved saturation
  - stable haemodynamics and mental status.
Initiating and titrating CPAP in ARDS: Children

- **Start CPAP at 5 cm H$_2$O and FiO$_2$ 10–20% above previous needs:**
  - **TITRATE UP BY 1–2 CM H$_2$O EVERY 5 MINUTES TO ACHIEVE CLINICAL RESPONSE,** BUT NOT TO EXCEED A MAXIMUM OF 10–12 CM H$_2$O.
  - **IN CONJUNCTION, TITRATE FIO$_2$ TO LOWEST SETTING NEEDED TO ACHIEVE TARGET SPO$_2$ $\geq$ 90%.

- **CLINICAL RESPONSE INCLUDES:**
  - patient comfortable
  - improved work of breathing
  - improved saturation
  - stable haemodynamics and mental status.
Weaning from CPAP

- Currently no consensus on any specific weaning process for patients on CPAP.

Three approaches have been described in practice and literature in the paediatric population: graded time off wean; sudden wean; and pressure wean.

1. **GRADED TIME OFF**: CPAP is reduced and allowed for a predetermined number of hours each day then gradually increase amount of time off.

2. **SUDDEN WEAN**: The patient is taken off CPAP all in all, with no consideration of level of airway pressure, and continuing off until indication for CPAP are met necessitating the patient to go back on CPAP.

3. **PRESSURE WEAN**: Gradually reducing the CPAP to prior determined level then come off CPAP.
Initiating BiPAP: Adult

Common BiPAP initiation pressures are:

- IPAP 10 CM H₂O, EPAP 5 CM H₂O, DELTA = 5
- IPAP 15 CM H₂O, EPAP 10 CM H₂O, DELTA = 5
- IPAP 13 CM H₂O, EPAP 5 CM H₂O, DELTA = 7.

Other settings may be used depending on individual patient needs and clinician expertise.

Start with FiO₂ 100% and titrate down to amount needed to achieve target SpO₂ > 90%. **Use lowest FiO₂ necessary to achieve target.**
Titrating BiPAP: Adult

**Titrating ePAP for hypoxaemia:**
- INCREASE EPAP AT INCREMENTS OF 2–3 CM H$_2$O TO A MAXIMUM OF 15 CM H$_2$O; RANGE 5–15 CM H$_2$O.
- WITH EVERY CHANGE IN EPAP MONITOR PATIENT FOR 3–5 MINUTES FOR CLINICAL RESPONSE.

**Titrating iPAP for work of breathing:**
- ALWAYS INCREASE THE IPAP WHEN INCREASING THE EPAP, SO THAT IPAP REMAINS AT LEAST 5–10 CM H$_2$O GREATER THAN EPAP (DELTA = 5–10).
- INCREMENTS OF 3–5 CM H$_2$O TO A MAXIMUM OF 20 CM H$_2$O; RANGE 10–20 CM H$_2$O.
- WITH EVERY CHANGE IN EPAP MONITOR PATIENT FOR 3–5 MINUTES FOR CLINICAL RESPONSE.
Initiating BiPAP in ARDS: children

- **Common BiPAP initiation pressures:**
  - IPAP 9 CM H$_2$O, AND EPAP 5 CM H$_2$O, DELTA = 4 CM H$_2$O.
  - SET FIO$_2$ 10–20% ABOVE PREVIOUS NEEDS.
  - IF TRANSITIONING FROM CPAP, START EPAP AT SAME LEVEL AND ADD IPAP TO ACHIEVE DELTA = 4 CM H$_2$O HIGHER.
  - SET RESPIRATORY BACK-UP RATE = 15 (FOR CHILDREN USE AGE SPECIFIC LOWER LIMIT).
Titrating BiPAP in ARDS: Children

• Titrating ePAP for hypoxaemia:
  • IN INCREMENTS OF 1–2 CM H₂O EVERY 5 MIN (MAX OF 10 CM H₂O).

• Titrating iPAP for work of breathing:
  • START 10–15 CM H₂O.
  • IN INCREMENTS OF 2–3 CM H₂O (MAX OF 20 CM H₂O).
  • BETWEEN EACH TITRATION, EVALUATE FOR CLINICAL RESPONSE: KEEP DELTA = 4 CM H₂O TO AVOID SELF-INFlicted LUNG INJURY FROM THE MACHINE.
  • Titrating FiO₂ to achieve SpO₂ ≥ 90% (aim for SpO₂/FiO₂ ratio (SF) > 200). Use lowest amount of FiO₂ necessary to achieve the goal.
Titrating BiPAP to clinical response and tidal volume

**Remember, a good clinical response includes:**
- patient comfortable
- improved work of breathing
- reduced RR
- improved saturation
- stable haemodynamics and mental status.

When using NIPPV, also monitor the **tidal volume (TV)**. A safe tidal volume target is 6–8 mL/kg ideal body weight. This is important to avoid injurious large tidal volumes.
**Emergency signs**
- Obstructed or inadequate breathing
- Central cyanosis
- Severe respiratory distress (i.e. significant tachypnoea, accessory muscle use)
- Signs of shock
- Seriously reduced level of consciousness
- Seizures
- Acidosis (pH < 7.30)
- Severe hypoxaemia, P:F < 100

**Escalate oxygen therapy** if not achieving SpO₂ goal on simple non-invasive O₂ delivery devices

**Are Emergency signs present?**

- **NO**
  - Consider 1–2 hr trial of one of the following based on patient & local context:
  - **Consider CPAP** (bCPAP in infants and young children)
    - 5–10 cmH₂O infants and children;
    - 10–15 cmH₂O adolescents and adults
  - **If adequate O₂**
    - 2 L/kg/min if 0–10 kg; 1 L/kg/min if 10–20 kg; 0.5–1 L/kg/min (max 30) if 20–40 kg; 0.5–1 L/kg/min (max 60) if > 40 kg; (may also adjust FiO₂)

- **YES**
  - **Consider intubation and mechanical ventilation** if Max FiO₂ ≤ 1.0
    - Use lung protective ventilation
  - **Consider NIPPV/BiPAP** if COPD or left heart failure contribute to respiratory failure
    - PS Δ5–15/PEEP 5–15
    - i.e., IPAP 10–30/EPAP 5–15
    - (IPAP = PEEP + PS; EPAP = PEEP)

**Assess response**
- (~q1h initially; q2–4h once stable or improving)
  - Increased/continued distress, SpO₂ < 90%, pH < 7.30, PaCO₂ > 45, declining or altered mental status?

**GOOD RESPONSE**
- Continue therapy
- Wean for SpO₂ > 90% and improved work of breathing

**BAD RESPONSE**
- **Escalate oxygen therapy** if not achieving SpO₂ goal on simple non-invasive O₂ delivery devices
Special precautions: patients that are **not appropriate** for advanced non-invasive respiratory support

- **Abnormal mental status:** patient may not tolerate tightfitting mask (i.e. agitation) or patient may not be able to protect airway (i.e. coma).

- Patients with multi-organ failure, including haemodynamic instability, for when coupled with acute respiratory failure raise concern of imminent arrest.

- Anatomic barriers that do not permit adequate face mask seal (i.e. NIPPV).

- Copious respiratory secretions when using face mask (i.e. NIPPV).

- Active vomiting when using face mask (i.e. NIPPV) increases risk of aspiration.

The primary risk NIPPV is a delay to intubation that may increase mortality. Thus, patients need to be managed by trained staff, close monitoring and short trial period.
Indications to prepare for intubation and invasive mechanical ventilation (IMV)

• Despite appropriate titration of HFNO if patient shows any urgent indication for intubation or fails to show improvement, then proceed to airway management, intubation and invasive mechanical ventilation.

• RED FLAGS:
  • Severe signs of respiratory distress, such as consistently elevated respiratory rate for > 60 min ≥ 60 bpm if < 2 months; ≥ 50 bpm in 2–11 months; ≥ 40 bpm if 1–5 years; ≥ 30 bpm in adults and children > 5 years.
  • Severe hypoxaemia, such as P/F < 100.
  • Apnoea or periodic breathing (unstable drive).
  • Hypoventilation:
    • INCREASE IN PACO$_2$ ≥ 10 MMHG OR 1.3 KPA
    • RESPIRATORY RATE < 8/MIN.
  • Severe agitation, acute change in mental status, diaphoresis, patient discomfort.
  • Haemodynamic instability (signs of shock).
Adjunctive interventions: awake proning

The WHO COVID-19 clinical Guideline Development Group conditionally recommends:
Awake prone positioning of patients severely ill and hospitalized with COVID-19 requiring supplemental oxygen (including high-flow nasal oxygen) or non-invasive ventilation.

**Benefits:** observational studies of awake prone patients with severe COVID-19 suggest decreased mortality and need for intubation (*very low certainty evidence*).

**Harms:** include possible patient discomfort and pain (*very low certainty evidence*).

COVID-19 Clinical management: living guidance
https://www.who.int/publications/i/item/WHO-2019-nCoV-clinical-2021-1
## Awake proning indications and contraindications

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<thead>
<tr>
<th>Characteristics of patients appropriate for prone position</th>
<th>Contraindications to prone positioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Awake and alert</td>
<td>• Need for immediate intubation</td>
</tr>
<tr>
<td>• Capable of communicating and moving independently</td>
<td>• Haemodynamically unstable (tachycardia, hypotension)</td>
</tr>
<tr>
<td>• Patient must be able get help if they have discomfort or pain</td>
<td>• Spinal instability</td>
</tr>
<tr>
<td>• Patient must be able supinate independently, if needed</td>
<td>• Altered mental status or reduced ability to protect the airway</td>
</tr>
<tr>
<td>• Hemodynamically stable</td>
<td>• Unable to readily call for help if needed</td>
</tr>
<tr>
<td>• Able to protect their airway</td>
<td>• Caution if nausea or vomiting</td>
</tr>
<tr>
<td>• Able to be closely monitored by workers with experience with prone positioning</td>
<td>• Not enough human resources in the unit to monitor</td>
</tr>
</tbody>
</table>

Awake proning tips

Patients should be able to follow instructions to self-prone without assistance from health care workers

- Patients should attempt to prone on a regular basis (e.g. every 4 hours) and maintain the prone position for as long as possible. (Many patients are unable to maintain the prone position for more than 1–2 hours.)
- Patients should be able to stop proning at any time and return to the supine position as needed.

Rotation and timed position changes

- Regimens vary, and target being in awake prone position 8–12 hours/day, broken into shorter periods over the day. For example, some institutional protocols describe rotational protocols, with patients changing position on a regular schedule (e.g. every 1 hour changing position, with positions rotating from prone, to lying on right side, to sitting straight upright, to lying on left side, to prone again, etc.).

Patient comfort: frequent limitations for patients are low back pain, nausea and vomiting

- For nausea or vomiting, immediately assist the patient to an upright position or recovery position. Gently suction or wipe the airway, if the patient cannot clear spontaneously.
- For low back pain, patients may find comfort using padding (i.e. pillows, blankets) under the pelvis.
- If possible, tilt the bed slightly in reverse Trendelenburg position to reduce pressure on the eyes and face.

Clinical care of severe acute respiratory infections – Tool kit
Resource considerations: medicinal oxygen and air supply

1. Depending on the specifications of the non-invasive device, it may require an external source of medical oxygen and/or air. It is important to verify if the requirement is a high-pressure or low-pressure inlet to properly select the source. (Link: Priority medical devices list for the COVID-19 response and associated technical specifications(who.int))

2. If high-pressure medicinal air is required, it can be supplied by integrated air compressors or turbines, or by piped from the medicinal gas station (wall outlet is > 50 psi).

3. If high-pressure medicinal oxygen is required, it can be supplied by high-pressure gas cylinders or piped from the medicinal gas station (wall outlet is > 50 psi). If low pressure medicinal oxygen is required, it can be supplied by a bedside oxygen concentrator.

4. Between the gas supply and the non-invasive device there is typically a pressure and/or flow regulator (see image below).
Troubleshooting

For patients with persistent hypoxaemia or respiratory distress:

• Check the **equipment**: Ensure the settings are appropriate and flow is maximized.

• Check the **oxygen source**: there is sufficient oxygen available and flowing through the device. If FiO$_2$ > 50% of oxygen is needed, the device must have a blender.

• Check there is no **obstruction with secretions**: patients with COVID-19 may have very thick secretions which may block small and large airways and cause sudden respiratory deterioration.

• **AVOID STRATEGIES WHICH MAY DRY SECRETIONS** (E.G., HIGH FLOW DRY O$_2$/AIR).

• **ENSURE ADEQUATE SECRETION CLEARANCE** and consider failure to clear secretions as a trigger to abandon advanced non-invasive respiratory support and proceed to intubation and invasive mechanical ventilation.

Do not delay intubation if the patient is worsening on a short trial (1 hour) of advanced non-invasive respiratory support or has any urgent indication for intubation.
Uganda COVID ARDS respiratory strategy experience 2020-2021

Adults hospitalized with AHRF, n=782

COVID-19 AHRF, n=591

Criteria for COVID-19 AHRF not fulfilled, n=191

COVID-19 ARDS, n=499

Missing data, n=17
Unable to consent, n=53
No ARDS Criteria, n=22

Included into statistical analysis, n=499

Lost to follow-up until hospital discharge, n=0
Mortality difference

No escalation of respiratory support vs. Escalation of respiratory support

178/400 (44.5%) vs. 81/99 (81.8%)

*p<0.001*
Survival by respiratory strategy

Cumulative Survival

Hospital LOS (days)

$\text{SOX}$

$\text{HFNO}$

$\text{CPAP}$

$\text{NIV}$

$\text{IMV}$

$\text{p<0.001}^*$
Resources


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And ALL COVID Health Workers world over!!