# INTERIM INTENSIVE CARE UNIT (ICU) PROTOCOL

# FOR THE CARE OF PATIENTS WITH COVID-19

**PREPARED BY:**

**NEPALESE SOCIETY OF CRITICAL CARE MEDICINE**

**(NSCCM)**

**6th September, 2020 AD**

**Contributors:**

**Dr. Hem Raj Paneru (Co-ordinator)**
**Dr. Diptesh Aryal**
**Dr. Gentle Sunder Shrestha**
**Dr. Mukund Prasad Kafle**
**Dr. Sabin Koirala**
**Dr. Tamanna Bajracharya**
**Prof. Dr Subhash Prasad Acharya**
**Prof. Dr. Shital Adhikari**
**Dr. Lava N Joshi**
**Dr. Sanjay Lakhey**

## Contents

# 1 Purpose of the protocol

Coronavirus Infectious Disease - 2019 (COVID – 19) is caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) affecting millions and killing tens of thousands of individuals around the globe. COVID-19 is a disease whose pathobiology is still not fully understood at the time writing this protocol.

This document provides guidance to help clinicians managing critically ill patients with COVID-19 in the intensive care unit (ICU). It is based on current limited evidence which is still evolving and will require frequent updates in the future. These suggestions should not be considered as mandates, but as an interim guidance to standardize care and to improve outcomes. Moreover, this protocol aims to improve safety of patients in need of critical care during the COVID-19 pandemic and to protect healthcare professionals from infection.

The target users of this protocol are clinicians and allied healthcare professionals involved in the care of patients with COVID-19 in the ICU.

This is an interim version of the protocol. With the emerging evidences in future, we will come up with a second version of the protocol if needed.

## 2 Organization of ICU

- Define and identify level of ICU care
- Preferably use private rooms with good ventilation for each patient
- Designate one senior physician as clinical co-ordinator for ICU
- Designate one senior nurse as ICU in-charge
- ICU bed: Nurse ratio should be 1:1 for Level III, 2:1 for Level II (High Dependency Unit), and 3 – 4: 1 for level I (Monitoring bed)
- One attendant/ housekeeping staff for every 6 beds
- Visitors not allowed to stay by the side of patients
- Visitors allowed for brief time with PPE if available otherwise can connect via phone/internet
- Define visiting time for family members
- Do family meeting as soon as possible after patient's admission to ICU
- Make separate entry and exit from ICU

## 3 ICU Admission Criteria

### 3.1 Admit to Level III ICU, if any one of the following is present:

1. Respiratory failure requiring mechanical ventilation
2. Presence of shock requiring vasopressors or inotropes
3. Older patients (>60 years) with comorbidities
4. $PaO_2/FiO_2$ < 200 mmHg (or $SPO_2/FiO_2$ ratio ≤ 235 if ABG is not available) with respiratory distress

### 3.2 Admit to Level II ICU bed (Step-down or High Dependency Unit), if any one of the following is present:

1. Respiratory rate ≥ 30 breaths/min
2. $SPO_2$ ≤ 90% in room air at rest
3. $PaO_2/FiO_2$ ≤ 300 mmHg (or $SPO_2/FiO_2$ ratio ≤ 315 if ABG is not available)
4. Multi-organ dysfunction syndrome

### 3.3 Admit to Level I ICU bed (Monitoring bed), if any one of the following is present:

1. Respiratory rate > 24/min
2. $SPO_2$ < 94% on room air at rest
3. Confusion/drowsiness
4. Systolic BP < 90 mmHg or diastolic BP < 60 mmHg
5. Those at high risk for severe disease:
   a. Age > 60 years without any comorbidities
   b. Cardiovascular risk including hypertension
   c. Diabetes mellitus/other immunocompromized states
   d. Chronic lung/liver/kidney disease

## 4 Receiving the patient in ICU

### 4.1 Handover and preparation

- Assigned ICU doctor must be called by the doctor at the referring end (e.g. emergency room or general ward) regarding the current status and care needs of the patient
- ICU nurse must receive complete handover from the nurse at the referring end (e.g. emergency room or general ward) regarding the current status and care needs of the patient
- Assigned ICU nurse must prepare the allocated room or bed for the patient with all the necessary equipment and drugs needed for patient care
- Transfer checklist should be used to ensure readiness for transfer of the patient
- Patient status must be documented in the transfer notes and handed over to the ICU on duty doctor.
- All healthcare staff working in ICU should wear appropriate PPE inside ICU (see Appendix for PPE recommendations)

### 4.2 Patient arrival in the ICU

- All healthcare staffs in ICU will don the appropriate PPE before receiving the patient.
- Keep the patient in a negative pressure room or if not available in an adequately ventilated single room
- If single rooms not available, COVID POSITIVE patients can be cohorted in one room

- The assigned nurse will attach monitors as necessary based on level of care needed
- The assigned nurse will check Airway, breathing and circulation and then perform complete head to toe assessment
- Open IV access, if not already done
- Give oxygen therapy as needed
- ICU on duty doctor will do clinical assessment (history and physical examination, chart review) of the patient and identify the issues and intervention needs
- ICU on duty doctor will make management plans and will do interventions after discussion with ICU consultant

### 4.3 Investigations to be sent at admission

- Send the following investigations if not already done
    - RBS
    - CBC: Hb, TC, DC, Platelets
    - RFT: Urea, Creatinine, Na+ and K+
    - LFT : Bilirubin (total and direct), AST, ALT, ALP, PT/INR, Albumin
    - Chest X-Ray
    - Coagulation profile: PT/INR, aPTT, FDP/d-dimer, fibrinogen
    - Appropriate cultures if patient presents with sepsis or septic shock e.g. blood, urine, sputum cultures
- Diagnostic investigations, if not already sent before transfer to ICU
    - Nasopharyngeal swab & oropharyngeal swab, or
    - Deep tracheal aspirate if the patient is intubated
    - Follow airborne precautions during sample collection
- Other investigations on the basis of clinical assessment and need of the patient

### 4.4 Patient room supplies

- Use disposable supplies as far as possible
- Supplies to the patient room should be delivered by a clean staff member at the request of on duty nurse caring for the individual patient
- Avoid overstocking rooms – only bring in supplies as required

## 4.5 Daily patient management

### 4.5.1 Level III ICU

- 1:1 nursing care (one nurse for one patient)
- A runner nurse will do all record keeping works – One runner nurse for every 6 patients
- One doctor will care for every 6 patients and will stay in-house
- Continual monitoring of Heart rate, Non-invasive blood pressure, $SPO_2$, ECG, and Temperature.
- Hourly patient vitals recording in the nursing record sheet
- Feeding every four hours or use continuous feeding pumps if available
- Position change of the patient as required to prevent pressure sores
- Daily investigations to be sent at 7am – CBC, RFT, ABG by the attending nurse
- On duty doctor (medical officer/ resident/ registrar) will do detailed clinical physical examination two times daily (8am and 8 pm)
- Daily round by Intensivist or designated consultant two times daily
- Event notes will be documented by nurse and doctor on duty

### 4.5.2 Level II ICU

- 2:1 nursing care (one nurse for 2 patients) and one additional nurse for every 6 patients for record keeping and charting
- One doctor will care for every 12 patients and will stay in-house
- Continual monitoring of Pulse, BP, ECG, $SPO_2$ & Temperature
- Two hourly patient vitals recording and charting
- Four hourly feeding or on demand of the patient
- Position change of the patient as required to prevent pressure sores
- Daily investigations to be decided after clinical assessment by on duty doctor
- On duty doctor (medical officer/ resident/ registrar) will do detailed clinical physical examination two times daily (8am and 8 pm)
- Daily round by Intensivist or designated ICU consultant once daily
- Events notes will be recorded by nurse as well as doctor on duty

### 4.5.3 Level I ICU

- 3 - 4:1 nursing care (one nurse for 3 – 4 patients)
- Doctor will not stay inside the ICU but will be on call
- Four hourly vitals recording and charting
- Four hourly feeding or feeding on demand of the patient
- Position change of the patient as required to prevent pressure sores
- Daily investigations to be decided after clinical assessment by on duty doctor
- On duty doctor will do detailed clinical physical examination two times daily (8am and 8 pm)
- Daily round by designated consultant once daily
- Adverse event situations will be attended by on duty doctor at Level II ICU or designated on duty doctor and will be documented appropriately

## 4.6 Record keeping and charting

- Do not take the paper chart or laboratory results into the patient room or keep on patient bed
- One additional nurse dedicated for every 6 patients as shift senior or shift in-charge for documentation and managerial activities in Level II and Level III ICU

# 5 Airway management protocol

## 5.1 Airway Team Organization

- The team will be responsible for securing airway at any location inside the hospital for suspected or confirmed COVID 19 cases.
- The number of Airway teams will vary depending upon the anticipated COVID 19 cases and the availability of medical personnel and resources.
- The team will comprise of four members:
    - Team leader- Seniormost doctor available on floor in the COVID designated area (Intensivist, Anesthesiologist, Internist, or medical officer whoever is available)
    - Airway assistant- Nurse (to help with airway equipment).
    - Nurse assistant (to help with drugs)
    - Runner
- Limit the number of healthcare workers in the room.
- Discuss the airway plan and use an airway checklist
- The most skilled practitioner should perform the procedure to limit attempts.
- Airway nurse should have PPE on and remain ‘clean’ in order to pass additional unanticipated equipment and assist.
- A ‘runner’ role should be assigned outside the room to provide additional equipment or drugs to the ‘clean’ assist in PPE.

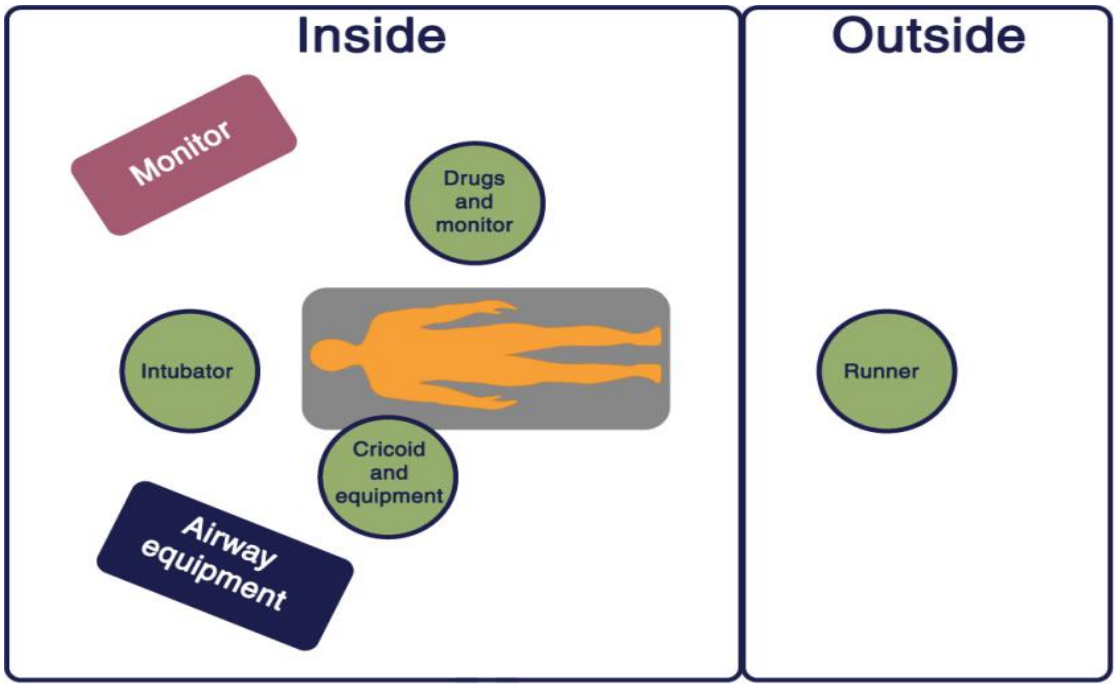



Figure 1: Plan for Airway team position for intubation. Three members inside the patient room one each for intubation (patient's head end), drugs and equipment. Runner stays outside the patient room. (*Source: Br J Anaesth. 2018;120(2):323-352)*

## 5.2 Resources preparation

- Personal protective equipment (PPE)
- Four sets of personal protective equipment, one for each team member, will be required for single airway securing procedure.
- The PPE should consist of at least:
    - N-95/FFP2 Respirator
    - Face shield or Goggles
    - Whole body gown or coverall
    - Two sets of hand gloves
- Mechanical Ventilator with circuit, closed suction catheter, catheter mount, capnograph and viral filter assembly
- Oxygen source

## 5.3 COVID-19 intubation tray

| | | | |
|---|---|---|---|
| Macintosh blade 4<br><br>(disposable, if available)<br><br>Macintosh handle | Tight fitting mask<br>Capnograph | Endotracheal tube (7/7.5/<br>ETT fixator | AMBU bag with reservoir with viral filter fitted in between the bag and face mask |
| 20ml flush syringe | HME filter x 2 | 10mg/ml Ketamine in 10ml syringe | 10mg/ml Rocuronium in 20ml syringe(150mg total)<br>Succinylcholine 100 mg |
| Closed suction (In-line suction) | IV Cannula (20, 22 G)<br>Cannula fix | 1mg/ml Adrenaline in 3 ml syringe | 0.6mg/ml Atropine in 3ml syringe |

## 5.4 Team Dynamics

- Team leader
  - Clear delineation of roles
  - Debriefing of situation
  - Revision of Airway plans
- Closed communication throughout in clear and loud voice
- Addressing each other by names
- Cross monitoring by all team members for potential contamination and notification

## 5.5 Securing the Airway

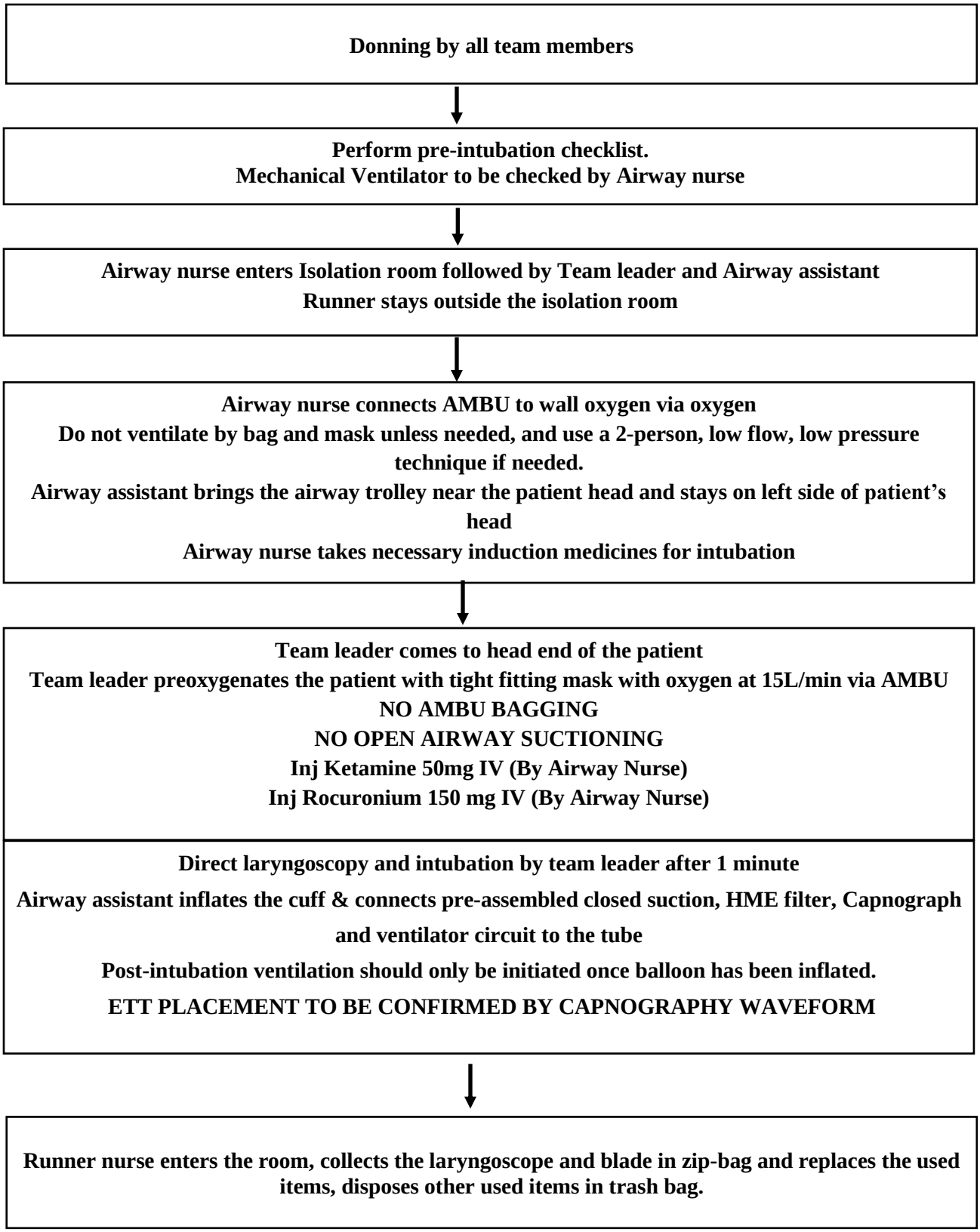
- AVOID IF POSSIBLE
  - Non-Invasive Ventilation (can be used with airborne isolation precautions)
  - High Flow Nasal Cannula (can be used in case of awake proning with airborne isolation precautions)
  - Bronchoscopy
  - Open Airway Suction
  - SupraglotticAirway Device insertion

- Manual Positive Pressure Ventilation via AMBU or Bain Circuit (Until Intubation Completes and ET Cuff is inflated)

## 5.6 Trainings for Airway Team

- PPE use- Donning and Doffing
- Hand Hygiene
- Mock Drill- Preparation, Intubation, Transfer of patient

## 5.7 Intubation Algorithm for Suspected / Confirmed COVID-19 Cases



| 5.8 COVID-19 Pre-Intubation Procedure Checklist | | |
|---|---|---|
| | Hand hygiene | |
| | Full PPE<br>(Gloves, Gown, Goggles/Face shield, N95) | |
| | Team leader, Airway Assistant, Airway Nurse, Runner Nurse | |
| Airway tray | Mac 4, Handle | |
| | ET tube 7 / 7.5 | |
| | AMBU BAG connected to HME filter and Tight fitting Mask | |
| | Capnograph | |
| | ET Tube fixator | |
| | HME filter(Extra) | |
| Drugs | Ketamine (10mg/ml) in 10ml syringe (Labeled) | |
| | Rocuronium (10mg/ml) in 20ml syringe (Labeled) | |
| | Adrenaline (1mg/ml) in 3ml syringe (Labeled) | |
| | Atropine (0.6mg/ml) in 3ml syringe (Labeled) | |
| Machine | Mechanical Ventilator | |
| Patient | IV Access | |
| | Monitoring (ECG, $SPO_2$, NIBP) | |
| Post | Trash Bag | |

# 6 Aerosol Generating Procedures (AGP)

1. Should be carried out in a single room with the doors shut but preferably should be completed in a Negative Pressure Room.
2. Only those healthcare professionals who are needed to undertake the procedure should be present.
3. Full PPE Equipment should be worn by those undertaking the procedure. The following procedures are considered to be potentially infectious AGPs:
    - Intubation, Extubation and Related Procedures
    - Tracheotomy/Tracheostomy Procedures
    - Bronchoscopy
    - Non-Invasive Ventilation (NIV) e.g. Bi-level Positive Airway Pressure (BiPAP) and Continuous Positive Airway Pressure Ventilation (CPAP)
    - Surgery and Post-Mortem Procedures in which high-speed devices are used;
    - High-Frequency Oscillating Ventilation (HFOV)
    - High-flow Nasal Oxygen (HFNO)
    - Manual Ventilation (should be minimized)
    - Open Suctioning (DO NOT perform)
    - Induction of Sputum (DO NOT perform)

## 6.1 Nebulization

- Do not use nebulized agents e.g. Salbutamol, Saline etc
- Use metered-dose inhalers if necessary

## 6.2 Humidification

- Do not use heated humidifiers.
- Use HME filters (bacterial + Viral) instead

## 6.3 Tracheostomy

- Use optimal PPE throughout the procedure
- Percutaneous versus open surgical tracheostomy should be decided by the treating team with proper planning.

### 6.4 Suctioning

- Always use closed suction i.e. in-line suction system
- If circuit disconnection is needed, clamp the endotracheal tube and disable the ventilator before disconnection.

### 6.5 Bronchoscopy

- Do not do diagnostic bronchoscopy unless absolutely necessary
- Retrieve deep tracheal aspirate instead of BAL for lower airway sampling

## 7 Monitoring of Patients with COVID-19

### 7.1 Standard monitoring in ICU includes the following:

- Non-Invasive Blood Pressure
- ECG
- $SPO_2$
- Temperature
- $EtCO_2$ (for intubated patients)

### 7.2 Advanced monitoring for patients with ARDS and Shock

- Invasive blood pressure monitoring
- Cardiac output monitoring (if available)

## 8 Laboratory Investigations

### 8.1 Detection of viral nucleic acid detection

- RT-PCR for diagnosis
- Follow NMC (Nepal Medical Council) and MoHP (Ministry of Health & Population) guidelines for testing.
- Send:
    - Nasopharyngeal swab with full PPE
    - Deep tracheal aspirate if the patient is intubated
- Send samples in Viral Transport Media (VTM) or as per recommendation by MoHP

- Avoid induction of sputum
- Repeat testing if clinical suspicion is strong and initial testing result is negative

### 8.2 Routine investigations in hospitalized patients

- Random Blood Sugar
- Complete blood count: Hb, TC, DC, Platelets
- Renal function tests- urea, creatinine and serum electrolytes
- Liver function tests- AST, AST, ALP, Bilirubin, & PT/INR
- Arterial blood gas (ABG) analysis

### 8.3 Other investigations

- Detection of secondary bacterial or fungal infection especially in septic patients- blood, urine, sputum culture etc.
- Tests for other causes of acute undifferentiated febrile illness (AUFI) such as Scrub typhus, Influenza, Typhoid, Leptospirosis, Malaria depending upon epidemiology and clinical judgement
- Markers of other organ damage and poor prognostic factors- Troponin I, D-dimer, CRP, Ferritin, Lactate dehydrogenase (LDH) where available
- Chest Imaging
    - Chest X-ray &/or USG if available
    - CT chest should not be done routinely

## 9 Transport of possible or confirmed COVID-19 patients

### 9.1 In hospital transport

- Limit transport for essential purposes only
- The movement and transport of patients with suspected or confirmed COVID-19 should be limited to essential purpose only. There are simple basic steps to follow.
- Inform the staff at the receiving destination
- Make the patient wear a surgical mask
- Oxygen, if needed, via nasal cannula under the mask

- Patients must be taken straight to and returned from clinical departments and must not wait in communal areas
- Patients should be placed at the end of clinical lists
- The staff(s) should use hand hygiene and Don personal protective equipment (PPE) which includes:
    - Surgical mask (seal the top edge with a tape)
    - Goggles or visor
    - Water resistant or standard disposable gowns
    - Regular disposable cap
    - Gloves (loose gloves acceptable)

### 9.2 Transport to or from other hospitals

- The ambulance service should be informed of the infectious status of the patient
- Staff of the receiving hospital must be advised in advance of the infectious status of the patient
- Perform hand hygiene and don appropriate PPE
- In ambulance
    - Use single use or single patient use medical equipment where possible
    - Use disposable linen if available
    - Monitor and document vitals and medical management done in ambulance
    - Ensure arrangements are in place before taking out the patient from ambulance
    - After transfer of patient, perform hand hygiene and doff PPE
    - Medical equipment should be cleared as per protocol

## 10 Oxygen therapy & Intubation

- Monitor O2 saturation continually during oxygen therapy
- Give supplemental O2 immediately to all patients with SARI and respiratory distress, hypoxemia or shock
- Oxygen delivered by nasal prongs should be titrated to a maximum flow rate of 6 L/min for patient comfort.

- Apply a surgical mask over the patient's mouth, nose and the oxygen delivery device to reduce the dispersion of respiratory droplets.
- If a patient requires up to 6 L/min by nasal prongs, a venturi mask or a Non-Rebreathing (NRB) mask should be used.
- Oxygen should be delivered without added humidity (Do not use bubble through bottles)
- Use lowest effective rate of flow of oxygen with the following SPO2 targets
    - >88 to 92% for patients with type II respiratory failure
    - 88 – 95% for patients with ARDS
    - 93 – 96% for patients without chronic respiratory failure
- Go for early invasive mechanical ventilation in case of worsening hypoxemia, hypercapnia, acidemia, respiratory fatigue, hemodynamic instability or altered mental status.

### 10.1 HFNO (High Flow Nasal Oxygen)

- Use if available for COVID-19 patients with hypoxemia who do not require immediate intubation.
- Use contact and droplet precautions with a fit tested N95 mask (given the risk of aerosol generation with High Flow Nasal Cannula).
- Use in a private/isolation room (ideally Negative Pressure Room) or in a cohorted ward with COVID-19 positive cases.
- Make the patient wear a surgical mask covering the mouth, nose, and cannula to reduce the risk of dispersion of infected respiratory droplets.

### 10.2 NIV (Non-Invasive Ventilation)

- Do not use for COVID-19 induced acute respiratory failure
- Can use for acute exacerbation of COVID-19 and acute cardiogenic pulmonary edema with airborne precautions in a negative pressure isolation room
- Use Helmet CPAP if available

### 10.3 Intubation

- Do Rapid Sequence Induction and Intubation (to minimize Bask-Mask ventilation and aerosol generation)

- If possible, intubation should be performed in a controlled environment such as an ICU or ED, and ideally in a negative pressure isolation room or a well ventilated room with exhaust fans or with full PPE and doors closed for the duration of the procedure.

### 10.3.1 Indications for intubation

- Increased work of breathing
    - accessory muscle use
    - tachypnea (RR >35 breaths/min)
- Rapidly worsening hypoxemia

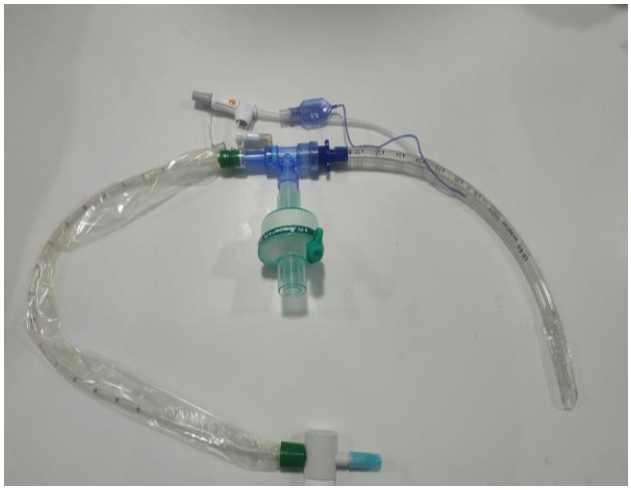


**Figure: endotracheal tube, viral filter, and in-line suction assembly (Photo courtesy: Dr Sabin Koirala)**

**Figure: ambu bag, viral filter and face mask assembly (Photo courtesy: Dr Sabin Koirala)**

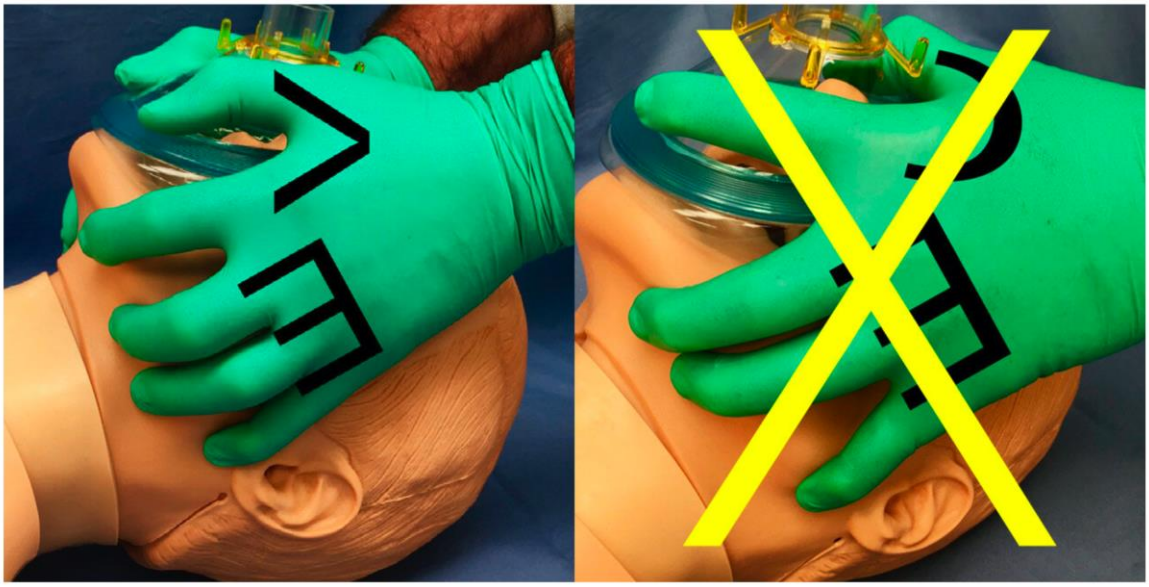


Figure: two-handed technique for bag-mask-ventilation source: https://icmanaesthesiacovid-19.org/covid-19-airway-management-principles

# 11 COVID-19 specific therapies

- Corticosteroids:
    - For severe cases receiving supplemental oxygen &/ or mechanical ventilation.
    - Choices are as follows:
        - Dexamethasone 8 mg IV or PO daily for 10 days or until discharge; or
        - Inj Methylprednisolone 40 mg IV twice daily x 5 days; or
        - Inj Hydrocortisone 50 mg x four times per day x 7 days
- Remdesivir:
    - For severe cases receiving supplemental oxygen &/ or mechanical ventilation, Remdesivir should be used for patients fulfilling the criteria set by Nepal Health Research Council (NHRC)
    - Dosing: Inj Remdesivir 200 mg IV on day 1 followed by 100 mg daily for 5 days for patients without mechanical ventilation and for 10 days for patients on mechanical ventilation.
- Convalescent Plasma Therapy:
    - For severe cases receiving supplemental oxygen and/ or mechanical ventilation
    - As a trial therapy with proper consent
    - ABO compatible plasma from a recovered, PCR negative donor can be transfued to patients fulfilling the criteria set by Nepal Health Research Council (NHRC)
    - Dosing: 200 mL one dose intravenous infusion as per NHRC protocol
- Do not use hydroxychloroquine, chloroquine or other research drugs at present outside of clinical trials

# 12 Management of common clinical conditions associated with COVID 19

## 12.1 ARDS

- Recognize ARDS and assess severity according to Berlin definition
    - Mild ARDS: $PaO_2/FiO_2$ ratio 200 to < 300 mmHg
    - Moderate ARDS: $PaO_2/FiO_2$ ratio 100 to < 200 mmHg
    - Severe ARDS: $PaO_2/FiO_2$ ratio < 100 mmHg
- Target euvolemia, avoid fluid overload (restrictive fluid management strategy)

- Mild ARDS
    - Give $O_2$ via nasal prongs, recognize deterioration promptly and escalate $O_2$ therapy appropriately (see section 10)
    - Offer the awake patient to lie prone
- Moderate to Severe ARDS
    - Intubate early
    - Prone early, within 12 hours of $PaO_2/FiO_2$ <150 mmHg with $FiO_2$ >60% and PEEP ≥ 5 $cmH_2O$
    - Prone positioning: Keep prone for 16 hours
    - Do ABG in one hour of proning to assess for response
    - Assessment at 4 hours after making supine – clinical assessment and ABG
        - If $PaO_2/FiO_2$ ratio <150 mmHg – Prone again for 16 hours
    - Stop proning sessions if any of the following criteria is met
        - Improvement in oxygenation (defined as $PaO_2$:$FiO_2$ ratio ≥ 150 mmHg, with PEEP ≤ 10 $cmH_2O$ and $FiO_2$ of ≤ 60% at four hours after the end of prone session)
        - Decrease in the $PaO_2/FiO_2$ ratio of more than 20% relative to the ratio in the supine position, before two consecutive prone sessions
        - Complications occurring during a prone session and leading to immediate interruption (e.g. nonscheduled extubation, main-stem bronchus intubation, endotracheal –tube obstruction, hemoptysis, oxygen saturation of less than 85% on pulse oximetry of $PaO_2$ of less than 55 mmHg for more than 5 minutes when $FiO_2$ is 100%, cardiac arrest, heart rate less than 30 beats per minute for more than 1 minute, systolic blood pressure of less than 60 mmHg for more than 5 minutes, and any other life-threatening reason)
    - Resume prone position before scheduled assessment at 4 hours in the supine position if the criteria for oxygen saturation level, $PaO_2/FiO_2$, or both are met.
    - Sometimes continuous proning for 24 – 48 hours may be done (if required, with caution)
    - Do not prone patients with spinal cord injury and open chest

  - Watch for pressure points and pad adequately
  - Ensure that the abdomen is free and not interfering with ventilation
  - Continue feeding, positioning, dialysis (if required) during proning
  - Continue sedation and analgesia during proning with target RASS of – 1.
- Ensure lung protective ventilation strategy is in place (*see Evidence-based ARDS strategy below*)
- Adopt permissive hypercapnia
- Use VAP (Ventilator Associated Pneumonia) bundles strictly
- Target RASS 0 to -1 for sedation management
- Avoid neuromuscular blockade if possible; use only if patient ventilator dyssynchrony does not improve with optimal sedation
- Review need of sedation and neuromuscular blockers daily and stop early if possible

### 12.1.1 Mechanical Ventilation

#### *12.1.1.1 Evidence-based ARDS strategy*

- Mode: Volume Assist Control (or Pressure Assist Control )
- Targets tidal volume 4-8 ml/kg Predicted Body Weight (Start with 6 ml/kg PBW),
- Target Plateau Pressure (Pplat) <30 $cmH_2O$; Driving pressure <15 $cmH_2O$
- If Pplt is >30 $cmH_2O$, consider decreasing tidal volume upto 4 ml/kg PBW.
- Set initial PEEP at 8-10 $cmH_2O$, and then adjust according to the PEEP-$FiO_2$ table (see below)
- Target $SPO_2$: 88-95%
- Adjust Respiratory Rate (RR) to target pH ≥7.25 (RR upto 35)
- Watch for Auto-PEEP
- Permissive Hypercapnia (pH upto 7.25) is acceptable if there is no evidence of raised intracranial pressure.
- If pH is persistently below 7.20 increase tidal volume upto 8ml/kg PBW.
- Prone position for at 16 hours/day if $PaO_2/FiO_2$ <150 mmHg.

**Lower PEEP/higher FiO2**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **$FiO_2$** | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.7 | 0.7 |
| **PEEP** | 5 | 5 | 8 | 8 | 10 | 10 | 10 | 12 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **$FiO_2$** | 0.7 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0 |
| **PEEP** | 14 | 14 | 14 | 16 | 18 | 18-24 |

Figure: PEEP-$FiO_2$ table

#### *12.1.1.2 Refractory hypoxemia:*

If the patient develops worsening gas exchange ($SPO_2$ <95, $PaO_2/FiO_2$ <150 mmHg on $FiO_2$ > 60%, or persistent pH<7.25), options include:

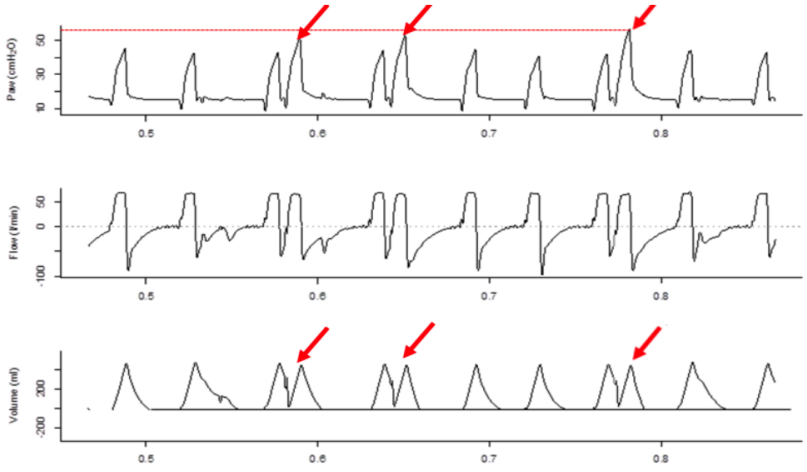
- Optimize PEEP/FiO2 as per table above
- Increase analgesia and sedation and administer neuromuscular blockade
- Recruitment maneuver: (Note- RM may cause more harm than benefit, so should be performed very cautiously; also repeatedly RM over small time intervals should not be done)
    - Option 1: set continuous positive airway pressure (CPAP) at 30-40 $cmH_2O$ for 30-40 sec.
    - Option 2: set pressure controlled ventilation 15 $cmH_2O$, PEEP 10 $cmH_2O$, RR 20 beaths/minute, then increase PEEP by 5 $cmH_2O$ every 2 minutes until Pplat is 50-60 $cmH_2O$
    - Consider higher PEEP strategy if patient responds to the recruitment maneuver, judged by increased $PaO_2/FiO_2$ ratio, decreased $PaCO_2$, or increased compliance
- Identify and manage Ventilator Asynchrony
- Prone ventilation as described above.

#### *12.1.1.3 Ventilator Asynchrony:*

- Identify ventilator asynchrony early and address according to identified cause
- Scale up the dose of sedatives if required
- Use neuromuscular blocker if persistent (do not use neuromuscular blockers routinely)

#### *12.1.1.4 Liberation from Mechanical Ventilation*

- Switch from volume control to pressure support ventilation when:
  - The patient has a $PaO_2/FiO_2$ safely above 200 mmHg
  - PEEP of 8 $cmH_2O$or less.
  - $FiO_2 \leq 40\%$
- In the absence of obesity, reduce PEEP to 5 $cmH_2O$ before a spontaneous breathing trial (SBT).
- Do SBTs on a closed circuit (Pressure Support (PS) 5 – 8 $cmH_2O$ /zero PEEP for 30 minutes). Do not use T-piece.
- Extubate once the SBT is passed.
- Do a cuff leak test using contact and droplet precautions with a fit tested N95 mask.
- Consider diuresis (to target negative fluid balance if not contraindicated) starting at least 12 hours before planned extubation.
- Delay extubation until patient is fully optimized.
- Extubate the patient in the morning or early afternoon.




Source: JAMA 2017;318(14): 1335–1345.

Figure: Ventilator Graphics showing breath stacking (red arrows in patients ventilating with low tidal volume

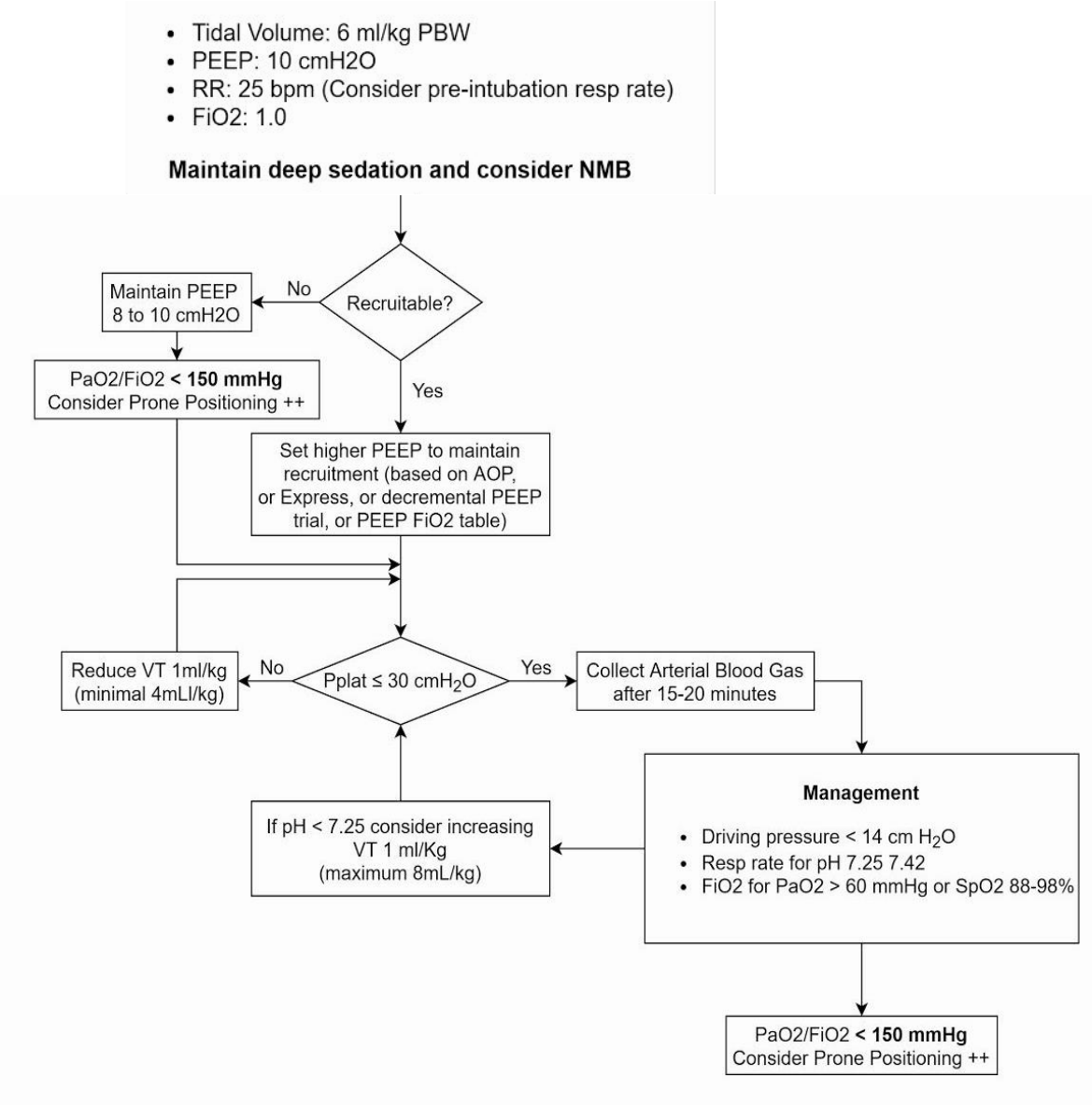



Figure: Approach to ventilator management of COVID-19 ARDS patients
++: if no contraindications
Source: https://www.criticalcare.utoronto.ca/covid-19-resources

#### *12.1.1.5 Extubation*

- Minimize the number of healthcare professionals in the room (ideally only one person, or two persons for higher risk extubation [one MD and/or one RN]
- Pre-assemble the equipment needed for extubation prior to entering the patient room
- Prior to extubation, do suctioning using closed circuit (in-line) suction with the ETT cuff inflated.
- Once the ETT cuff is deflated, avoid further suctioning or encouraging the patient to cough.
- Cap ventilator tubing to avoid spillage of condensate.
- Avoid an airway exchange catheter due to the risk of inducing cough.
- Place a Non-Rebreathing Bag (NRB) mask/ Venturi mask on the patient immediately after extubation.
- Get ready the following (to manage immediate post-extubation failure):
    - intubation equipment,
    - medications
    - intubating MD in full PPE outside the room (if not already in the room) prepared to come in to re-intubate.
- Use aerosol box during extubation procedure if available.

### 12.2 Septic Shock

- Identify sepsis and septic shock early (Use sepsis 3 definition)
- Open large bore (18 or 16G cannula) IV access
- Do ABG and measure arterial lactate level
- Give fluid boluses in aliquots of 500 mL (Plasmalyte, RL, or NS) boluses in 15 minutes
- Reassess for signs of fluid overload after each bolus
- If MAP ≤ 65 mmHg and not responding to fluid boluses, start Noradrenaline infusion to target MAP 65 – 90 mmHg
- Add Vasopressin and then Adrenaline to achieve the MAP target
- Insert Central Venous Catheter as soon as possible (USG guided Right Internal Jugular Vein as far as possible; next option is femoral; third option is right subclavian vein)
- Insert arterial line if available

- Send 2 sets of blood culture, urine culture, sputum gram stain and culture (with contact, and airborne isolation precautions; full PPE)
- Administer broad spectrum antibiotics within one hour of presentation
- Keep in mind the potential source of infection while selecting empirical antibiotics, e.g.:
    - Community acquired pneumonia & no prior multidrug resistant organism: 3rd generation ceftriaxone +/- Azithromycin or doxycycline
    - For hospital acquired pneumonia or risk factors for multi-drug resistant organisms: Cefepime or Piperacillin-Tazobactam or Meropenem/Imipenem-cilastatin +/- Teicoplanin or Vancomycin
- Mechanical ventilation if needed (similar ventilation strategy as that for ARDS, section 12.1.1)
- Repeat ABG to measure lactate in 2 hours
- Try to identify the source of sepsis (secondary infection on top of COVID-19?) and treat promptly without delay
- Deescalate or stop antibiotics as soon as the cultures reports are available or if bacterial infection is ruled out clinically
- Cover potential co-infections:
    - If concurrent influenza: treat with Oseltamivir 75mg x PO x q12h x 5 days

### 12.3 Cardiogenic shock

- Assess patients thoroughly with myocarditis, acute myocardial infarction, and acute decompensated heart failure arrhythmias in mind.
- Do 12 lead ECG
- Do focused Echocardiogram if expertise available
- Arrhythmias:
    - Do immediate electrical cardioversion for ventricular or atrial tachyarrhythmias with hemodynamic instability.
    - Inj Amiodarone 150 mg in 100 mL Normal Saline IV over 10 minutes for new onset atrial fibrillation or flutter without hemodynamic instability – followed by infusion.

  - Inj Adenosine 6 mg IV stat for supraventricular tachycardia, can be repeated with increased dose.
- Follow ACLS protocol below in case of cardiac arrest.
- Send blood for CPK-MB, Cardaic Troponin T/I and BNP/NT-proBNP
- If acute myocardial infarction,
  - Give Tab Aspirin 300 mg stat, Tab Clopidogrel 300 mg stat, Inj LMWH 1mg/kg SC and transfer to center with intervention facility
  - Do fibrinolysis, if not contraindicated, for STEMI if percutaneous intervention facility is not available or as a bridging therapy
  - Transfer to COVID center with cardiac (cath lab) intervention facility
- Start inotropes – Dobutamine, Dopamine, Noradrenaline if needed
- Treatment is largely supportive for COVID-19 related heart failure
- Consult cardiologist early for appropriate management

## 13 General standard care of critically ill patients

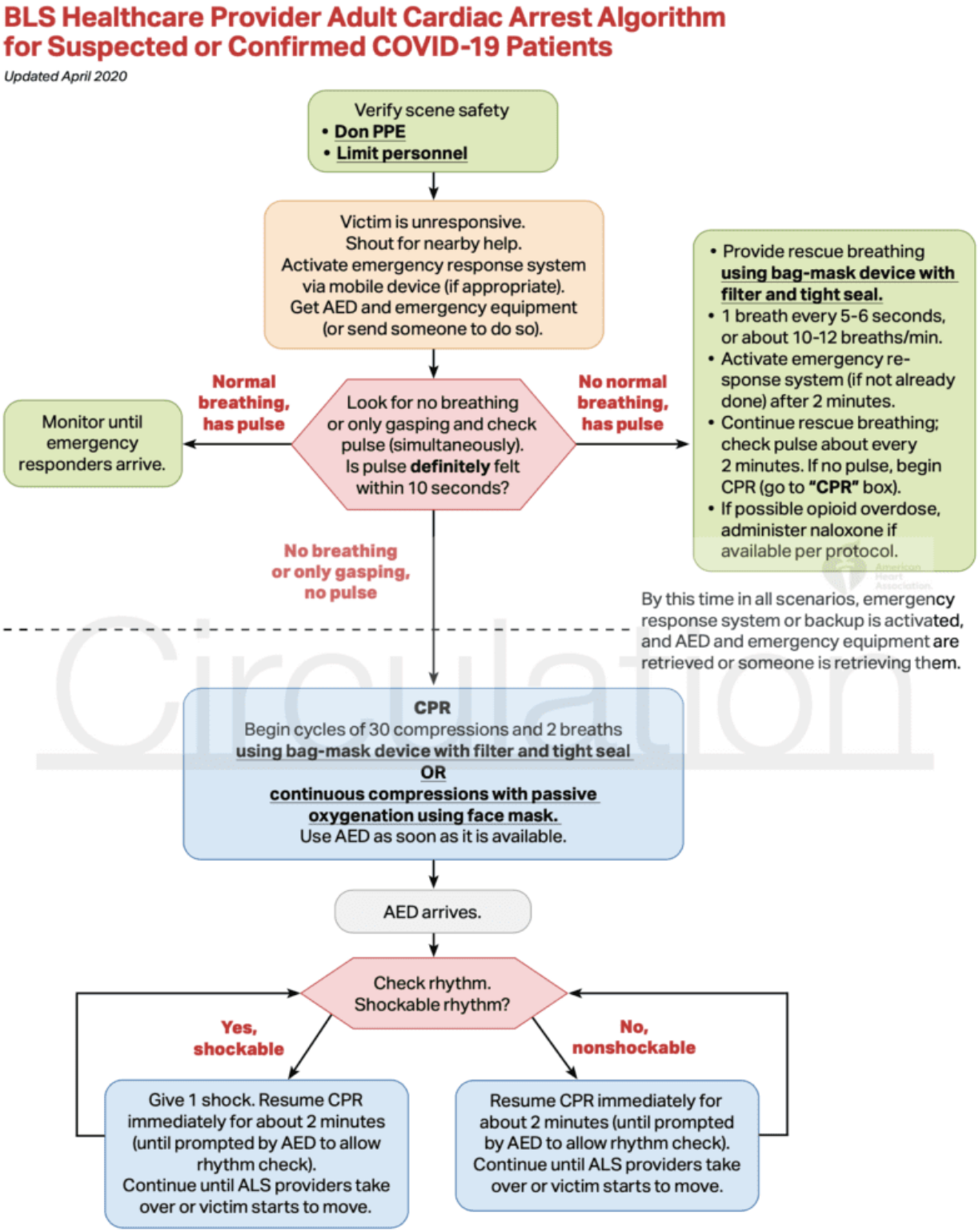
- Nutritional support:
  - Start enteral feeding as early as possible after admission to ICU
  - Start orogastric tube feeding in intubated patients
  - Start TPN if cannot be fed for more than a week and not tolerating enteral feeding or if enteral feeding is contraindicated
- DVT prophylaxis
  - Start Inj Enoxaparin 1 mg/Kg SC x q24h or Inj UFH 5000 units SC x q12h for all patients unless contraindicated (Dalteparin or fondaparinux can also be used instead)
- Stress ulcer prophylaxis
  - Inj Ranitidine 50 mg IV q8h or Inj Pantoprazole 40mg IV q24h for patients on mechanical ventilator, coagulopathy or other risk factors for stress ulceration
- Physiotherapy and early mobility.

## 14 CPR – BLS/ACLS

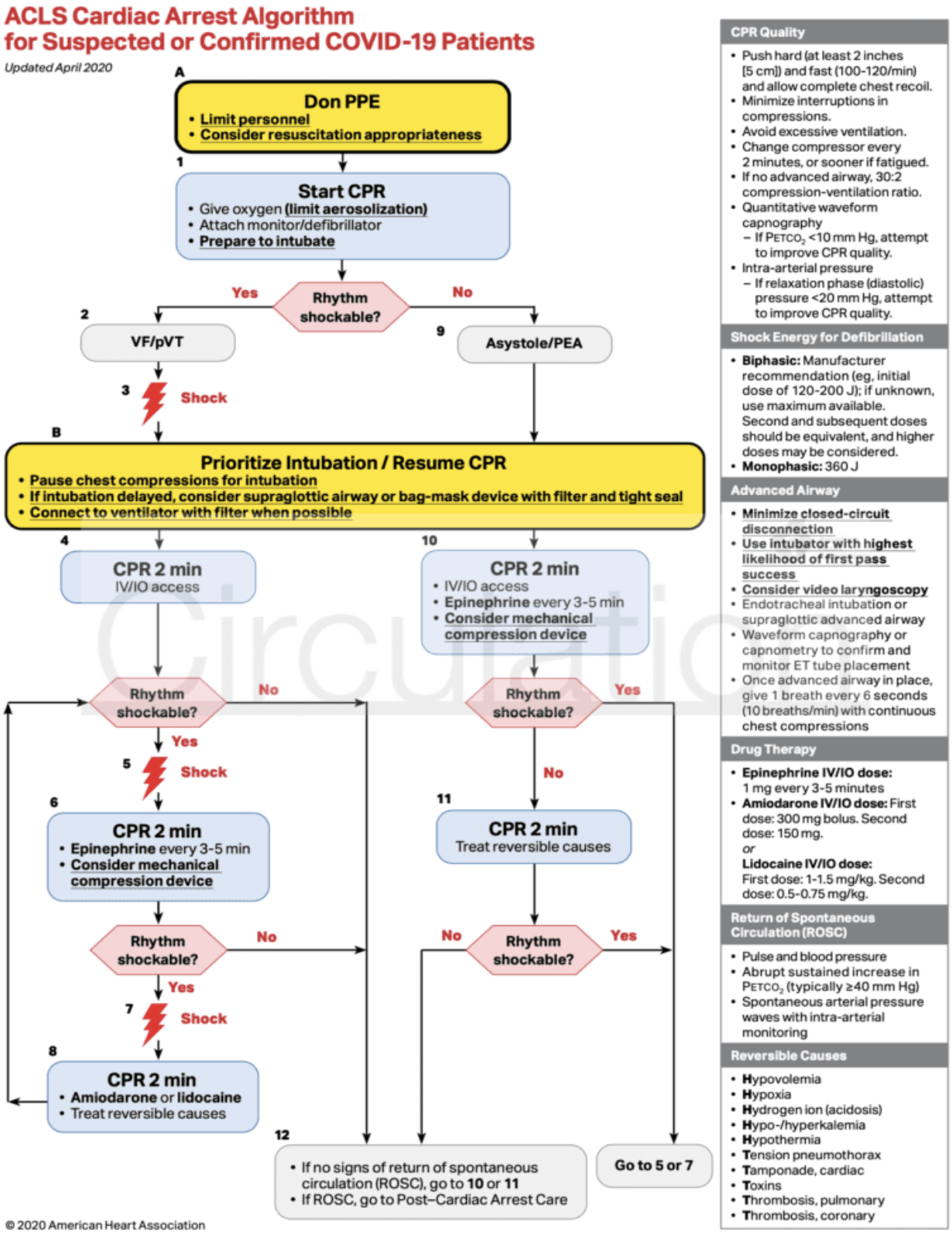
In additional to the standard CPR guidelines:

- Before entering the scene, all rescuers need to don appropriate PPE for airborne and droplet precautions
- Limit the number of health care personnels to the minimum, required for effective resuscitation
- After initial rhythm assessment and delivering shock for the shockable rhythms, the patients in cardiac arrest need to be intubated using a cuffed endotracheal tube at the earliest feasible time.
- Minimize the likelihood of failed intubation. The most experienced person in the team need to attempt intubation, chest compression need to be paused during intubation and video laryngoscope can be used when available.
- If intubation is delayed, consider ventilating the patient using supraglottic airway or bag mask device with a HME filter.
- Once intubated, connect pre-assembled closed suction, HME filter, capnograph and ventilator circuit to the tube, and start mechanical ventilation
- Once on a closed circuit system, minimize disconnections.
- Follow the BLS and ACLS algorithms below.

## 14.1 Adult BLS algorithm



## 14.2 Adult ACLS algorithm



## 15 Discharge criteria

- Patients should be discharged from ICU to step down units if the following criteria are met:
  - Patient extubated (for >24 hours) and spontaneously breathing or breathing through through tracheotomy
  - Hemodynamically stable without any vasopressor or inotrope support for >8 hours
  - No or minimum oxygen support (<4 L/min via nasal prongs)
  - Underlying organ dysfunctions stabilized and improving

## 16 Family visit and visiting policies

- Visitors who are sick will not be permitted to enter the Hospital without fail
- No visitors are allowed to stay by the side of adult patients.
- One visitor per pediatric patient is allowed in the pediatric units and the Neonatal Intensive Care Unit (NICU). These visitors can only be parents, guardians, or family care partners.
- When possible, the designated visitors should remain the same for the course of admission.
- Temporary visitation may be granted for patients in extenuating circumstances, such as imminent end-of-life and/or a specific patient needing extra support.
- Any visitor must wear appropriate personal protective equipment at all times.

## 17 Patient and family counseling:

- Call responsible family member for the meeting as soon as possible after ICU admission
- Address the concerns of the family if any
- Brief about the current status of the patient, possible benefits of any critical treatment options
- Explain the potential risks of critical care treatment options
- Discuss and decide goals of care
- Do daily family counseling over phone.

## 18 Documentation

- Use standard ICU documentation sheets in use at your ICU facility
    - Include all relevant clinical parameters, expert advices, untoward events, and interventions done in the document with timing
- Sign the document properly with full name
- Fill the WHO case record form to complete COVID-19 case record (Appendix V)
- Maintain a timed record of identity of individuals (including doctors, nurses, housekeeping staff, patient relatives) coming in contact with the COVID patient in sequential order.

## 19 End-of-life Care and Care of the dying patient

- Do the following, if a decision is made to to go for comfort care at the end-of-life
    - Continue general nursing care e..g. positioning, feeding, and general body care
    - Discontinue artificial life supports
    - On duty doctor will obtain Do Not Resuscitate order (after discussion with the family and the attending consultant)
    - Use Morphine (oral or intravenous) as needed

## 20 Policies, guidelines and training

- For proper and effective management of any critically ill patients, there must be proper trainings and policies in place
- Ensure that all the staff working in ICU have attended the following trainings, if not arrange for trainings as soon as possible:
    - Donning and doffing of PPE
    - Infection prevention and control
    - ICU visiting policy
    - Waste management

## 21 Contributors

- Dr. Hem Raj Paneru, MD, DM Critical Care Medicine. Assistant Professor, TU Teaching Hospital, Kathmandu, Nepal.
- Dr. Diptesh Aryal, MD, FACC, Consultant Intensivist. Nepal Mediciti Hospital, Bhainsepati, Kathmandu, Nepal.
- Dr. Gentle Sunder Shrestha, MD, FACC, EDIC, FCCP, FNCS. Associate Professor, TU Teaching Hospital, Kathmandu, Nepal.
- Dr. Mukund Prasad Kafle, MD, DM Nephrology. Assistant Professor, TU Teaching Hospital, Kathmandu, Nepal.
- Dr. Sabin Koirala, MD, FACC. Intensivist, Hospital for Advanced Medicine and Surgery, Mandikhatar, Kathmandu, Nepal.
- Dr. Tamanna Bajracharya, MD. Consultant Intensivist. B & B Hospital, Kathmandu, Nepal.
- Professor Dr. Subhash Prasad Acharya, MD, FACC, FCCP. Professor, TU Teaching Hospital, Kathmandu, Nepal.
- Prof. Dr. Shital Adhikari, MD, DM Pulomonology, critical care and sleep medicine. Professor, Chitwan Medical College, Bharatpur, Chitwan.
- Dr. Lava N Joshi, MD. Consultant Cardiologist. Nepal Mediciti Hospital, Bhainsepati, Kathmandu, Nepal.
- Dr. Sanjay Lakhey, MD. Consultant Physician, B & B Hospital, Kathmandu, Nepal. President, NSCCM.

## 22 References


1. ICU design for COVID-19 prepared by NSCCM for design and organization of ICU for COVID-19. Available from http://nsccm.org.np/downloads/files
2. Interim clinical guidance for care of patients with COVID-19 in healthcare settings by Nepal Medical Council. Available from https://www.nmc.org.np/nmc-covid-19-interim-guideline-for-prevention-5-april
3. NSCCM ICU Protocols for general management of critically ill patients. Available from
4. Nepal Medical Council interim guidance for infection prevention and control when COVID-19 is suspected. https://www.nmc.org.np/nmc-covid-19-interim-clinical-guideline-for-care-3-april
5. Guidelines for use of personal protective equipment in relation to COVID-19: Developed by expert team of NMC and Government of Nepal with reference from WHO. Available from https://www.nmc.org.np/guidelines-for-use-of-personal-protective-equipment-in-relation-to-covid-19
6. Interim guidance for Basic and Advanced Life Support in adults, children and neonates with suspected or confirmed COVID-19. Available from https://www.ahajournals.org/doi/pdf/10.1161/CIRCULATIONAHA.120.047463
7. Prone positioning in severe acute respiratory distress syndrome. N Engl J Med. Guerin et al. PMID: 23688302. DOI: 10.1056/NEJMoa1214103. https://www.nejm.org/doi/full/10.1056/NEJMoa1214103
8. Handbook of COVID-19 prevention and treatment. The first affiliated hospital, Ahejiang University School of Medicine. 2020.
9. Surviving sepsis campaign: guidelines on the management of critically ill adults with COVID-19. Waleed Alhazzani et al. Int Care Med(2020). https://doi.org/10.1007/s00134-020-06022-5
10. Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. N Engl J Med 2000; 342:1301-1308. https://www.nejm.org/doi/full/10.1056/NEJM200005043421801
11. Ventilator protocol card – ARDSNet. Available from http://www.ardsnet.org/files/ventilator_protocol_2008-07.pdf

12. Guidelines for the management of tracheal intubation in critically ill adults. A. Higgs et al. Br J Anaesth. 2018;120(2):323-352. https://bjanaesthesia.org/article/S0007-0912(17)54060-X/fulltext
13. Respiratory support in novel Coronavirus disease (COVID-19) patients, with a focus on resource-limited settings. AM Dondorp et al. Am J Trop Med Hyg. 2020 Apr 21. https://doi.org/10.4269/ajtmh.20-0283
14. Association Between Administration of Systemic Corticosteroids and Mortality Among Critically Ill Patients With COVID-19: A Meta-analysis. *JAMA.* Published online September 2, 2020. https://jamanetwork.com/journals/jama/fullarticle/2770279

## 23 Appendix: Guidelines for use of personal protective equipment

(Developed by the Expert Team of NMC and Government of Nepal with reference from WHO, published on March 26, 2020)

**A. For Aerosol Generating procedures**: Dental procedures, Bronchoscopy, Upper GI Endoscopy, ENT procedures, Nebulization, Intubation of a patient, CPR, Non-invasive ventilation, endotracheal suctioning, when obtaining nasopharyngeal or oropharyngeal swab, etc. **in Covid-19 suspected or confirmed cases health personnel need to use the following protective equipment:**

a. N-95 mask

b. Goggles or visor

c. Gloves (loose gloves acceptable)

d. Water resistant OR standard disposable gowns

e. Cap: Regular disposable

**B. For Non aerosol generating covid-19 suspected or confirmed patients: Health personnel need to use the following protective equipment:**

a. Surgical mask (seal the top edge with tape)*

b. Goggles or visor

c. Gloves (loose gloves acceptable)

d. Water resistant or standard disposable gowns

e. Cap: Regular disposable

**C. For Physician/Staff running the fever/screening clinics the following PPE is recommended:**

a. Surgical mask (seal the top edge with a tape)*

b. Goggles or visor

c. Water resistant or standard disposable gowns

d. Regular disposable Cap

e. Gloves (loose gloves acceptable)

**D. For escorts or drivers, the following PPE is recommended:**

a. Surgical masks

b. Gloves

c. If physical contact is expected, depending on circumstances, a gown PLUS goggles or face-shield are also recommended, otherwise need to maintain minimum 2 metres distance from the patient.

d. The patient should be given surgical mask and instructed to perform hand-hygiene.

**E. For Laboratory staff: depending upon the chance of splash:**

a. Surgical masks or N-95 depending on availability and use of biological hood (BSL-2)

b. Gown

c. Loose Gloves

d. Eye protection (if risk of splash)

F. **For all staff, including health care workers** involved in any activity that does not involve contact with COVID-19 patients and working in other areas of patient transit (e.g. wards, corridors). **No PPE required**.

**For everyone**

- ***Maintain 3-6 feet distance while visiting patients, if no need to touch the patient.***
- ***Mandatory hand-hygiene after each use of PPE and between patients.***
- ***Mandatory surface cleaning of bed or furniture with 0.5% Chlorine disinfectant (Virex* or similar) between each patient in OPD or in an inpatient setting.***

*** Use N-95 masks if close contact with COVID-19 suspect or confirmed cases expected**

----------The End----------