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Timbalan Ketua Pengarah Kesihatan (Kesihatan Awam)
Kementerian Kesihatan Malaysia
(u/p : Dr. Wan Noraini binti Wan Mohamed Noor)

Y.Bhg. Dato',

***GUIDELINES ON THE PAEDIATRIC INTENSIVE CARE UNIT (PICU)
MANAGEMENT OF CHILDREN WITH COVID19***

Dengan hormatnya saya merujuk kepada perkara di atas.

2. Bersama-sama ini disertakan ***Guidelines On The Paediatric Intensive Care Unit (PICU) Management Of Children With COVID19*** yang telah disediakan oleh pakar-pakar paediatik intensif KKM untuk dimuatturun ke dalam laman sesawang KKM.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,



(DATUK DR. HJ. ROHAIZAT BIN HJ. YON) (MMC : 26029)
Timbalan Ketua Pengarah Kesihatan (Perubatan)
Kementerian Kesihatan Malaysia

s.k Ketua Setiausaha
Kementerian Kesihatan Malaysia

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Pengarah Perkembangan Perubatan
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GUIDELINES ON THE PICU MANAGEMENT OF CHILDREN WITH COVID-19

INTRODUCTION

SARS CoV-2 (which causes COVID-19 disease) can result in severe respiratory infection and multi-organ dysfunction in some patients, especially among older patients with comorbidities.

The predominant signs and symptoms of COVID-19 reported to date among all patients are similar to other viral respiratory infections. These include fever, cough, and difficulty breathing. Gastrointestinal symptoms, including abdominal pain, diarrhea, nausea, and vomiting, were reported in a minority of adult patients.

There have been concerns that the virus may be airborne in certain situations. However, WHO guidance to date suggest that the virus that causes COVID-19 is mainly transmitted through contact with respiratory droplets rather than through the air. COVID-19 has been declared a pandemic by the WHO, and excellent up-to-date information on the disease burden and spread of the disease throughout the world is available on this website: <https://www.who.int/westernpacific/emergencies/covid-19>

SCOPE AND PURPOSE

This document provides guidance and information on infection control measures, recommended personal protective equipment and critical care considerations in managing seriously ill children with COVID-19 disease. It can be adapted based on clinical judgement and local circumstances. This guidance has been written for the Malaysian MOH hospitals, but the principles apply to other settings where healthcare is delivered. It is issued jointly by the MOH National Head of PICU Services, Head of PICU team from Hospital Tuanku Azizah Kuala Lumpur, Hospital Umum Sarawak, Hospital Raja Permaisuri Bainun Ipoh and Faculty of Medicine UiTM.

DEFINITION

Case definitions for children with confirmed and suspected COVID-19 should follow Annex 1 Case Definition of COVID-19.

CLINICAL DISEASE IN CHILDREN

Based on available evidence, epidemiologic data to date suggests that children afflicted by COVID-19 suffer less severe clinical manifestations compared to adults. While some children and infants have been sick with COVID-19, adults make up most of the known cases to date. As of Feb. 20, 2020, 2.4% of the 75,465 cases (confirmed and suspected) in China had occurred among persons younger than 19 years old. An analysis from one large city in southern China suggests that, among all cases, the proportion of children younger than 15 years old may have increased from 2% to 13% from the early phase to later in the outbreak.

In a report of nine hospitalized infants in China with confirmed COVID-19, only half presented with fever. At least one child to date had primarily gastrointestinal symptoms of vomiting, diarrhea, and anorexia at initial presentation. There have been multiple reports to date of children with asymptomatic SARS-CoV-2 infection.

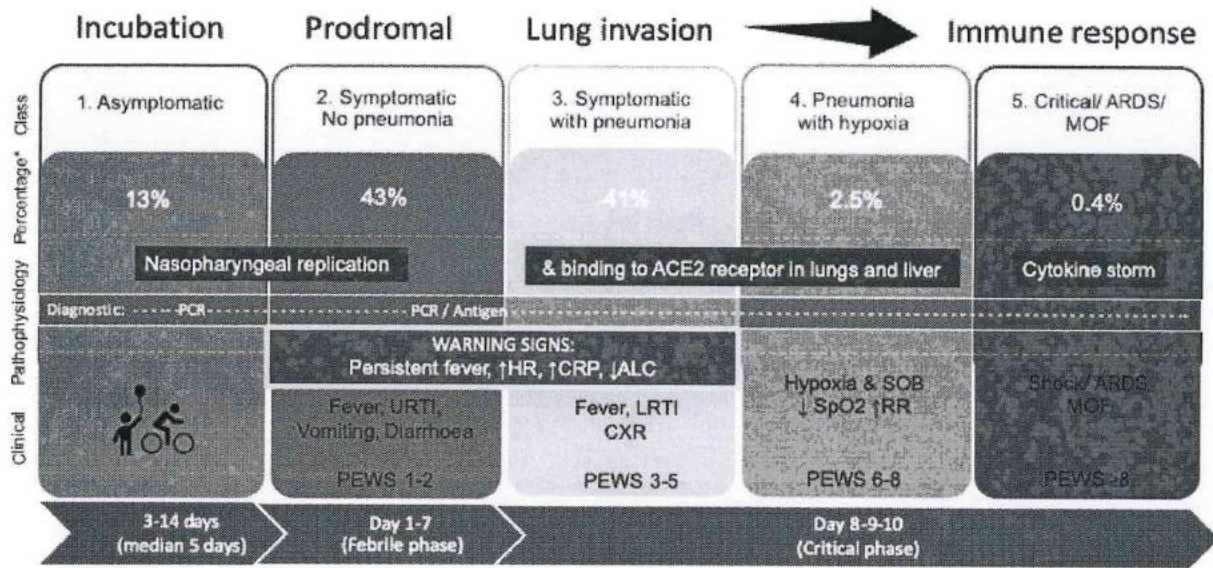
As of February 20, 2020, just one of the 2,114 deaths among 55,924 confirmed COVID-19 cases in China occurred among children younger than 20 years old. A more recent publication⁶ described a case series of 2134 paediatric patients in Wuhan. The youngest patients (under 1 year) had the highest proportion of severe or critical illness (10.6%), most of which were unconfirmed by specific COVID-19 testing (293/379). It is uncertain how many of these were actually RSV, Influenza or other viruses. This data was collected during peak bronchiolitis season. Critical illness (defined as presence of ARDS, shock or organ failure) was uncommon in general (0.4-0.6% overall).

Possible vertical transmission has been reported recently in newborns to COVID 19 mothers¹⁰. There are also reports on COVID 19 infection in neonates. However the symptoms were mild and outcomes were favourable.

In summary, the vast majority of available data is indicative of lower disease severity in children, and critical illness is extremely rare.

Figure 1. Suggested Clinical Classification of disease and timeline for COVID 19 infection in children.

Coronavirus disease in children



*Dong Y. *Pediatrics*. 2020 (missing value 0.1%). PEWS score adapted from Hospital Selayang

GOOD PRACTICE FOR PAEDIATRICIANS AND HEALTHCARE WORKERS

1. Only clinically essential meetings should occur
2. Telephone and videoconferencing facilities should be used whenever possible in place of face-to-face meetings, between healthcare professionals and in conducting patient consultations when clinically necessary.

CRITICAL CARE CONSIDERATIONS:

CRITERIA FOR PICU ADMISSION

SEVERE ILLNESS (Class/ Clinical stage 4 or 5)*refer to figure 1

CLINICAL

Child with cough or difficulty in breathing, plus at least one of the following:

1. central cyanosis or $SpO_2 < 90\%$
2. severe respiratory distress (e.g. grunting, very severe chest indrawing)
3. signs of pneumonia with general danger signs (inability to breastfeed or drink, lethargy or unconsciousness or seizures)
4. in very young child: respiratory exhaustion or apnoea
5. +/- gastrointestinal symptoms



OR

Shock in children: any hypotension (SBP < 5th centile for age) with at least 2 of the following features:

1. altered mental status
2. tachycardia or bradycardia (HR < 90 bpm or > 160 bpm for infants: HR < 70 bpm or > 150 bpm in children)
3. prolonged capillary refill time OR
4. vasodilation with bounding pulses; tachypnoea; mottled skin or presence of petechiae/purpura; increased lactate; decrease urine output or temperature instability.



LABORATORY

1. Lymphopenia and progressive reduction of lymphocyte count (ALC) $< 1.5 \times 10^9/L$
2. High LDH and D-dimer
3. Acidosis $pH < 7.3$ or $PaCO_2 > 50\text{mmHg}$
4. Serum Lactate $> 2.0\text{mmol/L}$

SEGREGATION/ COHORTING PATIENTS

A. PICU bed capacity:

1. The designated COVID-19 PICU or combined Adult-Paediatric-Neonatal COVID-19 ICU will be the designated ward for cohorting these patients.
2. Surge capacity will need to be arranged using any available space, such as High Dependency Wards, General Wards and Carers' Rooms, depending on the extent of clinical need.
3. Additional equipment, consumables and manpower will be required if expansion is implemented- this will be planned by the attending Consultant / Intensivist and PICU Ward Managers.

B. Suspected patients with COVID-19 (PUI):

1. Place patient in a negative-pressure isolation room whenever available. In the absence of negative pressure, patients will be cared for in isolation rooms, and finally in a dedicated open ward if no rooms available.
2. In a limited resource setting, highest risk patients should be given priority for negative pressure rooms, followed by isolation rooms and cohort open wards.
3. Assigning a dedicated team of healthcare workers to care for patients in isolation/cohort rooms is an additional infection control measure. This should be implemented whenever there are sufficient levels of staff available (so as not to have a negative impact on non-affected patients' care).
4. For a symptomatic PUI who has not yet been tested: Send an Oropharyngeal/ Nasopharyngeal swab or Nasopharyngeal Aspirate for COVID-19 PCR, and Respiratory Virus Panel as per national guidelines¹.
5. For intubated patients, a lower respiratory sample, e.g. Endotracheal Aspirate for COVID-19 PCR, is preferred over upper respiratory sampling⁴.
6. For guidance on definition, sampling technique, notification etc please refer to the same document¹. Consult Paediatric Infectious Disease Specialist if any additional input needed.

7. For SARI patients, suggest to cohort the patients and screen for SARS Cov-2 virus. Please wear the appropriate PPE while handling the patients [Annex 8 The Infection Prevention and Control (IPC) Measures in Managing Patient Under Investigation (PUI) or Confirmed COVID-19].

C. Designated COVID-19 PICU:

1. **NO** visitors in the rooms.
2. For young stable children, ONE parent/carer may be required to care for them. Carer should be isolated together with child until discharge. COVID-19 positive carers and children who can should wear a 3-ply face mask. If both parent and child are positive, a mask is not required.
3. All staff must document their details for contact tracing when they first come into contact with a suspected / confirmed COVID-19 patient using the standard MOH listing document.
4. Minimize the number of personnel and time spent in a COVID-19 patient's room. For stable patients, accompanying parents / carers can be taught to perform vital sign measurements and basic nursing care, to reduce the need for healthcare worker (HCW) contact and conserve PPE. If a chaperone is needed, he/she should be outside the Isolation Room chaperoning the doctor whenever presence in the room can be avoided.
5. **Personal Protective Equipment (PPE):** When entering a patient's room who is suspected or confirmed to have COVID-19, staff should wear OT scrubs and the following PPE **MUST** be worn (Appendix 1):
 - I. N-95 mask. Fit testing is required. N95 masks should be available in the PICU. If impossible to obtain N-95 mask, 3-ply face mask should be used.
 - II. Goggles or Face Shield
 - III. Shoe Covers
 - IV. Long Sleeve Isolation Gown
 - V. Double Glove (1st pair inside gown sleeve and 2nd over the sleeve)
 - VI. Plastic Apron
 - VII. Hair Cover
 - VIII. Hand hygiene pre and post. Soap and water are best, but alcohol rub is effective.

- IX. Proper donning and doffing technique with an **observer** to ensure compliance- follow the national guidance¹.
- X. Change to new gown and new outer gloves when transporting patient to a new location.

6. **Equipment (i.e. ultrasound, video laryngoscope, etc):**

- I. Drape nonessential parts of equipment with waterproof drapes to minimize exposure.
- II. All equipment brought into the patient's room must remain there and will be unusable until appropriately disinfected.

7. **Respiratory considerations:**

- I. The **RECOMMENDED** mode of respiratory support for any child with respiratory failure is **INVASIVE VENTILATION**.
- II. **Non humidified** oxygen therapy (nasal cannulae, face mask, high flow mask) with target SpO₂ of 92-96% is preferred.
- III. High Flow Nasal Cannulae can be considered with the additional measure of placing a 3-ply surgical face mask on top of the HFNC to reduce aerosol spread and reduce the risk of virus transmission⁸.
- IV. Children who are receiving HFNC should be monitored closely. Proceed with early intubation if there are signs of progressive respiratory distress after a maximum of 1-2 hours on HFNC. The goal is to intubate early when needed, and avoid emergency intubations whenever possible.
- V. Non-invasive ventilation (NIV) modes such as Continuous Positive Airway Pressure (CPAP) and Bilevel Positive Airway Pressure (BiPAP) are not advised as they may disseminate droplet spread more readily.
- VI. Use disposable stethoscopes if available, and clean earpiece thoroughly with alcohol swabs before use.
- VII. Other procedures that may cause aerosolisation of a patient's respiratory secretions include provision of humidified high flow oxygen and nebulisation. These are not considered to represent a significant infectious risk; however, the use of MDI could be considered as alternatives to flow driven nebulisation.

8. Monitoring

- I. Class 1 PUI/ COVID 19 positive patients need to be monitored for clinical wellbeing and vital signs as per usual. *Refer to Figure 1.*
- II. However, for Class 2 and Class 3 PUI/ COVID 19 positive patients, PEWS charting is recommended to ensure early recognition of patient deterioration and steps need to be taken by the attending HCW.

D. INTUBATION:

Intubation should be done safely with the aim of **minimizing aerosolization of virus** (prevent spread), **maximising first-pass success** (patient safety) and **reducing personnel exposure** (limit contamination). The use of a checklist and closed loop communication are essential. Simulation training should be done on a regular basis.

1. Early elective tracheal intubation is preferred with the goal of avoiding emergent intubations.
2. Briefing of the strict protocolised intubation process, identification of roles and confirmation of airway plan should be done prior to entering the room.
3. Staffing:
 - I. Person to intubate – the most experienced staff on duty (senior registrar/paediatrician or intensivist).
 - II. If the patient is deemed **at risk for difficult intubation, and in centres without Paediatric Intensivists**, an experienced Anesthesiologist and/or ENT Specialist should be called as needed.
 - III. Limit clinicians in room for intubation: Maximum 3 people inside the room. Additional staff may be gowned in full PPE and waiting outside to help if needed, depending on the patient's condition.
4. Intubation and extubation should be performed in a **negative pressure room** depending on availability. An isolation room is a less favourable option.
5. Wear **enhanced droplet personal protective equipment (PPE)** as described above, and have a colleague check adequacy of PPE whenever possible.

6. **Powered Air Purifying Respirators (PAPRs)** will be available in the PICU, or can be obtained from Emergency Department or Adult ICU if needed. PAPR should be used if available, ideally by all personnel in the room during intubation. If limited PAPR available, priority will be for the staff performing endotracheal intubation.
7. Video laryngoscope should be used if available and staff competent in its use.
8. Equipment/Supplies:
 - I. Use dedicated COVID Video Laryngoscope (if available). If no video laryngoscope, use disposable laryngoscope.
 - II. Use the dedicated COVID Emergency Bag (Appendix 2) for airway supplies, but **LEAVE BAG OUTSIDE OF PATIENT ROOM**.
 - III. Use disposable equipment whenever possible and wipe down all other equipment with disinfectant.
 - IV. Drape non-essential parts of carts (i.e. ultrasound, video laryngoscopes) when in room.
9. Procedure:
 - I. Leave personal belongings outside.
 - II. Consider additional personnel in full PPE outside the patient room in anticipated difficulty with securing the airway or need for complex airway manoeuvre.
 - III. Preparation:
 - a. Refer to Pre-Intubation Checklist (Appendix 3)
 - b. Equipment at bedside: Use COVID video laryngoscope if available, cuffed ETT (age appropriate) with stylet. Prepare personnel, patient, equipment and medication as per checklist.
 - c. Induction agents: Use IV Fentanyl 1mcg/kg + Ketamine 1mg/kg + Rocuronium 1mg/kg unless contraindicated (rapid-acting agents with minimal hypotensive effects preferred).
**For those who are not familiar with Rocuronium use, Suxamethonium 1-2mg/kg is an option for stable haemodynamics patients with no contraindications.*
 - d. Avoid atomized local anaesthetic and nebulized medication administration.

- IV. Modified Rapid Sequence Intubation is recommended, without cricoid pressure.
- V. Minimize suctioning or other airway manipulation.
- VI. **Pre-oxygenation for 3-5 minutes via:** (option of 3 methods)
 - a. **Non rebreathing face mask** with 100% oxygen at flow rate of 10-15L/min (*for non-experts*).
 - b. **Flow-inflating bag (Ayre's T-piece)** attached to an HMEF and a tight-fitting mask with 100% oxygen at flow rate 6-10L/min (*for experts*).
 - c. **HFNC** with FiO₂ of 100% and proceed with apnoeic oxygenation. Apply a 3ply mask on top of nasal canulae to reduce aerosol spread. Switch off the machine during intubation (*for experts*).
- VII. After pre-oxygenation and ready for intubation, apply plastic cover over the face area and place appropriately sized **mask + HMEF + Self-inflating bag/ T-piece** with flow running at 6-10L/min as shown in the picture (Appendix 6)
- VIII. Avoid bag-mask ventilation unless patient desaturated. If needed, always use an HMEF at the end of the bag. If possible, use a two-handed technique to maintain seal (2-person technique) (Appendix 6).
- IX. Appropriate induction and paralysing agents need to be used to avoid patient coughing and struggling during intubation. Allow adequate time for NMBD onset of paralysis prior to attempting intubation (at least 1 minute for Rocuronium).
- X. Proceed with intubation if there are signs of respiratory failure.
- XI. If you have a clear view of ETT passing through vocal cords, and the ventilator is set up with ETCO₂ monitoring, consider connecting directly to ventilator (to minimize disconnects).
- XII. Change connector of ETT and connect closed suction system and HME as in the diagram, before connecting to ventilator (Appendix 4).
- XIII. Look for chest rise, improving saturations and confirm CO₂ tracing with the ventilator.
- XIV. Cover laryngoscope blade with outer glove immediately after confirming placement of ETT.
- XV. In the event of failed intubation, consider inserting a Laryngeal Mask Airway.
- XVI. Use a Paediatric HMEF between ETT and Y-piece or expiratory limb of ventilator circuit. Make sure CO₂ sampling line is post-filter (Appendix 4).

- XVII. **DO NOT USE EXTERNAL HEATED HUMIDIFIER** (e.g. heated plate humidifier) except in smaller children whereby the risk of tube blocked by thick secretion due to dry circuit is higher.

10. Post-Procedure

- I. All disposable airway equipment should be gently placed in a biohazard bag and sealed after intubation and outer glove of hand that touches ETT should be discarded as well.
- II. Adhere to doffing procedures with an observer, including hand washing.
- III. Follow steps according to this video (minor modifications may be necessary depending on local setting):
https://www.youtube.com/watch?v=yytVJzTgV_c
- IV. All equipment brought into the patient's room must remain there and will be unusable until appropriately disinfected.

11. Management:

General

- I. For now, care is supportive in nature.
- II. Most of the experience managing critically ill COVID-19 patients is in adults, and the following recommendations are largely extrapolated from adult data.

Ventilation

- I. Give supplemental oxygen immediately to patients with SARI and respiratory distress, hypoxaemia or shock.
- II. Adult experience has shown that severely affected patients have severe hypoxaemic respiratory failure with relatively preserved lung compliance.
- III. The use of moderately elevated PEEP, controlled tidal volumes (4-8ml/kg), and high FiO₂ (0.6-0.7) has been used in critically ill adults. There is not much experience in paediatric patients up to now.
- IV. Early prone positioning for at least 12-16 hours a day has shown beneficial results in adults, and should be considered in persistently hypoxaemic children.
- V. Ventilation strategy should be implemented in accordance to current PARDS guidelines². (Appendix 2)

- VI. When managing an invasively ventilated child with suspected or confirmed COVID-19, early consultation with a Paediatric Intensivist or Consultant Paediatrician with PICU experience is recommended.
- VII. Circuit disconnection should be avoided as far as possible. If disconnection is necessary, the circuit should be disconnected proximal to the HMEF, to reduce risk of virus transmission.
- VIII. When changing the HMEF, the ventilator should be put on Standby and the ETT carefully clamped until the new HMEF is safely attached.

Circulation

- I. For children in shock, a fluid restrictive strategy with boluses of buffered or balanced crystalloids is preferred.
- II. If inotropes are required for septic shock, Adrenaline and Noradrenaline are the inotropes and vasopressors of choice. Dopamine should be avoided whenever possible.
- III. In the presence of hypoperfusion and significant cardiac dysfunction noted during ECHO, after fluid resuscitation and initiation of noradrenaline and adrenaline, we suggest adding dobutamine. The dose of dobutamine should not exceed 10 mcg/kg/min if possible.
- IV. Steroids should be avoided except in refractory catecholamine-resistant shock or suspected/confirmed adrenal insufficiency.

Fluids and Medication

- I. A restrictive fluid strategy should be used in euvolemic children, with fluid restriction to 2/3rd maintenance and avoidance of excessive positive balance. Fluid overload may worsen oxygenation especially in settings with limited availability of mechanical ventilation.
- II. Early enteral nutrition is preferred over intravenous fluids whenever possible.
- III. Steroids are **NOT shown to be beneficial** in improving ventilation, and should **NOT be given** unless indicated for another reason, as this may increase duration of viral shedding.
- IV. Consult Paediatric Infectious Disease colleagues and national guidance for role of antiviral therapies and novel therapies such as Kaletra (Lopinavir and Ritonavir), Hydroxychloroquine and Interferon-beta/ Interferon alpha.

- a. Lopinavir/ritonavir and Interferon beta/ Interferon alpha have been used for treatment of children with COVID-19 in China but safety and efficacy of these drugs have not been determined. Remdesivir is an investigational antiviral drug that has been reported to have in-vitro activity against SARS-CoV-2. Some adult patients with COVID-19 have received intravenous remdesivir through clinical trials or compassionate use, although remdesivir has not been used for treatment of children with COVID-19.

The treatment regime as suggested in the latest MOH guideline 5th edition. Kindly discuss with ID Consultant/ Paediatrician for specific treatment. Dose range as per drug dosage recommended for children.

Figure 2. Suggested treatment regime for children with COVID 19

CLASS/ CLINICAL STAGE	1	2	3	4	5
Hydroxychloroquine*		✓	✓	✓	✓
Lopinavir/ Ritonavir			✓ + warning sign	✓	✓
Ribavirin					✓ OR
s/c Interferon β					✓

*alternative chloroquine

Sepsis

- I. If sepsis is clinically suspected or child requires mechanical ventilation, early empirical antibiotic therapy should be considered within **ONE hour** of identification of sepsis or respiratory failure, and appropriate cultures taken. Assess for de-escalation daily. Empiric therapy should be de-escalated on the basis of microbiology results and clinical judgement³.
- II. Management of sepsis and septicaemic shock should be done in accordance with the current Surviving Sepsis Campaign Paediatric guidance³. See weblink in the 'References' section for the full guidance.
- III. In critically ill children with fever, we suggest the use of Paracetamol for temperature control.

- IV. According to adult guidance, the routine use of IV Immunoglobulin or covalent plasma in critically ill COVID-19 patients cannot be recommended at present due to lack of evidence. The role of these therapies in critically ill children is unclear.

Transfer of Patients

- I. Do not disconnect circuit for transfer, or clamp ETT with forceps.
- II. Maintain HMEF during transport. Use Isopod for transfer depending on availability.
- III. Consider using PICU ventilator by transporting patient with PICU ventilator to Operating Theatre/ destination. Use planned routes that minimize exposure.
- IV. Consider paralysis with rocuronium infusion for transport
- V. HCWs transporting patients must wear appropriate PPE.
- VI. Assign a dedicated transporter in PPE for opening doors, pushing elevator buttons without touching the patient
- VII. Remove PPE in anteroom upon arrival at destination (i.e. OT or PICU)

Extubation

- I. Wear appropriate PPE (Appendix 1).
- II. You may place low flow nasal cannula oxygen prior to removal of ETT to ensure good oxygenation. A face mask oxygen can be applied post extubation to enhance oxygenation.
- III. Consider using a clear plastic drape for equipment and over the face mask oxygen upon patient waking up (emergence) in view of possibility of coughing and aerosolization of secretions.
- IV. Dispose of ETT gently in biohazard bag and seal.

CARDIAC ARREST / CPR:

1. Will be evaluated on an individual basis with Senior Consultant or Paediatric Intensivist in charge. General risks and benefits to be considered.
2. Most experienced staff to intubate; intubation strategy, as above.
3. Do not enter room without PPE.
4. Minimize personnel.
5. Paediatric Emergency Trolleys will be available in PICU and in Emergency Department.

6. Even in emergent situations, personnel are **NOT** permitted to shortcut PPE requirements.

EXTRACORPOREAL ORGAN SUPPORT

1. Adult guidance suggests use of veno-venous ECMO in adults with refractory hypoxaemic respiratory failure despite optimizing ventilation, lung recruitment and proning. There is no data on the role of ECMO in children, and it is unlikely to be an option in most MOH centres due to lack of availability.
2. There is no published data on the role of CRRT or TPE in the management of COVID-19 in children. Risks and benefits must be considered on an individual basis and the advice of an experienced paediatric intensivist or paediatric nephrologist should be sought.

DEATH

In the event of a death from COVID-19, a paediatrician / intensivist must notify Forensic services and the CPRC as per national guidelines¹.

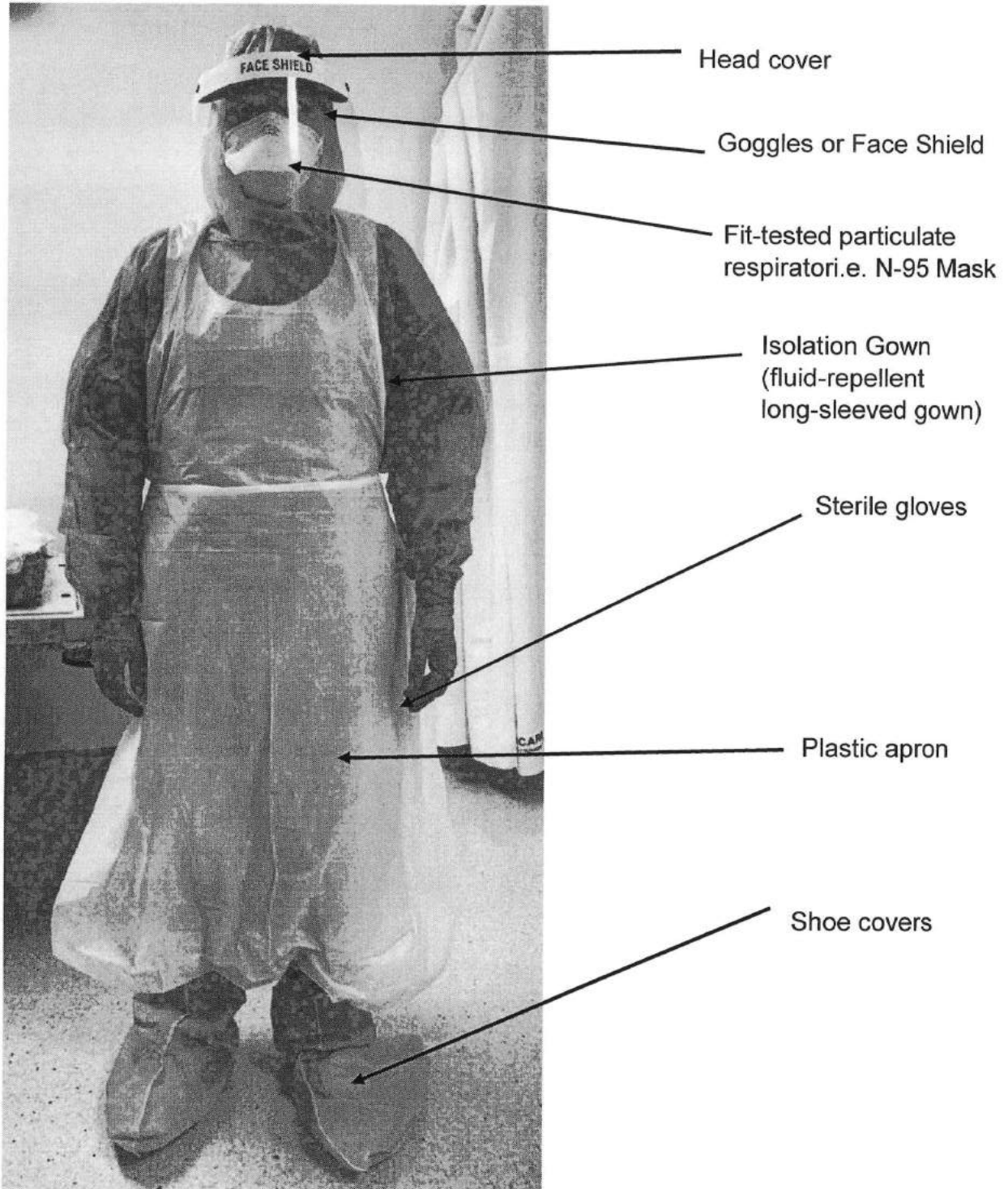
Acknowledgement:

Dr Muhammad Yazli Yuhana, Faculty of Medicine UiTM

(adaptation of infographics for classification of disease for adult COVID 19 patients)

Appendix 1

Level II Personal Protective Equipment (PPE) with N95



Level III Personal Protective Equipment (PPE) with PAPR



Appendix 2

Please follow the weblink below for the Paediatric Acute Respiratory Distress Syndrome Consensus Recommendations from the Paediatric Acute Lung Injury Consensus Conference http://pedscm.vpicu.net/file_uploads/PALICC_pediatric_ARDS.pdf

Table 1: Definition of Paediatric ARDS

Age	Exclude patients with peri-natal related lung disease			
Timing	Within 7 days of known clinical insult			
Origin of Edema	Respiratory failure not fully explained by cardiac failure or fluid overload			
Chest Imaging	Chest imaging findings of new infiltrate(s) consistent with acute pulmonary parenchymal disease			
Oxygenation	Non Invasive mechanical ventilation	Invasive mechanical ventilation		
	PARDS (No severity stratification)	Mild	Moderate	Severe
	Full face-mask bi-level ventilation or CPAP ≥ 5 cm H ₂ O ² PF ratio ≤ 300 SF ratio ≤ 264 ¹	$4 \leq OI < 8$	$8 \leq OI < 16$	$OI \geq 16$
		$5 \leq OSI < 7.5$ ¹	$7.5 \leq OSI < 12.3$ ¹	$OSI \geq 12.3$ ¹
Special Populations				
Cyanotic Heart Disease	Standard Criteria above for age, timing, origin of edema and chest imaging with an acute deterioration in oxygenation not explained by underlying cardiac disease. ³			
Chronic Lung Disease	Standard Criteria above for age, timing, and origin of edema with chest imaging consistent with new infiltrate and acute deterioration in oxygenation from baseline which meet oxygenation criteria above. ³			
Left Ventricular dysfunction	Standard Criteria for age, timing and origin of edema with chest imaging changes consistent with new infiltrate and acute deterioration in oxygenation which meet criteria above not explained by left ventricular dysfunction.			

Table 2: Patients at Risk of PARDS

Age	Exclude patients with peri-natal related lung disease		
Timing	Within 7 days of known clinical insult		
Origin of Edema	Respiratory failure not fully explained by cardiac failure or fluid overload		
Chest Imaging	Chest imaging findings of new infiltrate(s) consistent with acute pulmonary parenchymal disease		
Oxygenation	Non Invasive mechanical ventilation		Invasive mechanical Ventilation
	Nasal mask CPAP or BiPAP	Oxygen via mask, nasal cannula or High Flow	Oxygen supplementation to maintain SpO ₂ $\geq 88\%$ but OI < 4 or OSI < 5 ¹
	FiO ₂ $\geq 40\%$ to attain SpO ₂ 88-97%	SpO ₂ 88-97% with oxygen supplementation at minimum flow ² : < 1 year: 2 L/min 1 – 5 years: 4 L/min 5 – 10 years: 6 L/min >10 years: 8 L/min	

Appendix 3

COVID-19 Pre-Intubation Checklist

PICU HOSPITAL TUNKU AZIZAH KUALA LUMPUR PAEDIATRIC TRACHEAL INTUBATION CHECKLIST FOR COVID-19

PPE AND PERSONNEL

PREPARE EQUIPMENT

PREPARE FOR DIFFICULTY

INTUBATION

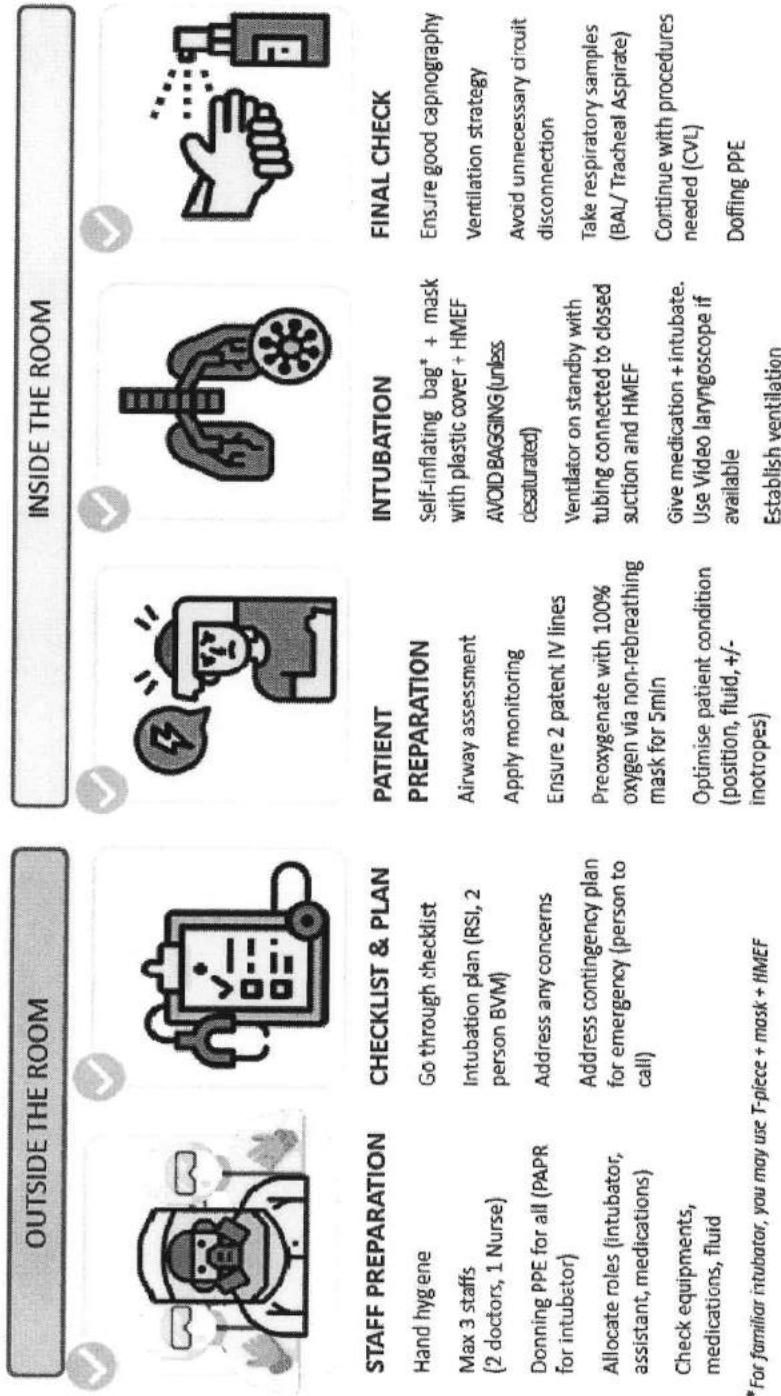
POST INTUBATION

OUTSIDE THE ROOM	INSIDE THE ROOM	
<p><input type="checkbox"/> Hand hygiene</p> <p><input type="checkbox"/> PPE - <input type="checkbox"/> N95 <input type="checkbox"/> Goggles/ face shield <input type="checkbox"/> Gown <input type="checkbox"/> Head cover <input type="checkbox"/> Shoe / boot cover <input type="checkbox"/> Gloves</p> <p><input type="checkbox"/> Checking each other's PPE</p> <p><input type="checkbox"/> Intubator & - <input type="checkbox"/> PAPR Assistant</p> <p><input type="checkbox"/> Write name on plastic gown</p> <p><input type="checkbox"/> Allocate roles <input type="checkbox"/> Team leader <input type="checkbox"/> Intubator <input type="checkbox"/> Assistant <input type="checkbox"/> Drugs <input type="checkbox"/> Monitor <input type="checkbox"/> Timer <input type="checkbox"/> Runner (outside)</p> <p>*MAX ONLY 3 people inside</p> <p><input type="checkbox"/> Plan on how to get help if required</p>	<p><input type="checkbox"/> Intubation plan <input type="checkbox"/> RSI <input type="checkbox"/> 2 handed <input type="checkbox"/> 2 person BMV</p> <p><input type="checkbox"/> All plan agreed</p> <p><input type="checkbox"/> Anybody has concerns</p> <p><input type="checkbox"/> Identify who to contact in an emergency. Do they need to be pre-warned? <input type="checkbox"/> No <input type="checkbox"/> Yes</p>	<p><input type="checkbox"/> Airway assessment</p> <p><input type="checkbox"/> Difficult airway? <input type="checkbox"/> Yes → Anaesthetist help <input type="checkbox"/> No</p> <p><input type="checkbox"/> Apply monitoring <input type="checkbox"/> SpO2 <input type="checkbox"/> Capnography <input type="checkbox"/> ECG <input type="checkbox"/> BP (1 min auto)</p> <p>Prepare patient <input type="checkbox"/> 2 patent IV access <input type="checkbox"/> Pre oxygenate with 100% O₂ <input type="checkbox"/> Optimise patient's position <input type="checkbox"/> Does an NG tube need to be inserted or aspirated?</p> <p>Could the patient's condition be optimised further before intubation? <input type="checkbox"/> Inotropes <input type="checkbox"/> Fluid</p> <p><input type="checkbox"/> Ready to proceed?</p>
<p>Check equipment (Airway + Breathing) <input type="checkbox"/> Bag Valve Mask with attached bacterial/viral filter and O₂ tube <input type="checkbox"/> Mask <input type="checkbox"/> Guarded airway <input type="checkbox"/> Laryngoscope (or video laryngoscope if available) <input type="checkbox"/> Closed suction <input type="checkbox"/> Appropriate cuffed ETT size x 2 <input type="checkbox"/> Syringe <input type="checkbox"/> Bougie/ stylet <input type="checkbox"/> ETT tapes and string <input type="checkbox"/> Capnography (etCO₂) <input type="checkbox"/> Ryles tube <input type="checkbox"/> Mucus extractor</p> <p>Prepare drugs <input type="checkbox"/> Ketamine <input type="checkbox"/> Fentanyl <input type="checkbox"/> Rocuronium <input type="checkbox"/> Inotropes / Emergency drugs <input type="checkbox"/> Maintenance sedation</p> <p>Fluid <input type="checkbox"/> Normal saline <input type="checkbox"/> Human Albumin 5% (Plasmanate) <input type="checkbox"/> Dextrose 10%</p>	<p><input type="checkbox"/> Airway</p> <p><input type="checkbox"/> Establish ventilation ONLY after cuff is inflated</p> <p><input type="checkbox"/> Check capnography</p> <p><input type="checkbox"/> Clamp ETT and put ventilator on standby mode for each disconnection</p> <p><input type="checkbox"/> Avoid unnecessary circuit disconnection</p> <p><input type="checkbox"/> Connect bacterial / viral filter to ventilator</p> <p><input type="checkbox"/> While still wearing PAPR and full PPE, to take tracheal aspirate sample</p> <p><input type="checkbox"/> Careful equipment disposal</p> <p>**STRICT DOFFING OF PPE <input type="checkbox"/> Observe each other</p>	

Intubation Steps in COVID-19 Patients – Pictorial Guide

Guidelines on the PICU Management of Children with COVID-19
Ministry of Health Malaysia. VI, March 2020

Intubation Steps in COVID 19 patients



* For familiar intubator, you may use T-piece + mask + HMEF

Appendix 5

Photo: Setup of Self-Inflating Bag, ETT and Ventilator with ETCO₂ sampling line, HME/Filter and Closed Suction System

Note that End-tidal CO₂ sampling line is connected **PROXIMAL** to the HME/Filter, to avoid virus contamination of the sampling line.

Heat Moisture Exchanger with Bacterial/Viral Filter (HMEF)

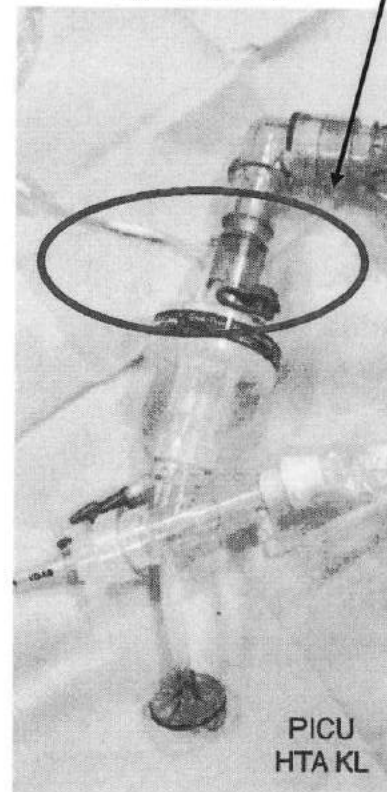
Bag-valve-mask connected to end tidal CO₂, HME bacterial/viral filter and mask



Bag-valve-mask connected to end tidal CO₂, HME bacterial/viral filter and ETT

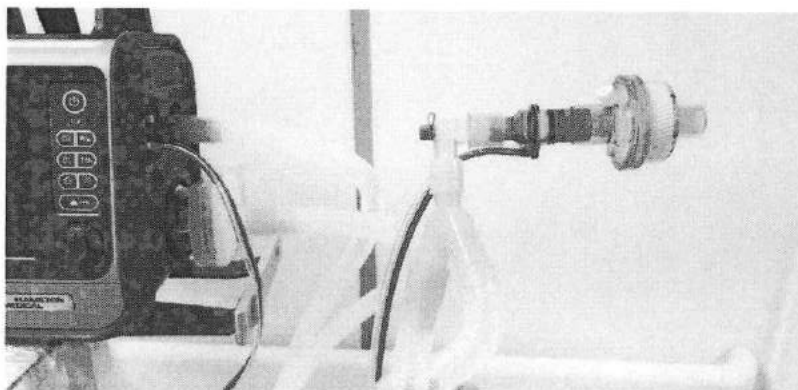


Ventilator circuit connected to end tidal CO₂, HME bacterial/viral filter, ETT and closed suction

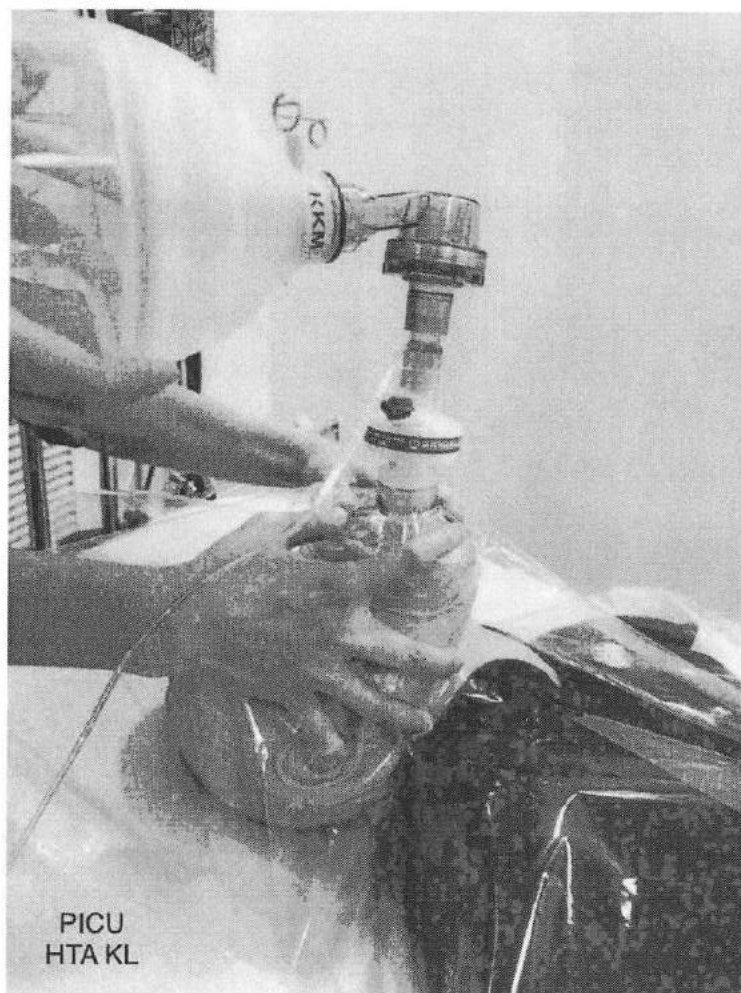


Appendix 6

Setup of Ventilator Tubing with HMEF for a Transport Ventilator



Use of a Plastic Sheet to Cover Patient's Face during Bag Mask Ventilation, and 2-Hand Technique to Hold Face Mask



Appendix 7

Checklist for COVID Emergency Bag (for resuscitation outside PICU)

No.	Item	Tick
1	2 full sets of PPE	
2	Oropharyngeal airways- various sizes	
3	In-line suction catheter and ETT connector	
4	Yankauer suction device	
5	Suction catheters	
6	Disposable Laryngoscope + blades	
7	Handheld Video laryngoscope (if available)	
8	Stethoscope	
9	ET tubes (cuffed preferred)-various sizes	
10	ETT Stylet	
11	Disposable Laryngeal mask airway- various sizes	
12	Syringes	
13	Nasogastric tube	
14	ETT tape + Scissors	
15	Self-inflating Bag	
16	Face Mask- various sizes	
17	HME/Bacterial+ViralFilter(HMEF)	
18	IV Cannulae and IV infusion tubing	
19	Alcohol swabs	
20	Drugs for Intubation (Fentanyl+Rocuronium+Ketamine)	
21	Adrenaline	

Appendix 8

Example of Paediatric Early Warning Score

Age	PEWS SCORE	3	2	1	0	1	2	3	Score
0 – 3 months	RR	<15	<20	<30	30 – 60	>60	>70	>80	
	RE				normal	mild	mod	severe	
	O ₂ T			≤2L			>2L		
	SpO ₂	≤85	86 – 89	90 – 93	≥94				
	Systolic BP	<45	<50	<60	60 – 80	>80	>100	>110	
	HR	<80	<90	<110	110 – 150	>150	>180	>190	
	CRT			>2 sec	≤2 sec				
	AVPU				A	V		P/U	
4 – 11 months	RR	<15		<30	30 – 50	>50	>60	>70	
	RE				normal	mild	mod	severe	
	O ₂ T			≤2L			>2L		
	SpO ₂	≤85	86 – 89	90 – 93	≥94				
	Systolic BP	<60	<70	<80	80 – 100	>100	>110	>120	
	HR	<60	70-100	100-110	110 – 150	>150	>170	>180	
	CRT			>2 sec	≤2 sec				
	AVPU				A	V		P/U	
1 – 4 years	RR	<15		<20	20 – 40	>40	>50	>60	
	RE				normal	mild	mod	severe	
	O ₂ T			≤2L			>2L		
	SpO ₂	≤85	86 – 89	90 – 93	≥94				
	Systolic BP	<70	<80	<90	90 – 110	>110	>120	>130	
	HR	<60	60-80	<80	80 – 130	>130	>150	>170	
	CRT			>2 sec	≤2 sec				
	AVPU				A	V		P/U	
5 – 11 years	RR	<10		<15	15 – 30	>30	>40	>50	
	RE				normal	mild	mod	severe	
	O ₂ T			≤2L			>2L		
	SpO ₂	≤85	86 – 89	90 – 93	≥94				
	Systolic BP	<80		<90	90 – 120	>120	>130	>140	
	HR	<50	50-70	<70	70 – 110	>110	>130	>150	
	CRT			>2 sec	≤2 sec				
	AVPU				A	V		P/U	
12+ years	RR	<10		<15	15 – 20	>20	>25	>30	
	RE				normal	mild	mod	severe	
	O ₂ T			≤2L			>2L		
	SpO ₂	≤85	86 – 89	90 – 93	≥94				
	Systolic BP	<90		<110	110 – 120	>120	>130	>150	
	HR	<40	40-60	<60	60 – 100	>100	>120	>140	
	CRT			>2 sec	≤2 sec				
	AVPU				A	V		P/U	

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