Covid Management

Where Resources are Limited

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Outline

• Classification of severity
• Triage plans
• Oxygen use
• Prone Positioning
• Respiratory Support Methods
• Questions
Clinical management of COVID-19

Interim guidance
27 May 2020
Key resources for supporting management of severe acute respiratory infections in children

**Basic emergency care (BEC): approach to the acutely ill and injured (2018)**
Developed by WHO and ICRC, in collaboration with the International Federation for Emergency Medicine, Basic emergency care (BEC): approach to the acutely ill and injured is an open-access training course for frontline health care providers who manage acute illness and injury with limited resources. Produced in response to requests from multiple countries and international partners, the BEC package includes a Participant Workbook and electronic slide decks for each module. Integrating the guidance from WHO-Emergency Trauma Care (ETC) for children and the Integrated management of adult and childhood illness (IMAI), BEC teaches a systematic approach to the initial assessment and management of time-sensitive conditions where early intervention saves lives.
https://www.who.int/publications-detail/basic-emergency-care-approach-to-the-acutely-ill-and-injured

This is for use by doctors, nurses and other health workers caring for children at first level referral hospitals with basic laboratory facilities and essential medicines. These guidelines focus on the management of the major causes of childhood mortality in most developing countries including pneumonia, and also cover common procedures, patient monitoring and supportive care on the wards.

**Oxygen therapy for children (2016)**
This is a bedside manual for health workers to guide the provision of oxygen therapy for children. The manual focuses on the availability and clinical use of oxygen therapy in children in health facilities to guide health workers, biomedical engineers and administrators. It addresses: detection of hypoxemia, use of pulse oximetry, clinical use of oxygen, delivery systems and monitoring of patients on oxygen therapy. The manual also addresses the practical use of pulse oximetry, and oxygen concentrators and cylinders.

**Technical specifications for oxygen concentrators (2015)**
This provides an overview of oxygen concentrators and technical specifications to aid in selection, procurement and quality assurance. It highlights the minimum performance requirements and technical characteristics for oxygen concentrators and related equipment that are suitable for the use in health facilities.

**WHO-UNICEF technical specifications and guidance for oxygen therapy devices (2019)**
The purpose of this document is to increase access to quality products to ensure the supply of oxygen, especially in low- and middle-income countries and low-resource settings within countries from all income groupings. This project is one of many related to improving oxygen supply that other stakeholders are working on. These efforts aim to support ministries of health to ensure oxygen supply is available, as well as raise awareness of the importance of appropriate selection, procurement, maintenance and use of medical devices, both capital equipment and single-use devices.
COVID-19 Diagnostic and Management Protocol for Pediatric Patients

Ana Paula de Carvalho Panzeni Carletti, Wethor Brunow de Carvalho, Cintia Johnston, Isadora Souza Rodrigues, Artur Figueiredo Delgado

Departamento de Pediatria, Hospital das Clínicas, Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, SP, Brazil. Instituto da Criança e do Adolescente (ICA), Hospital das Clínicas HOMUNI, Faculdade de Medicina, Universidade de São Paulo, São Paulo, SP, Brazil.

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This review aims to verify the main epidemiologic, clinical, laboratory-related, and therapeutic aspects of coronavirus disease 2019 (COVID-19) in critically ill pediatric patients. An extensive review of the medical literature on COVID-19 was performed, mainly focusing on the critical care of pediatric patients, considering expert opinions and recent reports related to this new disease. Experts from a large Brazilian public university analyzed all recently published material to produce a report aiming to standardize the care of critically ill children and adolescents.

The report emphasizes on the clinical presentations of the disease and ventilatory support in pediatric patients with COVID-19. It establishes a flowchart to guide health practitioners on triaging critical cases. COVID-19 is essentially an unknown clinical condition for the majority of pediatric intensive care professionals. Guidelines developed by experts can help all practitioners standardize their attitudes and improve the treatment of COVID-19.

KEYWORDS: COVID-19; Pediatric Critical Care Medicine; Infection; Ventilatory Support; Diagnostic Criteria.

Management of critically ill patients with COVID-19 in ICU: statement from front-line intensive care experts in Wuhan, China

You Shang, Chun Pan, Xianghong Yang, Ming Zheng, Xueling Zhang, Zhikang Wu, Zhu Yi, Wei Zhang, Dong Zhang, Xia Zheng, Ling Yang, Li Jiang, Jiancheng Zhang, Wei Xiong, Jiao Liu, and Dechang Chen

Abstract

Background: The ongoing coronavirus disease 2019 (COVID-19) pandemic has swept all over the world, posing a great pressure on critical care resources due to large number of patients needing critical care. Statements from front-line experts in the field of intensive care are urgently needed.

Methods: Seven front-line experts in China fighting against the COVID-19 epidemic in Wuhan were organized to develop an expert statement after 3 rounds of expert seminars and discussions to provide trustworthy recommendations on the management of critically ill COVID-19 patients. Each expert was assigned tasks within their field of expertise to provide draft statements and rational parts of the expert statement are based on epidemiological and clinical evidence, without available scientific evidences.

Results: A comprehensive document with 46 statements are presented, including protection of medical personnel, strategical treatment, diagnosis and treatment of tissue and organ functional impairment, psychological interventions, immune therapy, nutritional support, and transportation of critically ill COVID-19 patients. Among them, 6 recommendations were strong (Grade 1), 21 were weak (Grade 2), and 20 were experts’ opinions. A strong agreement from voting participants was obtained for all recommendations.

Conclusion: There are still targeted therapies for COVID-19 patients. Dynamic monitoring and supportive treatment for the restoration of tissue oxygenation and organ function are particularly important.

Keywords: COVID-19, Critical care, Expert statement.
Clinical Presentation of Covid-19

- **Asymptomatic Infection**: Absence of clinical signs and symptoms of the disease and normal chest X-ray or CT scan associated with a positive test for SARS-CoV-2.

- **Mild Infection**: Upper airway symptoms such as fever, fatigue, myalgia, cough, sore throat, runny nose and sneezing. Pulmonary clinical exam is normal. Some cases may not have fever and others may experience gastrointestinal symptoms such as nausea, vomiting, abdominal pain, and diarrhea.

- **Moderate Infection**: Clinical signs of pneumonia. Persistent fever, initially dry cough, which becomes productive, may have wheezing or crackles on pulmonary auscultation but shows no respiratory distress. Some individuals may not have symptoms or clinical signs, but chest CT scan reveals typical pulmonary lesions.

- **Severe Infection**: Initial respiratory symptoms may be associated with gastrointestinal symptoms such as diarrhea. The clinical deterioration usually occurs in a week with the development of dyspnea and hypoxemia (blood oxygen saturation [\(\text{SaO}_2\]) <94%).

- **Critical Infection**: Patients can quickly deteriorate to acute respiratory distress syndrome or respiratory failure and may present shock, encephalopathy, myocardial injury or heart failure, coagulopathy, acute kidney injury, and multiple organ dysfunction.

Figure 1 - Clinical Presentation of COVID-19.
Interagency Integrated Triage Tool: ≥12 years

1. CHECK FOR RED CRITERIA
   - Unresponsive
   - AIRWAY & BREATHING
     - Stridor
     - Respiratory distress* or central cyanosis
   - CIRCULATION
     - Capillary refill >3 sec
     - Weak and fast pulse
     - Heavy bleeding
     - HR <50 or >150
   - DISABILITY
     - Active convulsions
     - Any two of:
       - Altered mental status
       - Hypothermia or fever
       - Stiff neck
       - Hypoglycaemia
   - OTHER
     - High-risk trauma*
     - Poisoning, ingestion or dangerous chemical exposure*
     - Threatened limb*
     - Snake bite
     - Acute chest or abdominal pain (≥60 years old)
     - ECG with acute ischaemia (if done)
     - Violent or aggressive
   - PREGNANT WITH ANY OF:
     - Heavy bleeding
     - Severe abdominal pain
     - Seizures or altered mental status
     - Severe headache
     - Visual changes
     - SBP >180 or DBP >110
     - Active labour
     - Trauma

2. CHECK FOR YELLOW CRITERIA
   - AIRWAY & BREATHING
     - Any swelling/swelling of mouth, throat or neck
     - Wheezing (no red criteria)
   - CIRCULATION
     - Vomiting everything or ongoing diarrhoea
     - Unable to feed or drink
     - Severe pallor (no red criteria)
     - Ongoing bleeding (no red criteria)
     - Recent fainting
   - DISABILITY
     - Altered mental status or agitation (no red criteria)
     - Acute general weakness
     - Acute focal neurologic complaint
     - Acute visual disturbance
     - Severe pain (no red criteria)
   - OTHER
     - New rash worsening over hours or peeling (no red criteria)
     - Visible acute limb deformity
     - Open fracture
     - Suspected dislocation
     - Other trauma/burns (no red criteria)
     - Known diagnosis requiring urgent surgical intervention
     - Sexual assault
     - Acute testicular/scrotal pain or prepuce
     - Unable to pass urine
     - Exposure requiring time-sensitive prophylaxis (e.g. animal bite, needling)
     - Pregnancy, referred for complications

Patients with high-risk vital signs or clinical concern need up-triage or immediate review by supervising clinician. NO

3. CHECK FOR HIGH-RISK VITAL SIGNS
   - HR <60 or >130
   - RR <10 or >30
   - Temp ≤36° or ≥39°
   - SpO2 <92%
   - AVPU other than A

NO

MOVE TO HIGH ACUITY RESUSCITATION AREA IMMEDIATELY

MOVE TO CLINICAL TREATMENT AREA

MOVE TO LOW ACUITY OR WAITING AREA

*See Reference Card

Developed by World Health Organization, The International Committee of the Red Cross, Médecins Sans Frontières
This is adapted from the recently published American College of Chest Physicians consensus statement (Biddison et al, 2014) (see References and resources). It is presented as a framework only, and has not been validated in any population.

Conceptualized framework for how the critical care (tertiary) triage process and decisions would flow in a disaster or pandemic

**Inclusion criteria:**
- Refractory hypoxia require ventilation
- Hypotension refractory to volume resuscitation and requiring vasopressor/inotropic support

**Exclusion criteria:**
- Low probability of survival criteria
  - Cardiac arrest
  - Severe trauma
  - Severe burns
  - Severe irreversible neurologic event or condition
  - Prematurity
- Short life expectancy criteria
  - Metastatic malignancies
  - Haematologic malignancies with poor prognosis
  - End-stage organ failure with expected survival ≤ 1 year
  - Very advanced age
  - Advanced and irreversible immunocompromise
  - Congenital anomalies with expected survival ≤ 1 year

**Prioritization:**
- Admit to ICU based upon priority and as bed available

**Daily reassessment:**
- Assess for development of exclusion criteria or discharge criteria

**Triage process decision flow**

1. Yes → 2 → No
2. No → 3
3. No → 5
4. Yes → 4

- 72 hour trial of care: Did patient meet the goals of the trial of care is showing significant evidence of improvement?
- Recovered
- Discharge or palliative care
- Palliative care

- Monitor and reassess as required
- Medical management +/− palliative care
FLU-LIKE SYNDROME FLOWCHART

Triage: provide surgical mask to the patient

Healthcare professional: Use surgical face mask, gown (ideally disposable), gloves and protective goggles for the initial evaluation. Aerosol generating procedures (tracheal intubation, airway aspiration, respiratory secretion sample): all the above, but exchange surgical face mask for N95 face mask and use surgical cap.

Severe Acute Respiratory Syndrome (SARS)
RR ≥ 24 bpm ** and/or Sats O2 < 93% room air
- Admit to unit (ward / ICU)
- Collect nose and oropharyngeal swab (influenza, respiratory syncytial virus and SARS-CoV-2)
- Case notification
- Prescribe symptomatic relief
  (give oseltamivir until influenza is excluded)

NO Severe Acute Respiratory Syndrome
RR < 24 bpm ** and Sats O2 ≥ 93% room air
- Do not notify
- Prescribe symptomatic relief
- Do not collect nose and oropharyngeal swab
- Self isolation according to Health Ministry Guidelines
- Oseltamivir for high-risk patients***
- Monitor high-risk patients

ICU
- No improvement of Sats O2 after oxygen support
- Hypotension
- Capillary refill alterations
- Concordance level alterations
- Oliguria

WARD
- ** High-risk of complications
  - Age < 5 or ≥ 60 years old
  - Comorbidities (ex: cardiovascular diseases, diabetes, cancer, hypertension, others)
  - Immunosuppression
  - Patients with pulmonary tuberculosis
  - Pregnant and postpartum women
  - Obesity

*** On imaging exams (X-ray/ CT scan), consider admitting to hospital if >50% of lungs show alterations or imaging alterations in high-risk patient.

Consider tachypnea based on appropriate respiratory rate for age:
- ≥ 60 bpm < 2 months old
- ≥ 50 bpm 2 – 11 months old
- ≥ 40 bpm 1 – 5 years old
- > 30 bpm > 5 years old
- ≥ 24 bpm adolescents and adults

** For children: Consider respiratory rate according to age and other signs of respiratory distress such as intercostal and suprasternal retraction, and nose flaring.
4.4 National Early Warning Score (NEWS) for adults

The NEWS score was developed by the Royal College of Physicians (United Kingdom of Great Britain and Northern Ireland) to improve the assessment of acute-illness severity of patients in hospital and pre-hospital settings. Please refer to all materials, including posters and training materials, on their website (https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2).

**Chart 1: NEWS scoring system**

<table>
<thead>
<tr>
<th>Physiological parameter</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiration rate (per minute)</td>
<td>≤8</td>
<td>9–11</td>
<td>12–20</td>
<td></td>
<td>21–24</td>
<td>≥25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SpO₂ Scale 1 (%)</td>
<td>≤91</td>
<td>92–93</td>
<td>94–95</td>
<td>≥96</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SpO₂ Scale 2 (%)</td>
<td>≤88</td>
<td>84–85</td>
<td>86–87</td>
<td></td>
<td>88–92</td>
<td>≥93 on air</td>
<td>93–94 on oxygen</td>
<td>≥96 on oxygen</td>
</tr>
<tr>
<td>Air or oxygen?</td>
<td></td>
<td></td>
<td></td>
<td>Oxygen</td>
<td></td>
<td></td>
<td>Air</td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>≤90</td>
<td>91–100</td>
<td>101–110</td>
<td>111–219</td>
<td>≥200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse (per minute)</td>
<td>≤60</td>
<td>61–70</td>
<td>71–80</td>
<td>≥81</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consciousness</td>
<td></td>
<td></td>
<td></td>
<td>Alert</td>
<td></td>
<td></td>
<td>CVPU</td>
<td></td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>≤35.0</td>
<td>35.1–36.0</td>
<td>36.1–38.0</td>
<td>38.1–39.0</td>
<td>≥39.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Royal College of Physicians (2017)

**Chart 2: NEWS thresholds and triggers**

<table>
<thead>
<tr>
<th>NEWS score</th>
<th>Clinical risk</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate score 0–4</td>
<td>Low</td>
<td>Ward-based response</td>
</tr>
<tr>
<td>Red score</td>
<td>Score of 3 in any individual parameter</td>
<td>Low–medium</td>
</tr>
<tr>
<td>Aggregate score 5–6</td>
<td>Medium</td>
<td>Key threshold for urgent response*</td>
</tr>
<tr>
<td>Aggregate score 7 or more</td>
<td>High</td>
<td>Urgent or emergency response**</td>
</tr>
</tbody>
</table>

*Response by a clinician or team with competence in the assessment and treatment of acutely ill patients and in recognising when the escalation of care to a critical care team is appropriate.
**The response team must also include staff with critical care skills, including airway management.

Source: Royal College of Physicians (2017)
4.5 Paediatric Early Warning Score (PEWS)

This score was published in Critical Care in 2011 (see Parshuram et al, 2011), has been used in Canada and the United Kingdom of Great Britain and Northern Ireland and has been shown to be clinically effective in low-resource settings (see Brown et al, 2019).

As in the adult scoring system, it is used to alert staff on general paediatric wards that a child is becoming critically unwell. The scoring system may need calibration or adjustment if used in a different environment to that for which it was developed. A score of 8 or more has a sensitivity of 83% for an impending emergency, including a possible cardiopulmonary arrest, and indicates that the child is critically ill and should be evaluated immediately by a physician and that a higher level of care should be considered.

The seven items in the lefthand column should be scored and added together.

<table>
<thead>
<tr>
<th>Item</th>
<th>Age group</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (bpm)</td>
<td>0 to &lt; 3 months</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3 to 12 months</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1-4 years</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>&gt; 4-12 years</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>&gt; 12 years</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>0 to &lt; 3 months</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3 to 12 months</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1-4 years</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>&gt; 4-12 years</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>&gt; 12 years</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>GDI time</td>
<td>&lt; 3 seconds</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>RR (breaths/min)</td>
<td>0 to &lt; 3 months</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3 to 12 months</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1-4 years</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>&gt; 4-12 years</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>&gt; 12 years</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Respiratory effort</td>
<td>Normal</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Mild Increase</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Moderate Increase</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Severe Increase/ any apnoea</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>SpO₂ (%)</td>
<td>&gt; 94</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>91 to 94</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>≤ 90</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Oxygen therapy</td>
<td>Room air</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Any to &lt; 4 L/min or &lt; 50%</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>≥ 4 L/min or ≥ 50%</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>


Notes: GDI time = capillary refill time; HR = heart rate; RR = respiratory rate; SBP = systolic blood pressure; SpO₂ = peripheral oxygen saturation.
Use to predict mortality, NOT to diagnose sepsis, per 2017 Surviving Sepsis Guidelines.

When to Use  Pearls/Pitfalls  Why Use

Altered mental status
GCS < 15
Yes
No

Respiratory rate ≥ 22
Yes
No

Systolic BP ≤ 100
Yes
No

Is this a COVID-19 patient?
Confirmed positive
Suspected
Unlikely
Confirmed negative

2 points
qSOFA Score

High Risk
qSOFA Scores 2-3 are associated with a 3- to 14-fold increase in in-hospital mortality. Assess for evidence of
ROX SCORE

During high-flow nasal cannula (HFNC) therapy in patients with acute hypoxemic respiratory failure, it can be desirable not to delay intubation and have an adverse event.

The ROX index, defined as the ratio of oxygen saturation as measured by pulse oximetry/FIO2 to respiratory rate, has been assessed as a predictor of the need to intubate in patients received HFNC oxygen therapy.

Prediction accuracy of the ROX index increased over time with AUC of 0.679 at 2 h, 0.703 at 6 hours and 0.759 at 12 hours.

ROX >4.88 at 2, 6 and 12 hours after HFNC initiation was associated with a lower risk for intubation.

Predictors of HFNC failure include:
- ROX <2.85 at 2 hours
- ROX <3.47 at 6 hours
- ROX <3.85 at 12 hours

References
Respiratory Therapy for Covid 19
6.1 Algorithm to deliver increasing oxygen in adults

This is reproduced from the WHO IMAI district clinician manual: hospital care for adolescents and adults: guidelines for the management of illnesses with limited resources (Volume II WHO, 2011).

How to deliver increasing oxygen

1. **Start oxygen at 5 L/min**
   - Use nasal prongs
   - Assess response

2. **Use face mask**
   - Increase oxygen to 6–10 L/min
   - Assess response

3. **Use face mask with reservoir**
   - Increase oxygen to 10–15 L/min
   - Make sure bag inflates
   - Call for help from district clinician
   - Assess response

4. **Call for help from district clinician for possible tracheal intubation**
   - Start manual ventilation (bagging) with high-oxygen flow

---

**Estimating FIO2 when delivering oxygen**

**Adults**
- 2–4 L/min: FIO2 0.28–0.36
- 5 L/min: FIO2 0.40
- 6–10 L/min: FIO2 0.44–0.60
- 10–15 L/min: FIO2 0.60–0.95

**Note:**
- Patients presenting with emergency signs should receive oxygen therapy if SpO2 < 94%.
- Signs of shock:
  - Hypoxia (SpO2 < 90%)
  - Disoriented or absent breathing
  - Severe respiratory distress
  - Central cyanosis
  - Signs of shock (defined as cold extremities with capillary refill time > 3 sec, weak and fast pulse, coma (or seriously reduced level of consciousness))
  - Systolic BP < 90
  - Severe dehydration: lethargy or unconscious, sunken eyes, very slow return after pinching the skin.

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**Place prongs inside the nostril, head tilted back, and flow rate to match flow settings:**
- If increasing respiratory distress or SpO2 < 90%,
  - Use face mask
  - Increase oxygen to 6–10 L/min
  - Assess response

---

**Secure mask firmly on face over nose and mouth, full stop over head:**
- If increasing respiratory distress or SpO2 < 90%,
  - Use face mask with reservoir
  - Increase oxygen to 10–15 L/min
  - Make sure bag inflates
  - Call for help from district clinician
  - Assess response

---

**Make sure bag is full to deliver highest oxygen concentration. An empty bag is dangerous:**
- If increasing respiratory distress or SpO2 < 90%:
  - Transfer to a hospital with available invasive mechanical ventilator possible

---

**Call for help from district clinician for possible tracheal intubation:**
- Start manual ventilation (bagging) with high-oxygen flow
<table>
<thead>
<tr>
<th>Method</th>
<th>Maximum O₂ flow (L/min)*</th>
<th>Actual inspired O₂ fraction (%) from 1 L/min by a 5-kg infant</th>
<th>PEEP</th>
<th>Humidification</th>
<th>Risk for hypercapnia</th>
<th>Risk for airway obstruction</th>
<th>Equipment required</th>
<th>Nursing demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal prongs</td>
<td>Neonates: 0.5–1</td>
<td></td>
<td></td>
<td>Not required</td>
<td>No</td>
<td>Minimal</td>
<td>Nasal prongs</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Infants: 2</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Preschool: 4</td>
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<tr>
<td></td>
<td>School: 6</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>45</td>
<td></td>
<td>Minimal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasal catheter</td>
<td>Neonates: 0.5</td>
<td></td>
<td>+</td>
<td>Not required</td>
<td>No</td>
<td>+</td>
<td>8-F catheter</td>
<td>++</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasopharyngeal catheter</td>
<td>Neonates: 0.5</td>
<td></td>
<td>++</td>
<td>Required</td>
<td>No</td>
<td>++</td>
<td>8-F catheter, humidifier</td>
<td>+++</td>
</tr>
<tr>
<td></td>
<td>Infants: 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>55</td>
<td></td>
<td>++</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head box, face mask, incubator tent</td>
<td>Head box: 2–3 L/kg per min</td>
<td>Nil</td>
<td>Not required</td>
<td>Yes</td>
<td>No</td>
<td>Head box, face mask</td>
<td>+++</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Oxygen therapy for children (WHO, 2016).

**Notes:**
- * Higher flow rates without effective humidification may cause drying of nasal mucosa, with associated bleeding and airway obstruction.
- F = French; PEEP = positive end-expiratory pressure.

Not recommended as oxygen is used inefficiently.
4.2 Pulse oximetry monitoring

A pulse oximeter measures oxygen saturation of haemoglobin in the blood by comparing the absorbance of light of different wavelengths across a translucent part of the body. Pulse oximetry is the best method available for detecting and monitoring hypoxaemia. Even the best combinations of clinical signs commonly lead to misdiagnosis of hypoxaemia in some patients with normal oxygen saturation or fail to detect some hypoxaemic patients. **Pulse oximetry should be performed on all patients with SARI.**

Examples of pulse oximeter displays showing normal and abnormal readings are given below.

**Pulse oximeter displaying normal reading**

![Normal reading](image)

This image shows a pulse oximeter with a normal reading (pulse rate = 102 BPM; \(\text{SpO}_2\) = 97\%) and a plethysmographic (pulse) wave indicating a good arterial trace and a valid reading.

**Pulse oximeter displaying abnormal reading**

![Abnormal reading](image)

In this image (pulse rate = 150 BPM; \(\text{SpO}_2\) = 82\%), the pulse oximeter has a good plethysmographic wave, indicating a valid arterial trace. Therefore, the \(\text{SpO}_2\) reading, which is abnormally low (82\%), is accurate and indicates that the patient is hypoxaemic. Oxygen should be given. Note the increased heart rate, which is common in seriously ill patients.

*Source: Oxygen therapy for children (WHO, 2016).*
6.4 Algorithm to escalate supportive respiratory therapy

Start oxygen therapy

Mentor
If fails to respond to escalating oxygen

Proceed to intubation if there are argent indications

Consider in patients with mild-moderate and non-worsening hypercapnia, normal mental status, haemodynamic stability

Intubation and IMV
Use lung protective strategy and ABCDE bundle (Tool 12.7)

NIV at experienced centres

HFNCO at available

bCPAP in young children

Notes:
1. Health care worker must apply airborne precautions.
2. Patients receiving NIV, HFNCO, or bCPAP should be in a monitored setting and cared for by experienced personnel capable of performing endotracheal intubation in case the patient acutely deteriorates or does not improve after a trial (about 1 hour). Do not delay intubation if there is an indication.
3. Intubation and IMV only in experienced centres; and the most experienced clinicians should intubate given the risk of decompensation and aerosolization during the procedure.

bCPAP – bubble continuous positive airway pressure; HCW – health care worker; HFNCO – High flow nasal cannula; IMV – invasive mechanical ventilation; NIV – non-invasive ventilation; SARS – severe acute respiratory illness.
Fig. 1  Protocol of respiratory therapy for COVID-19-induced ARDS. NIV non-invasive ventilation, HFNC high-flow nasal cannula, PBW predict body weight, ECMO extracorporeal membrane oxygenation.
PRONE POSITION

• May improve Oxygen saturation, ? Decrease mortality

• Mechanism of benefit: recruiting lung, altered V/Q

• Can be tried prior to intubation as well as after

• Be aware of pitfalls and precautions
**Procedure for prone positioning**

**Preparation**

1. Check for contraindications:
   - b. Fracture of pelvis fracture.
   - c. Conditions associated with spinal instability (e.g., rheumatoid arthritis, trauma).
   - d. Conditions associated with increased intracranial pressure.
   - e. Life-threatening arrhythmia.

2. Consider possible adverse effects of prone positioning on chest tube drainage.

3. Whenever possible, explain the maneuver to the patient and/or their family.

4. Confirm from a recent chest roentgenogram that the tip of the endotracheal tube is located 2 to 4 cm above the main carina.

5. Inspect and confirm that the endotracheal tube and all central and large bore peripheral catheters are firmly secured.

6. Consider whether the patient's head, neck, and shoulder girdle will be supported after they are turned prone.

7. Check tube feeding, check for residual fully aspirate the stomach, and cap or clamp the feeding and gastric tubes.

8. Prepare endotracheal suctioning equipment, and review what the process will be if upper airway secretions abruptly overwhelm respiratory ventilation.

9. Decide whether the turn will be rightward or leftward.

10. Prepare all intravenous tubing and other catheters and tubing for connection when the patient is prone.

   a. Ensure sufficient tubing length.
   b. Secure all drainage bags on opposite side of the bed.
   c. Move chest tube drain between the legs.
   d. Reposition intravenous tubing toward patient's head, on the opposite side of the bed.

**Turning procedure**

1. Place one (or more) people on both sides of the bed (to be responsible for the turning process) and another at the head of the bed (to assure the central lines and the endotracheal tube do not become dislodged or kinked).

2. Increase the FiO₂ to 1 and note the mode of ventilation, the tidal volume, the minute ventilation, and the peak and plateau airway pressures.

3. Pull the patient to the edge of the bed furthest from whichever lateral decubitus position will be used while turning.

4. Place a new draw sheet on the side of the bed that the patient will face when in this lateral decubitus position. Leave most of the sheet hanging.

5. Turn the patient to the lateral decubitus position with the dependent arm tucked slightly under the thorax. As the turning progresses the nondependent arm can be raised in acocked position over the patient's head. Alternatively, the turn can progress using a log-rolling procedure.

6. Remove ECG leads and patches. Suction the oropharynx, oropharynx, and nasal passages if necessary.

7. Continue turning to the prone position.

8. Reposition in the center of the bed using the new draw sheet.

9. If the patient is on a standard hospital bed, turn his/her face toward the ventilator. Assure that the airway is not kinked and has not migrated during the turning process. Suction the airway if necessary.

10. Support the face and shoulders appropriately avoiding any contact of the supporting padding with the ears or the eyes.

11. Position the arms for patient comfort. If the patient cannot communicate, avoid any type of arm extension that might result in a brachial plexus injury.

12. Auscultate the chest to check for right mainstem intubation. Assess the tidal volume and minute ventilation.

13. Adjust all tubing and reassess connections and function.

14. Replace ECG patches and leads to the back.

15. Tilt the patient into reverse Trendelenburg. Slight, intermittent lateral repositioning (20 to 30°) should also be used, changing sides at least every two hours.


**FiO₂:** Fraction of inspired oxygen.

Figure. Individual Partial Pressure of Arterial Oxygen (Pao₂) Variation for Patients Who Sustained Prone Positioning (PP) for at Least 3 Hours

During PP indicates the 1 to 2 hours after proning and after PP indicates the 6 to 12 hours after resupination. Responders to PP = Pao₂ increase ≥20% between before and during PP. Persistent responders to PP = Pao₂ increase ≥20% between before PP and after resupination. All the persistent responders are also responders. One patient among the 15 refused arterial blood gas measurement during PP and after resupination. For 2 patients, arterial blood gas data after resupination were missing.
Mechanical Ventilation
### 14.5 Framework to guide allocation of scarce mechanical ventilators during disasters

#### Proposed strategy for ventilator allocation in epidemics of novel respiratory pathogens

<table>
<thead>
<tr>
<th>Principle</th>
<th>Specification</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prognosis for short-term survival</td>
<td>Adults (SOFa or paediatrics (PELOD-2))</td>
<td>SOFa score $\leq 8$</td>
<td>SOFa score $9–11$</td>
<td>SOFa score $12–14$</td>
<td>SOFa score $&gt; 14$</td>
</tr>
<tr>
<td>Prognosis for long-term survival</td>
<td>Prognosis for long-term survival (assessment of comorbid conditions)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Secondary considerations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifecycle considerations</td>
<td>Prioritize those who have had the least chance to live through life’s stages (age)</td>
<td>Age 0–49 years</td>
<td>Age 50–69 years</td>
<td>Age 70–84 years</td>
<td>Age $\geq 85$ years</td>
</tr>
</tbody>
</table>

Examples of severe comorbid conditions with associated life expectancy $< 1$ year. This list is meant as a guideline and is not exhaustive. Patients meeting the criteria of $< 1$ year predicted survival based on which of the listed or other similar conditions should be assigned a score of 3.

1. NYHA class IV heart failure.
2. Advanced lung disease with FEV$_1$ $< 25\%$ predicted, total lung capacity $< 60\%$ predicted, or baseline PaO$_2$ $< 55$ mmHg.
3. Primary pulmonary hypertension with NYHA class III or IV heart failure.
4. Chronic liver disease with Child-Pugh score $> 7$.
5. Severe trauma.
6. Advanced untreatable neuromuscular disease.
7. Metastatic malignant disease or high-grade brain tumors.

NYHA — New York Heart Association.

Treatment
Insufficient ICU ventilators
Insufficient oxygen supply
Insufficient medications

- Use transport ventilators and anesthesia units
- Splitting ventilators (i.e., attaching up to 4 COVID-19 patients to the same ventilator), using pressure cycling rather than volume cycling, and with continuous mandatory ventilation
- Improvised CPAP (iCPAP) to replace invasive ventilation
- Using bag-valve-ETT with PEEP valves
- Use portable oxygen concentrators rather than tanks, especially in field hospitals
- Early use of prone positioning
### 9.9 ARDS Network protocol to deliver lung protective ventilation

This protocol to deliver lung protective ventilation (LPV) was used in the low tidal volume (TV) trial published in 2000 (ARDS Network et al, 2000) (see References and resources). There are two PEEP/FIO\(_2\) grids; the second one can be used for more severe hypoxaemia.

Principles are the same for children except that children younger than 8 years require a lower maximum PEEP – 15 cm H\(_2\)O and the peak Pplat should be < 28 cm H\(_2\)O.

#### Ventilator set up and adjustment

1. Calculate predicted body weight (PBW):  
   - Males = 50 + 1.1 [height (cm) – 152]  
   - Females = 45.5 + 1.1 [height (cm) – 152].
2. Select any ventilator mode.
3. Set ventilator settings to achieve initial TV = 8 mL/kg PBW.
4. Reduce TV by 1 mL/kg at intervals ≤ 2 hrs until TV = 6 mL/kg PBW.
5. Set initial rate to approximate baseline minute ventilation (not > 35 breaths/min).
6. Adjust TV and RR to achieve pH and Pplat goals below.

#### Oxygenation goal: PaO\(_2\), 55–80 mmHg or SpO\(_2\), 89–95%

Use a minimum PEEP of 5 cm H\(_2\)O. Consider incremental PEEP/FIO\(_2\) combinations such as shown below to achieve goal. PEEP levels > 15 should not be used in children < 8 years.

<table>
<thead>
<tr>
<th>Lower PEEP/higher FIO(_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIO(_2)</td>
</tr>
<tr>
<td>PEEP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Higher PEEP/lower FIO(_2), for more severe hypoxaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIO(_2)</td>
</tr>
<tr>
<td>PEEP</td>
</tr>
</tbody>
</table>

- **Pplat goal:** ≤ 30 cm H\(_2\)O  
  - Check Pplat using 0.5 second inspiratory pause, at least every 4 hours and after each change in PEEP or TV.  
  - If Pplat > 30 cm H\(_2\)O or > 28 cm H\(_2\)O in children: decrease TV by 1 mL/kg steps (minimum = 4 mL/kg).  
  - If Pplat < 25 cm H\(_2\)O and TV < 6 mL/kg: increase TV by 1 mL/kg until Pplat > 25 cm H\(_2\)O or TV = 6 mL/kg.  
  - If Pplat < 30 cm H\(_2\)O and breath stacking or asynchrony occurs: may increase TV in 1 mL/kg increments to 7–8 mL/kg if Pplat remains ≤ 30 cm H\(_2\)O.
ARDS Network Protocol (cont’d)

- **pH goal: 7.30–7.45**
  - Acidosis management: (pH < 7.30),
    - If pH 7.15–7.30: increase RR until pH > 7.30 or PaCO₂ < 25 (maximum set RR = 35).
    - If pH < 7.15: increase RR to 35.
    - If pH remains < 7.15, TV may be increased in 1 mL/kg steps until pH > 7.15 (Pplat target of 30 may be exceeded). May give NaHCO₃ to act as a transient buffer.

- **Alkalosis management: pH > 7.45**
  - Decrease ventilator rate if possible.

- **Inspiration to expiration ratio goal**
  - Recommend that duration of inspiration be ≤ duration of expiration.
Key Points

• **Triage** to select those most at risk for deterioration AND most likely to benefit from limited resources

• Can monitor clinically with the aid of simple scores to aid (qSOFA, Pelod, ROX, NEWS, etc.)

• When initiating Oxygen or respiratory therapy it is ESSENTIAL to **monitor hourly for change:**
  • Those NOT improving need escalation in hours not days
  • e.g. nasal prong, face mask, HFNC, NIV, ETT
Key points 2

• Prone position MAY be helpful prior to need for intubation OR after intubated → assess response.
  • May be useful prior to intubation to assess need
• If available HFNC is preferable to NIV
• Once failed non-invasive oxygen method or NIV, do not delay intubation and mechanical ventilation
• Use lung protective strategy
• When mechanical ventilation is not available, systems for non-invasive CPAP can be fashioned
# Care of Critically Ill Patients with COVID-19

(Last updated June 11, 2020)

## Summary Recommendations

### Infection Control:
- For health care workers who are performing aerosol-generating procedures on patients with COVID-19, the COVID-19 Treatment Guidelines Panel (the Panel) recommends using fit-tested respirators (N95 respirators) or powered air-purifying respirators, rather than surgical masks, in addition to other personal protective equipment (i.e., gloves, gowns, and eye protection such as a face shield or safety goggles) (AIII).
- The Panel recommends that endotracheal intubation for patients with COVID-19 be performed by health care providers with extensive airway management experience, if possible (AIII).
- The Panel recommends that intubation be achieved by video laryngoscopy, if possible (CIII).

### Hemodynamic Support:
- The Panel recommends norepinephrine as the first-choice vasopressor (AII).

### Ventilatory Support:
- For adults with COVID-19 and acute hypoxic respiratory failure despite conventional oxygen therapy, the Panel recommends high-flow nasal cannula (HFNC) oxygen over noninvasive positive pressure ventilation (NIPPV) (BII).
- In the absence of an indication for endotracheal intubation, the Panel recommends a closely monitored trial of NIPPV for adults with COVID-19 and acute hypoxic respiratory failure for whom HFNC is not available (BII).
- For adults with COVID-19 who are receiving supplemental oxygen, the Panel recommends close monitoring for worsening respiratory status and that intubation, if it becomes necessary, be performed by an experienced practitioner in a controlled setting (AII).
- For patients with persistent hypoxemia despite increasing supplemental oxygen requirements in whom endotracheal intubation is not otherwise indicated, the Panel recommends considering a trial of awake prone positioning to improve oxygenation (CIII).
- The Panel recommends against using awake prone positioning as a rescue therapy for refractory hypoxemia to avoid intubation in patients who otherwise require intubation and mechanical ventilation (AII).
- For mechanically ventilated adults with COVID-19 and acute respiratory distress syndrome (ARDS), the Panel recommends using low tidal volume (VT) ventilation (VT 4–6 mL/kg of predicted body weight) over higher tidal volumes (VT >8 mL/kg) (BII).
- For mechanically ventilated adults with COVID-19 and refractory hypoxemia despite optimized ventilation, the Panel recommends prone ventilation for 12 to 16 hours per day over no prone ventilation (BII).
- For mechanically ventilated adults with COVID-19, severe ARDS, and hypoxemia despite optimized ventilation and other rescue strategies, the Panel recommends using an inspired oxygen concentration as a rescue therapy, if no rapid improvement in oxygenation is observed, the treatment should be tapered off (CIII).
- There are insufficient data to recommend either for or against the routine use of extracorporeal membrane oxygenation for patients with COVID-19 and refractory hypoxemia.

### Acute Kidney Injury and Renal Replacement Therapy:
- For critically ill patients with COVID-19 who have acute kidney injury and who develop indications for renal replacement therapy, the Panel recommends continuous renal replacement therapy (CRRT), if available (BII).
- If CRRT is not available or not possible due to limited resources, the Panel recommends prolonged intermittent renal replacement therapy rather than intermittent hemodialysis (BII).

### Drug Therapy:
- There are insufficient data for the Panel to recommend either for or against any immunomodulatory therapy in patients with severe COVID-19 disease.
- In patients with COVID-19 and severe or critical illness, there are insufficient data to recommend empiric broad-spectrum antimicrobial therapy in the absence of another indication.
QUESTIONS ?
2.9 Checklist for admission

☑ Once you have decided to admit a patient with severe influenza virus infection to the hospital, consider using this checklist to ensure the following have been done in preparation for admission. This is adapted from the *IMAI district clinician manual: hospital care for adults and adolescents* (WHO, 2011).

☐ Essential diagnostic tests obtained:
  e.g. complete blood cell count, chemistry panel, glucose, chest radiograph, upper respiratory tract specimens for viral testing (during influenza season), blood sample for culture (when possible, before first dose of antimicrobials), but do not delay antimicrobials.

☐ Emergency treatments given, patient's response checked:
  e.g. oxygen therapy, insertion of peripheral IV (use appropriate antisepsis for the skin to prevent catheter-related infections), initial fluid therapy (and vasopressors if in shock).

☐ First dose of antibiotics and oseltamivir (during influenza season).

☐ Documentation completed.

☐ Determined the level of care the patient needs:
  e.g. ICU, high dependency unit, ward.

☐ Determined infection prevention and control measures the patient needs.

☐ Verbal communication with ward staff completed to ensure continuity of care.

☐ Patient prepared for safe transfer.
2.10 Checklist for transfer

Transport of the critically ill patient can be risky as complications during this process can be life-threatening and may be related to clinical, organizational, or equipment issues.

Consider using this checklist to ensure the safe transport of the patient to the designated unit:
This is adapted from the IMAI district clinician manual: hospital care for adults and adolescents (WHO, 2011).

☐ Patient stabilized.

☐ Appropriate infection prevention and control measures in place:
  e.g. medical mask for patients with ARI.

☐ Everything secured: airway, NG tube, IV, monitors, endotracheal tubes, ventilator.

☐ Enough drugs: vasopressors, sedatives.

☐ Enough oxygen: adequate oxygen saturation (SpO₂).

☐ Enough IV fluids: blood pressure adequate.

☐ Health care workers (e.g. transporters, receiving staff) and receiving unit/ward prepared.
## 9.1 Memory aid: diagnosis and classification of ARDS

**Berlin definition of acute respiratory distress syndrome (ARDS)**

<table>
<thead>
<tr>
<th>Timing</th>
<th>Within 1 week of a known clinical insult or new or worsening respiratory symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chest imaging</strong></td>
<td>Bilateral opacities – not fully explained by effusions, lobar/lung collapse or nodules</td>
</tr>
<tr>
<td><strong>Origin of oedema</strong></td>
<td>Respiratory failure not fully explained by cardiac failure or fluid overload</td>
</tr>
<tr>
<td></td>
<td>Need objective assessment (e.g. echocardiography) to exclude hydrostatic oedema if no risk factor present</td>
</tr>
<tr>
<td><strong>Oxygenation</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mild</strong></td>
<td>$200 &lt; \text{PaO}_2 / \text{FiO}_2 \leq 300$ with PEEP or CPAP $\geq 5 \text{ cm H}_2\text{O}$</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>$100 &lt; \text{PaO}_2 / \text{FiO}_2 \leq 200$ with PEEP $\geq 5 \text{ cm H}_2\text{O}$</td>
</tr>
<tr>
<td><strong>Severe</strong></td>
<td>$\text{PaO}_2 / \text{FiO}_2 \leq 100$ with PEEP $\geq 5 \text{ cm H}_2\text{O}$</td>
</tr>
</tbody>
</table>

*Notes:*
* Chest radiograph or computed tomography scan;  
* If altitude is higher than 1000 m, the correction factor should be calculated as follows: \[ \text{PaO}_2 / \text{FiO}_2 \times \left( \text{barometric pressure} / 760 \right) \];  
* This may be delivered non-invasively in the mild ARDS group;  
* CPAP – continuous positive airway pressure; \( \text{FiO}_2 \) – fraction of inspired oxygen; \( \text{PaO}_2 \) – partial pressure arterial oxygen; PEEP – positive end-expiratory pressure.
## 9.2 Memory aid: diagnosis and classification of pARDS

### Paediatric acute respiratory distress syndrome (pARDS) definition

<table>
<thead>
<tr>
<th>Age</th>
<th>Exclude patients with perinatal related lung disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing</td>
<td>Within 7 days of known clinical insult</td>
</tr>
<tr>
<td>Origin of oedema</td>
<td>Respiratory failure not fully explained by cardiac failure or fluid overload</td>
</tr>
<tr>
<td>Chest imaging</td>
<td>Chest imaging findings of new infiltrates(s) consistent with acute pulmonary parenchymal disease</td>
</tr>
<tr>
<td>Oxygenation</td>
<td></td>
</tr>
<tr>
<td>Non-invasive mechanical ventilation</td>
<td></td>
</tr>
<tr>
<td>pARDS (no severity stratification)</td>
<td>Mild</td>
</tr>
<tr>
<td>Full face mask bilevel ventilation of CPAP ≥ 5 cm H₂O</td>
<td>4 ≤ OI &lt; 8</td>
</tr>
<tr>
<td>PF ratio ≤ 300</td>
<td>5 ≤ OSI &lt; 7.5</td>
</tr>
<tr>
<td>SF ratio ≤ 264</td>
<td></td>
</tr>
</tbody>
</table>

CPAP – continuous positive airway pressure; OI – Oxygenation Index ([FiO₂ × mean airway pressure × 100]/PaO₂); OSI – oxygen saturation index.
(A) In this configuration, the leak port is always open to atmosphere. Pressure is generated as the result of flow in the circuit and resistance through the leak port. Thus, with higher pressure, the ventilator must deliver more flow into the circuit. It is important to appreciate that, with this design, leak is integral to the function of the device. Thus, the leak should not be occluded. This circuit type is commonly used in ventilators designed for noninvasive ventilation. It is also the typical design for positive airway pressure devices used for the treatment of obstructive sleep apnea. (B) Single limb circuit with active exhalation valve near the patient. This circuit type is typically used with portable ventilators, such as those used for transport or in the home. During inspiration, the exhalation valve is closed via the pressurization line from the ventilator. (C) Dual limb