**The Challenge of COVID-19**

H

ow our lives have changed since the 31st of December 2019 when the Wuhan Municipal Health Commission in China, reported a cluster of cases of pneumonia in Wuhan, Hubei Province. Few of us could have predicted the devastating morbidity and mortality or even imagined the social, economic and political consequences that have shaped our lives since that fateful day. While in some ways COVID-19 has shown how communities can come together and act to protect each other (eg wearing masks in public) the virus has at times triggered extreme division within society (eg no vaxxers). It will be interesting to look back in the future to see how historians record this period in the human story ; will it be a story illustrating the ingenuity of humans to collaborate together successfully or will be it be a tale of shame where the negative aspects of humanity such arrogance, self-interest and opportunism are exposed ?

In this last section of the book we will explore the principles for responding to the challenge of this pandemic in the context of rural health. The chapters are written with the intent of providing a structure for thinking about how a hospital or health service together with their staff may prepare themselves for managing patients during a pandemic such as the one we are now facing. Recognising the challenges from limited resources and of great distances characteristic of many rural settings, the section aims to encourage the creative thinking, problem solving, and collaborative approach required to identify locally based solutions to providing emergency care during a pandemic.

Issues discussed include set up of the hospital and areas to receive emergency patients, location and procedure for triage, the importance of PPE, the approach to clinical assessment, the role and delivery of oxygen and the indications for respiratory support, intubation and ventilation. Although we now have immunisation, an increasing number of pharmaceutical agents and a rapidly increasing body of research, there remain many questions as to the most effective approach to the management of the disease and the prevention and treatment of its complications. The story is still incomplete, and we will be watching in the following months and years to see how the story of COVID-19 unfolds.

**COVID-19 Online Training @** [**www.learnem.com.au**](http://www.learnem.com.au/)

The *COVID-19 Course* is an open online course developed by LearnEM aimed at assisting health professionals working in rural and remote settings prepare for assessing and treating emergency patients during the current pandemic.

The COVID-19 course explores how to set up a health facility and perform triage, outlines the priorities in the nursing and medical assessment and options for the delivery of respiratory support. The course explores the principles for the intubation and ventilation of the patient with COVID-19 and how to approach the difficult issue of deciding on palliation for a patient. Other resources relevant to this topic may be found on the LearnEM website as part of the *EDGE21* course, the *RESP High Risk Emergencies* (Online) Workshop and the 30 specialised *CPD courses.*

# Chapter 111

# Preparation and Triage

#### Key Points

1. In the setting of a COVID-19 pandemic two distinct areas of the hospital should be set up for the management of emergency patients separating patients with respiratory symptoms (at risk for COVID-19 illness) from those with non-respiratory presentations
2. A single triage point should be placed at the entrance to the hospital with access to a thermometer and oximeter, PPE, facilities for hand hygiene and surgical face masks for patients
3. Most patients with COVID-19 experience a mild flu like illness characterised by fever, dry cough, headache and myalgia. In about 15% of cases the illness is complicated by pneumonia with increasing shortness of breath and severe hypoxia developing around 5 days after the onset of the illness with
4. Patients with complications may present with severe hypoxia, increasing confusion or drowsiness, renal failure, CCF and new onset AF.

In this first chapter our focus is on the patient presenting to the hospital for acute care – the ED patient.

**We can classify a patient’s presentation into one of two categories**

1. Patients presenting with respiratory symptoms such as cough, fever or shortness of breath – a presentation that may be the result of COVID-19 illness.
2. Patients presenting with non-respiratory symptoms eg chest pain due to myocardial ischaemia, vomiting and diarrhoea due to gastroenteritis, soft tissue injury or fracture from an accident.

At this point it becomes obvious that we should be separating these patients in an effort to reduce the risk of exposing non-respiratory patients to COVID-19. For this to work in practice we need two different areas of the hospital in which to manage these patients – a Respiratory ED and a Non-Respiratory ED. We also need to reassess in what circumstances we use oxygen and how we provide respiratory support aiming to reduce aerosol dispersion of the virus and risk of transmission to staff and other patients.

**The Respiratory ED**

It is important that in planning for managing a pandemic two distinct areas of the hospital are identified for managing emergency patients. In particular the area assigned for the assessment and treatment of patients with respiratory symptoms, the Respiratory ED” should be sealed off from the rest of the hospital and other (noninfected) patients and staff should not need to enter the area to move through the hospital. It is important also that the Respiratory ED has its own self-contained air conditioning system in order to limit possible transmission of the virus to other parts of the hospital through the air conditioning.

If such an area is not easily identified another option is to use a room (s) with an external window away as much as possible from other patient areas. This allows the door to be closed and the external window opened (just a little will be fine) in order to allow the air flowing into the room from the air conditioning to be directed outside (to an outside area away from the public) instead of flowing back through the door into the corridor and into the intake duct of the air conditioner.

It is also important to declutter the area of all unnecessary equipment to reduce the risk of transmission of the virus from surfaces and facilitate cleaning after each patient. Other critical considerations include entry and exit points to the hospital to reduce the need to transport COVID-19 patients through other patient areas of the hospital, signage of the area to alert staff, access to PPE and hand hygiene and ensuring all equipment and waste is managed in a way to avoid the risk transmission to patients and staff.

**Single Triage Point**

Having planned and set up the two distinct areas the next step is to identify a single triage point located at the entrance to the hospital that allows patients to be directed to the Respiratory ED and the Non-Respiratory ED based on their presenting symptoms. Consideration will need to be given to managing ambulance presentations and will require communication with ambulance services to coordinate this process.

One hospital for example quarantined their ED to assess and manage “Non Respiratory Presentations” while assigning three side rooms and if needed “Recovery” as the “Respiratory ED”. The three side rooms had outside windows and were located adjacent to recovery and near to the hospital entrance along a corridor that could be sealed off from the rest of the hospital. This enabled Respiratory patients with potential COVID-19 to remain outside the ED and away from other patients in hospital. A back entrance was utilised to enable ambulances to bypass the ED and access the Respiratory area. The recovery ward could if needed be used to manage respiratory patients requiring higher level care (eg awaiting transfer) and the second theatre used for resuscitation and/or intubation is required.

The single triage point at the front door of the hospital or health service is used to screen patients as they arrive and direct them to either the Respiratory ED or the Non-Respiratory ED. It is of course not expected that this triage will be staffed in most cases – this is simply not feasible for most smaller sites with a hand full of presentations each day. What is required however is to screen the patient before they are able to enter the hospital. For many sites this may involve locking the front doors and having a call bell or intercom available to allow staff to attend to triage the patient. Many rural sites already have this setup in place to manage ED presentations after-hours, so it is often a simple process of extending this to operate 24 x 7.

**Triage and Immediate Management**

*Equipment to assist triage should be available close to the entrance and include a thermometer and oximeter, PPE equipment for staff, facilities for hand hygiene and surgical face masks for the patient*

When the patient arrives the first step is to identify patients with Respiratory Symptoms that will need to be directed to the Respiratory ED.

**Step 1 : Begin with Personal Protective Equipment (PPE) precautions**

*If the patient is not already wearing one, a Surgical Mask should be placed on the patient.*

Minimum Standard precautions for staff include wearing gloves and use of Surgical mask. Where possible staff should distance themselves from the patient.

In high risk areas with widespread community transmission, gowns, N95 and face shields will be required. Local guidelines should be followed in these circumstances

PPE for aerosol exposure is required in a patient brought by ambulance who is receiving supplemental oxygen and includes gown/gloves, eye protection and N95 mask.

**Step 2 : Assess the patient for the following :**

* URTI symptoms : Sore throat, Runny nose, Cough
* Flu like symptoms : Sweats, Chills, Myalgia, Headache
* Significant Difficulty breathing : Shortness of breath
* Positive testing for COVID-19

*If any of the above are present the patient should be directed to the Respiratory ED for further assessment.*

**Step 3 : If the above symptoms are absent the patient should be assessed for**

* Tachypnoea (or signs of obvious respiratory distress eg difficulty speaking)
* Fever
* Saturations < 90%

*If any of the above are present the patient should be directed to the Respiratory ED for further assessment.*

**If these are absent the patient is directed to the “Non-Respiratory ED”**

**COVID-19 : Triage + ED Management**

**Triage Patient at Hospital Entrance**

**Place a Level 1 Surgical Face mask on the patient**

**Non-Respiratory**

**Emergency**

**Department**

**No**

**Respiratory**

**Emergency Department**

**Cardiac Arrest**

Confirm Resus status

PPE : N95 or P2 Mask, Goggles and Face Shield, Long Sleeved Gown, Gloves

No Bag/Mask Ventilation

Ventilate using iGEL LMA

**Deterioration 🡪 Respiratory Support**

PPE : N95 or P2 Mask, Goggles and Face Shield, Long Sleeved Gown, Gloves

Humidified High Flow Nasal Prong O2 delivered at 40 - 60 l/min to FiO2 = 0.4

If this fails confirm Resus Status Discuss with ICU/Retrieval

Options include BiPAP, Intubation/Ventilation

**Assess need for Respiratory Support**

Commence O2 in most patients where SpO2 < 92%

(If patient is at risk for hypercapnoea commence O2 if SpO2 < 88%)

Administer oxygen via Nasal Specs at 1 - 4 l/min

Titrate oxygen delivery to target SpO2 range

Give Bronchodilators via MDI with Spacer

**Yes**

**Assess Respiratory Symptoms**

**Does patient have any of the following ?**

URTI symptoms (Sore throat, Coryza)

Flu syndrome (Cough, Myalgia, Headache)

Respiratory symptoms (SOB)

Tachypnoea, Fever, Low Sats <92%

Tested Positive for COVID-19 Virus

**Staff PPE Requirements**

**During times of Community Transmission**

PFR : N95 or P2 Mask + Goggles or Face Shield, Long Sleeved Gown and Gloves

**Presentation of COVID-19 Illness**

Of those who develop symptoms with COVID-19 about 80% to 85% experience only a mild flu like illness characterised by fever, dry cough, headache and myalgia. In about 15% of patients the illness is complicated by the development of bilateral pneumonia with patient reporting increasing shortness of breath and about half requiring supplemental oxygen and/or intensive respiratory support with non-invasive or invasive ventilation.

The illness begins with a flu-like symptoms 2 to 11 days following exposure (with the mean being around 5 days). In patients developing pneumonia there is increasing shortness of breath and hypoxia beginning around 5 days into the illness. In the most critically ill there is a sudden release of cytokines (chemicals that the body use to mediate the immune system in the body) and this “cytokine storm” leads to acute ARDS and multiorgan failure and death.

Although in many circumstances patients with COVID-19 present flu like symptoms and or increasing shortness of breath, it is important to recognise that the presentation of severe disease is variable.

**Patients may present as a result of developing complications including:**

1. Severe hypoxia (with saturations as low as 75%) without feeling breathlessness or appearing to have respiratory distress
2. Increasing confusion or drowsiness due to encephalopathy
3. Renal failure associated with severe dehydration
4. Diabetic ketoacidosis or hyperglycaemic hyperosmolar syndrome
5. Congestive cardiac failure, New onset AF or Pericarditis

*Patients may be asymptomatic despite the presence of bilateral pneumonia (which may only be discovered on a CXR performed for an unrelated reason eg following trauma).*

Laboratory markers for patients at risk deterioration from COVID-19 have been identified and include extremely low levels of lymphocytes (lymphopenia) and platelets (thrombocytopenia) and markedly elevated levels of liver enzymes and possibly D-Dimer. These provide a useful early indicator of a patient who is at risk of deterioration and early transfer of a patient before they deteriorate to the point of requiring ICU care.

# Chapter 112

# ED Clinical Assessment

#### Key Points

1. Clinical assessment in suspected COVID-19 involves ensuring correct PPE is applied followed by an assessment of the patient for respiratory symptoms, respiratory distress, fever and hypoxia.
2. Characteristics of patients with severe illness include an oxygen saturation of < 92% and /or severe tachypnoea > 30 / min with or without signs of respiratory distress
3. Routine investigations in patients requiring admission for COVCID-19 include Antigen testing, CXR, CBP/FBE, EUC/LFTs, CRP, CK and D-dimer

Assessment of the patient presenting with symptoms suspicious for COVID-19 begins with applying and checking PPE. This will include a gown, gloves, face mask and eye protection. Although previously a surgical mask was considered adequate where the patient was not receiving oxygen this has increasingly changed toward the use of the N95 mask with the rapid spread of the delta variant of the virus. The patient should continue wearing the surgical face mask that was placed when they arrived at the hospital.

**Initial assessment should include:**

* Documenting presenting symptoms, history of illness, past medical history, medications and allergies
* Performing a set of vital signs (Resp rate, Oximetry, Pulse, BP and Temp)
* Applying nasal specs oxygen in the patient with saturations < 90% or with severe respiratory distress
* Providing analgesia if required
* In the patient likely to require admission obtaining IV access and drawing blood for bedside testing and laboratory testing : EUC/LFTs, CK, CRP, CBP and D-Dimer
* Where available rapid antigen testing may be performed to confirm/rule out COVID-19

Medical assessment focuses on assessing the patient’s respiratory status to rule out alternative diagnoses and identify those requiring admission, oxygen and ICU care. While previously this assessment would have included a “hands on” examination of the patient this is unlikely to add to the assessment and should be carefully considered. The risk here is that by approaching the patient and in particular placing our head close to their face to examine the throat and ears, significantly increases risk of transmission of the virus.

The other important consideration is auscultation of the chest. In most case this is unlikely to add any useful clinical information as patients with COVID-19 pneumonia have variable auscultatory findings and it is the clinical finding of hypoxia and/or respiratory distress with tachypnoea, increased work of breathing and difficulty completing sentences that determines immediate management. With the exception perhaps of the patient with a history of asthma, routine auscultation should be resisted and if required should be performed by standing behind the patient with auscultation of the posterior chest wall. Careful cleaning of the stethoscope is essential after such an examination to avoid the risk of transmission of the virus.

**ED workup of the unwell patient likely requiring admission will include**

1. Antigen testing to confirm the confirm the diagnosis
2. Chest X-ray to identify the finding of bilateral interstitial pneumonia typical of COVID-19
3. CBP/FBE: Typical findings are low WBC, lymphocytopenia, mild thrombocytopenia
4. EUC/LFTS, CRP, CK and D-dimer : These are commonly elevated in patients with COVID-19

Where available lung ultrasound (of the back) using a probe cover (or plastic sheath) to reduce the risk of probe contamination may be used to confirm the presence of bilateral pneumonia and identify the presence of pleural effusion, cardiac failure pneumothorax and lung consolidation.

**COVID-19 : ED Clinical Assessment**

**Background**

Based on current data it is expected that

* 15% of patients will require admission
* 40% of admitted patients require oxygen and 6% will require invasive ventilation

Assessment should focus on identification + continued monitoring for Respiratory Failure.

Ensure early communication with Retrieval in patients likely to require respiratory support

**Primary Assessment**

* Vital Signs (RR, Sat, BP, PR, Temp)
* Nasal spec O2 (1 - 4l/min) if Sats < 92%
* Nurse initiated analgesia as indicated
* Consider IV access + EPOC testing
* Bloods : CBP/FBE, EUC/LFTs, CK, CRP

**Predictors of Poor Outcome**

* Lymphocytopenia < 1.0 x 109/L
* Ratio of absolute neutrophil count to absolute lymphocyte count > 3.5
* Significant Thrombocytopenia
* LFTs > 5 times normal
* Elevated Interleukin

Patients with predictors of poor outcome may be considered for transfer

**Investigations in COVID-19**

* CXR : Bilateral interstitial pneumonia (begins generally in the RLL)
* CBP : WBC low, Lymphocytes low, Platelets lower than normal
* CRP, Ferritin : Elevated in most patients
* CK, LD, ALP/AST/ALT and D-Dimer are commonly elevated
* Procalcitonin : Normal in 95%

**Medical Assessment**

**In a patient with bilateral pneumonia**

* Hypoxia does not correlate to CXR findings
* Often minimal findings on auscultation (avoid stethoscope to reduce infection risk)
* Focus on the appearance of patient, signs of respiratory distress and vital signs
* Lung Ultrasound : Always use probe cover. Scan posteriorly and laterally. If indicated image IVC to assess fluid status. Image heart if suspect LV dysfunction or PE.

**Clinical Presentation**

**Presentation of severe disease is variable and includes**

* Severe Hypoxia without dyspnoea
* Encephalopathy (Confusion/Coma)
* Renal failure due to dehydration
* DKA
* CCF, New onset AF, Pericarditis

May be asymptomatic with bilateral pneumonia found on CXR/CT ordered for an unrelated indication eg trauma

**Clinical Course : in COVID-19**

* Flu-like symptoms : 2 - 11 days after exposure (mean 5 days)
* Onset : Fever, dry cough, headache, myalgia +/- anorexia, fatigue, nausea, abdominal discomfort (with some diarrhoea), loss of smell, backpain
* Day 5 : SOB with bilateral pneumonia
* Day 10 : Cytokine storm leading to acute ARDS and Multiorgan failure

**Assessment of Disease Severity[[1]](#footnote-1)**

A major focus of the assessment of the patient with COVID-19 will be to identify patients with evolving respiratory failure. The patient’s chest should be exposed to enable an adequate assessment of the respiratory rate and identify clinical features indicating increased work of breathing. In the adult patient markers for increased work of breathing include tripod positioning, soft tissue recession and use of accessory muscles.

The patient’s saturation, pulse rate and blood pressure should be documented and the finding of hypoxia (saturation less than 92%) and /or marked tachycardia and /or hypotension indicate the presence of serious disease.

Based on clinical assessment it is possible to classify patients with respiratory distress into the following groups.

**Mild Illness is characterised by**

* No symptoms
* Or Mild Upper respiratory tract symptoms
* Or cough, new myalgia or asthenia without shortness of breath or a reduction in oxygen saturation s

These patients have no clinical features of moderate or severe disease and are be treated symptomatically.

**Moderate Illness is characterised by**

* Stable patient presenting with respiratory and or systemic symptoms or signs
* Able to maintain oxygen saturation of > 92% (or > 90% in patients with chronic lung disease) with up to 4L/min via nasal prongs
* No clinical findings indicating severe respiratory distress

These patients require admission and careful titration of nasal spec oxygen (1 – 4l/min) aiming to maintain their saturations in the range of 92% to 96%. They require 4 hourly observations.

**Severe Illness is characterised by**

* Severe Tachypnoea > 30 / min that may or may not be associated with signs of respiratory distress
* Saturation of < 92% despite Nasal specs oxygen / Venturi mask

These patients fail to achieve the target SpO2 with nasal specs / venturi mask. Consider using HFNPO2 or CPAP. They are high risk for deterioration and should be discussed with the referral ICU.

**Critical Illness is characterised by**

* Patients deteriorating despite advanced forms of respiratory support (HFNFO2, BiPAP)
* Or patients requiring mechanical ventilation
* Or patients with hypotension, impaired consciousness or organ failure

These patients are critically ill, and a decision is required regarding the use of respiratory support in these patients It is important to acknowledge that in patients reaching the point where intubation and ventilation is being considered the prognosis for survival is poor particularly in older patients and those with significant comorbidities.

In the rural setting with minimal or no resources for advanced respiratory support it may be appropriate to discuss the management of these patients with experienced intensivists at the tertiary referral centre and consider in some circumstances the possibility of palliation.

# Chapter 113

# Respiratory and Drug Management

#### Key Points

1. Supplemental oxygen is indicated in patients where the SpO2 has fallen below 92% and in those at risk for hypercapnoea with an SpO2 below 88%.
2. In hypoxic patients first line management is to deliver oxygen via either nasal specs (1 – 4 l/min) or using a venturi mask (with FiO2 ranging up to 0.4) and titrating oxygen delivery to the patient’s target
3. In patient where first line therapy has not corrected the hypoxia, humidified high flow nasal prong O2 (HFNPO2) should be used.
4. Patients where first line therapy or HFNPO2 have not been successful should be discussed with the referral ICU to consider NIV or invasive ventilation.
5. Awake prone positioning reduces the incidence of treatment failure and the need for intubation in patients with COVID-19 and respiratory symptoms who are receiving any form of supplemental oxygen therapy.
6. Inhaled Budesonide and Systemic Corticosteroids have been identified as disease modifying therapies in COVID-19.
7. A wide range of antiviral, immunomodulating and other drugs are under investigation to determine their role in the management of COVID-19

**Respiratory Management**

*The COVID-19 pandemic has triggered a reassessment of the role of oxygen in the care of patients presenting to the emergency department.*

During the pandemic every patient should be considered a potential carrier of the virus whether or not they present with suggestive symptoms of COVID-19. Patients may for example have COVID-19 pneumonia but be asymptomatic and identified only when a CXR or CT scan is ordered for an unrelated presentation (eg major trauma).

Traditionally it has been taught to routinely consider placing oxygen on all patients presenting to the emergency department with serious illness or to use supplemental oxygen when a patient’s saturations are considered to have fallen below what is considered normal. During the pandemic a reappraisal of this approach has occurred with the result that a more uniform approach is now used to the administration of oxygen.

* **It is now recommended that supplemental oxygen should be considered in most patients where the saturations (SpO2) have fallen below 92%.**
* **In the subgroup of patients who are at risk for hypercapnoea (eg history of COPD) it is recommended that oxygen should be considered only when the SpO2 falls below 88%.**

The first line treatment for hypoxia is the administration of oxygen administered via Nasal specs (at rate between 1 to 4 l/min) or via a Venturi mask (using adapters with an FiO2 ranging between 24%- 40% and delivered at the recommended l/min). The supplemental oxygen should be titrated aiming for a target oxygen saturation (SpO2) of between 92% - 96% for most patients and a target SpO2 of 88% - 92% in patients at risk for hypercapnoea.

While the use of nasal specs will be the most common method of delivering oxygen, alternative methods will be needed in patients where even with the use of maximal oxygen delivered using nasal specs or a venturi mask this has not been successful in maintaining the patient’s target SpO2 (Oxygen saturation).

**Advanced Non-invasive Therapies**[[2]](#footnote-2)

As our experience and knowledge of the management of the severe respiratory failure associated with COVID-19 has increased it has been recognised that morbidity and mortality can be improved with the selective use of non-invasive forms of respiratory support. In addition while previously serious concerns had been held with regard to the possibility of promoting transmission of the virus, it is clear that oxygen delivered using humidified high flow nasal prong O2 or CPAP adds limited additional risk to the transmissibility of the Delta virus in inpatient environments[[3]](#footnote-3).

It is essential that careful local planning and a thoughtful approach to the development of clear policies and procedures for the use of these techniques is undertaken before staff are faced with a severely hypoxic patient requiring respiratory support. A failure to provide clear directions on the use of non-invasive methods of respiratory support creates the possibility that staff, and patients will be inadvertently exposed to COVID-19 or alternatively to the situation where life-saving treatment is withheld resulting in increased patient mortality.

**Humified High Flow Nasal Prong oxygen**

*Humified High Flow Nasal Prong oxygen (HFNPO2) should be considered where nasal specs or a venturi mask delivering the maximum level of oxygen has not been successful in maintaining a patient’s target SpO2.*

HFNPO2 should be delivered at a rate in adults of between 40l/min to 60l/min with an FiO2 of between 21% – 40% titrated to achieve the patients target SpO2[[4]](#footnote-4). Although higher levels of FiO2 may be used consultation with the referral ICU is recommended as these patients are at high risk for requiring intubation and ventilation.

**Continuous Positive Airway Pressure**

*Continuous positive airway pressure (CPAP) may be considered in patients where HFNPO2 with an FiO2 of 0.4 has failed to maintain the patients target SpO2.*

Most patients require pressures of 10 cm – 12 cm H2O with the FiO2 of between 0.4 – 0.6. It is important to recognise that patients requiring CPAP are at high risk for deterioration and discussion with the referral ICU is essential to plan for possible deterioration.

**Non-invasive Ventilation (BiPAP)**

BiPAP (often referred to as Non-invasive respiratory support) may be considered in some circumstances but requires experience with its use and should be used in consultation with the referral ICU as these patients will frequently require intubation and ventilation.

Strict attention should be given to ensuring staff safety with appropriate PPE and should be ideally delivered in a negative pressure room. Other alternatives include single rooms or shared ward spaces with cohorting of confirmed COVID-19 patients.

*Non-invasive therapy should not be used in shared wards, emergency department cubicles or during interhospital patient transfer/retrieval[[5]](#footnote-5).*

**Nebulised Therapy**

*Nebulised medications should be avoided where possible. In most cases salbutamol or ipratropium can be delivered more safely (and more effectively) using a spacer device.*

In a small minority of cases nebulised therapy can be life-saving such as in the child with life threatening croup, the patient with life threatening airway obstruction from anaphylaxis and in the severely hypoxic asthma patient where spacer device therapy has failed.

In these circumstances it is important to balance the risks of the therapy with the significant risk of the patient deteriorating into cardiac arrest. There is no easy answer here and each situation needs to be considered in order to weigh up the risks to the patient and to the treating medical and nursing staff and other patients.

It is important here to avoid absolutes and ensure staff are well informed on the risks and able to draw on their clinical experience and knowledge to select the best approach to a given situation.

**COVID-19 : Clinical Management**

**Respiratory Support**

**Hospital Environment**

All patients admitted for respiratory support should be managed in the designated “Respiratory ED”.

Consider using Side Rooms away from other patient areas with a window that can be opened slightly to a safe outside area and implement a strict “Door Closed” policy. Manage with full PPE.

**Patient requiring Oxygen**

*Administer IV Dexamethasone 6 mg for up to 10 days*

**Indications**

All patients with Covid-19 pneumonia requiring oxygen including those requiring mechanical ventilation

**Alternative Regimes**

* Prednisolone 25 – 50 mg daily for up to 10 days
* IV/IM Hydrocortisone 50 mg 6 hourly for up to 10 days

**Pharmacological Management**

**Patient Not requiring Oxygen**

*Administer inhaled Budesonide 800 ug bd for 14 days*

**Indications**

All patients > 65 years

Age > 50 years with any of the following :

* Diabetes (not treated with insulin)
* Heart disease and or hypertension
* Asthma or lung disease
* Weakened Immune system
* Mild hepatic impairment
* Stroke or other neurological problem

**Management**

Discuss with ICU / Retrieval Service

**Options**

* Non-invasive ventilation
* Intubation + Ventilation locally (if feasible)
* Prone Positioning (3 – 8 hours/day)

**Critical IIlness**

**Clinical Findings**

* Hypoxic despite HFNPO2
* Or Unstable : Hypotensive, Altered GCS, Organ Failure
* Or Intubated / Ventilated

**Severe Illness**

**Clinical Findings**

* Respiratory rate > 30
* Saturation < 92% with Nasal Specs O2

**Recommended Management**

* Humidified High Flow Nasal Prong O2
* Administer at 40 - 60l/min to FiO2 = 0.4
* Titrated to Target SpO2
* Prone Positioning (3 – 8 hours/day)

**Moderate Illness**

**Clinical Findings**

* Stable Patient
* Saturation > 92% with Nasal Specs O2

**Recommended Management**

* Nasal specs (1 – 4l/min) or Venturi mask
* Titrated to Target SpO2
* Monitor 4 hourly
* Prone Positioning (3 – 8 hours/day)

**Prone Positioning**

*Research suggests that positioning the patient in a face-down (prone) position assists to open up (recruit) collapsed alveoli and is effective in improving hypoxia associated with COVID-19.*

Awake prone positioning reduces the incidence of treatment failure and the need for intubation in patients with COVID-19 and respiratory symptoms who are receiving any form of supplemental oxygen therapy. Prone positioning should be commenced as early as possible in the patient with hypoxia associated with COVID-19. Recommendations are now encouraging that where it can be applied safely it should be commenced in the emergency department.

There are very few contraindications to prone positioning and almost all patients can be placed in the prone position. Patients who are obese or in the second and third trimester of pregnancy may require the use of multiple pillows to assist with maintaining position. Proning can be done either continuously or in short bursts as tolerated. In patients who are experiencing difficulties with a completely prone position, lateral or semi-prone positioning may be tried.

### Basic instructions for helping a patient into the prone position[[6]](#footnote-6)

1. Explain the procedure to the patient and its benefits.
2. Calmly help the patient roll on to their side, and then on to their stomach.
3. Hugging the pillow as they roll will help to keep any monitoring equipment from becoming tangled or stuck during the manoeuvre.
4. Ensure respiratory supports and monitoring are still correctly in place.
5. Repositioning of pillows will be necessary for comfort. Additional pillows will be required to position obese patients and women safely and comfortably in their second and third trimester of pregnancy.
6. Place the call bell within the patient's reach.

The aim should be to use prone positioning for at least 3 hours a day with each additional hour adding benefit. The best outcomes are seen in patents who are able to tolerate prone positioning for 8 or more hours per day. It is important that while proning patients should continue to receive routine nursing care including regular pressure area care, be able to take meal and toilet breaks and can call for assistance if required.

Respiratory support should continue while the patient is in the prone position and monitoring of patient’s vital signs should be done every 15 minutes for the first 30 minutes returning to their normal level of monitoring after this. Proning should be stopped if there is evidence of increased work of breathing, increasing hypoxia with proning or the patient develops hemodynamic instability or arrhythmias.

**Pharmacological Therapies**

**A wide range of drugs are under investigation in the management of COVID-19 including:**

* Antivirals (remdesivir, lopinavir-ritonair)
* Antimalarials (hydroxychloroquine, chloroquine)
* Interleukin receptor antagonists (tocilizumab, anakrina)
* Corticosteroids (dexamethasone)
* Convalescent plasma.

As trials of these and other agents are published it is likely that recommendations for the pharmacological treatment of COVID-19 illness will change. To date only a limited number of agents have been recognised as disease modifying therapies. These include :

**Oral / IV Corticosteroids**

There is strong evidence for the benefits of IV dexamethasone 6 mg (0.15mg/kg/day) administered daily for up to 10 days in patients with COVID-19 who require oxygen (including mechanically ventilated patients). Alternative regimes include Prednisolone 50 mg (in adults and adolescents) for up to 10 days or IV/IM Hydrocortisone 50 mg 1mg/kg/dose to a maximum of 50mg every 6 hours for up to 10 days. Any of these regimes are safe to use in pregnant and breastfeeding women.

**Inhaled Steroids**

Current evidence suggests a benefit with the use of that inhaled Budesonide in symptomatic patients with COVID-19 who do not require oxygen and who have one of more risk factors for disease progression. Risk factors include age > 65 years or age > 50 years with one or more of the following conditions

* Diabetes (not treated with insulin)
* Heart disease and or hypertension
* Asthma or lung disease
* Weakened immune system due to a serious disease or medication (eg chemotherapy)
* Mild hepatic impairment
* Stroke or other neurological problem

Inhaled Budesonide is administered by breath actuated inhaler in a dose of 800ug twice daily for a period of 14 days and is safe to use in pregnant and breastfeeding women.

**Other agents**

Other pharmacological agents where the evidence suggests possible benefit in selected patients with COVID-19 include antiviral agents (Remdesivir), immunomodulators (Baricitinib, Sarilumab and Tocilizumab) and monoclonal antibodies (Sotrovimab, Casirivimab plus imdevima). Research is continuing and we will see a gradual introduction of many of these agents to our clinical practice as we better understand how they should be used and in which patients they are most likely to benefit.

A useful resource for keeping track of developments and recommendation in this area of management is the Australian National COVID-19 Clinical Evidence Taskforce.[[7]](#footnote-7)

# Chapter 114

# Intubation and Ventilation

#### Key Points

1. Endotracheal intubation and assisted ventilation may be considered in severely hypoxic patients where non-invasive methods of respiratory support have failed or cannot be used
2. The procedure for endotracheal intubation is complex and requires careful planning to prepare the resuscitation room, check airway equipment and drugs required for the procedure and undertake preoxygenation and intubation in a way that minimises risk of aerosol transmission of the virus.
3. Checklists and Simulation provide excellent tools for assisting staff with undertaking endotracheal intubation in the stressful circumstances characteristic of the patient with coivd19 pneumonia.
4. Ventilation of the patient with COVID-19 pneumonia uses low tidal volumes and a lower ventilatory rate with PEEP to reduce the risk of causing additional lung injury from the positive pressure ventilation.

**Endotracheal Intubation[[8]](#footnote-8)**

*Attention to detail with setting up for intubation is critical to reduce the risk of exposure and aid the team to respond to complications associated with the procedure for intubation.*

One of the most challenging aspects of COVID-19 is caring for the patients who deteriorates to the point of requiring endotracheal intubation. In most cases the patient has deteriorated over hours to days with falling saturations and increasing oxygen requirements despite non-invasive respiratory support and invasive ventilation has become necessary. In this situation the patient will require intubation.

The procedure for emergency intubation is recognised as one of major challenges in the immediate care of the critically ill or injured patient and requires considerable technical expertise, procedural practice and attention to planning and detail. This becomes even more problematic in the patient with severe respiratory distress associated with COVID-19.

The patient is often significantly hypoxic with minimal respiratory reserve and significant precautions are required to reduce the risk of exposure to the virus. The airway team are at risk due to their close proximity to the face and the need to administer O2 during the procedure promoting aerosol dispersion of the virus.

**Preparation**

The set up for intubation begins communication - with notifying the team that a patient with COVID-19 will require intubation. As the procedure for setting up and performing intubation is highly structured with well-defined team roles and steps in management it may be most easily communicated by referring to the activation of a specific protocol.

The resuscitation room is the focus of the next stage in the preparation process. In the best circumstances, the hospital has forward planned for intubation of the COVID-19 patient, and the resuscitation room is equipped and ready to be used. Important factors to consider are signage (to keep staff not involved in the procedure out of the room), entry and exit points for the patient, removal of excess equipment (sometimes at the time of room set up) to reduce risk for contamination and cleaning requirements. Often draping plastic sheets over trolleys and equipment that are required to remain in the room facilitate later cleaning. In cases where the trolley has not been required the plastic drapes need only to be removed and replaced with new plastic sheets. Another important consideration is the availability of PPE, facilities for hand hygiene and bins for disposal of contaminated equipment and PPE.

**Checklists**

For many sites intubation is an uncommon or very rare procedure and there is a high likelihood that many of the staff have little or no experience with emergency endotracheal intubation other than perhaps observing (often from a distance) a retrieval team undertaking this procedure from time to time. In these circumstances it is even more important that during the pandemic medical and nursing staff likely to be called upon to assist with intubation receive training and in particular become familiar with the room set up, monitoring requirements and the specialised equipment and drugs required to safely perform the procedure. A useful method for assisting staff to follow the procedure is the use of checklists.

The use of checklists minimises the risk of clinical error by reducing the cognitive load on staff. Put simply the lists remove the pressure for staff to “remember everything” and the anxiety that occurs from the fear that we will miss or forget to do something or not do it in the correct order or correct way.

The checklists should cover not only the equipment required for intubation but include the procedure of preoxygenation, the dose, preparation and administration of drugs required for rapid sequence intubation and steps required for post intubation care.

**Graphical user interface, text, application

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*Examples of two checklists are shown above.* The checklist on the left is designed to assist with preparing for intubation and includes a check of the resuscitation room, airway equipment, intubating medication and communication with the team. The checklist of the right outlines steps for the procedures of preoxygenation, endotracheal intubation and post intubation care.

**Simulation**

It is important that if checklists are to be used in the pressured and challenging circumstance of intubation in a critically ill patient with COVID-19, staff need to be well acquainted with the checklist by ensuring they have had the opportunity to practice using it beforehand. Simulation introduces staff to the use of checklists, assists them to know where to find equipment and understand better how to draw up and administer drugs required for the procedure. Simulation also has the advantage of allowing staff to rehearse the procedure of intubation and to practice team skills including leadership, communication, situational awareness and creation of shared mental models.

**COVID-19 : Endotracheal Intubation**

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**Clinical Indications**

Primary Respiratory Disease with O2 sats < 88% despite use of nasal oxygen 6l/min

Altered Conscious State (including RICP)

Life threatening Airway Obstruction

Severe Haemodynamic Compromise

Post Arrest : Return of Spontaneous Circulation

**Laryngeal Mask Airway**

Restrict use to Cardiac Arrest Rescue Airway for failed ETT

**Bag and Mask (BVM)**

* Use only for preoxygenation
* Attach HME/viral filter to mask.
* No PPV during unless sats <85%
* Use 2 handed Vice VE technique to reduce airway leak

**Confirm Resuscitation Status**

**Call a “Respiratory Code”**

Notify On call GP Anaesthetist and Nursing TL

**Phone Retrieval** : Assists Planning

**PPE Requirements**

PFR : N95 or P2 Mask

Goggles and Face Shield

Long Sleeved Gown

Double Gloves

Change clothes/shoes

**Prepare Resuscitation Room**

Three staff in Room + One scout outside room

Don PPE (Use a Buddy to check PPE)

Airway Equipment Check + Check Suction

Set up Video Laryngoscope

Preload ETT with stylet or bougie

Prepare Drugs and Check Doses

Set up Ventilator, Check Connections

Attach monitoring, Check IV Access/Fluids

Team Review Intubation Drill

**Airway Equipment Checklist**

Scissors, Video Laryngoscope, ETTs,

Bougie / Stylet, Bag and mask, HME

Viral filter, ETCO2, Tube clamp and

Ties, Syringe, Lubricant, OPA/NPA,

LMA, Equipment for FONA

**Preoxygenation**

Turn off Nasal Specs Oxygen

Preoxygenate for > five minutes

Patient at 45 degrees

Use BVM + PEEP valve

Attach HME/Viral Filter to mask and then ETCO2 monitoring probe

Vice (VE) Grip to minimise air leak

No PPV unless critical desat < 85%

**Switch off O2 before removing BVM**

**Procedure for Intubation**

Administer Relaxant + Induction Agent

Allow full 60 seconds before attempting ETT

Use Video-laryngoscope + Preloaded ETT

Aim for correct tube depth during placement

Clamp endotracheal tube and Inflate cuff

Attach HME/viral filter directly to ETT before PPV

Remove outer set of gloves

Attach to ventilator and Commence Sedation

Use inline suction devices (if available)

**Ventilation[[9]](#footnote-9)**

Our aim with the use of mechanical ventilation in the patient with COVID-19 is to maintain oxygenation in the context of severe acute respiratory failure. There is only one absolute contraindication to ventilation, and this is untreated pneumothorax.

In years gone past it was believed that the best way to ventilate a patient using mechanical ventilation was to mimic physiologic breathing and deliver a volume with each breath similar to a normal breath. This approach unfortunately damages the delicate structures in the lung, and it is now recognised that using low tidal volumes combined with higher ventilator rates and PEEP reduce risk for lung injury. This approach to ventilation has been termed the *Lung Protective Strategy*. For patient with asthma or COPD who require ventilation a modified version of the lung protective strategy is used that aims to prolong the time for expiration and this is termed the *Obstructive Lung Strategy*.

**Permissive Hypercapnoea**

For the patient with COVID-19 a Lung Protective Strategy is used with low tidal volumes but with the one significant difference - lower ventilation rates are used as a means of further reducing the risk of causing injury to the lung as a consequence of the positive pressure. It is important to appreciate that when we ventilate someone with ARDS, many of the alveoli are so badly damaged that they will not be ventilated during invasive ventilation, and we are relying on the remaining functioning alveoli to ventilate and facilitate gas transfer. There is the risk that if we try to increase ventilation in a patient to achieve normal pCO2 blood levels this will require the use of pressures, tidal volumes and ventilation rates that increase injury to the remaining functioning alveoli leading to continued deterioration of the patient.

In general when commencing positive pressure ventilation in a patient with COVID-19 pneumonia low tidal volumes should be used and we ventilate and together with lower ventilator rates. The will be associated with an increase in pCO2 and associated with the development of a moderate respiratory acidosis (aiming to keep the pH above 7.2) This is termed as permissive hypercapnoea as we accept this an expected side effect with the use of lower tidal volumes and lower rates of ventilation.

With this background we are now ready to go through the ventilator settings and understand why these are so critical to get right from the onset in a COVID patient.

**Ventilator Settings**

*Begin with a tidal volume of 6 ml/kg (based on ideal body weight) and begin with a rate of 10 breaths / minute. Set the PEEP pressure to 10 cmH2O.*

PEEP assists to maintain pressure in the alveoli preventing the collapse of the small airways. It is particularly useful in patients with severe hypoxia and enables the concentration of oxygen (FiO2) to be reduced, avoiding the risk of oxygen toxicity. If a high inspired oxygen concentration is required to maintain saturations in the required range of 88% - 94%, increasing the PEEP will often allow the inspired oxygen concentration to be reduced. Begin ventilation with 10 cm H2O of PEEP. In critical cases and with the oversight of an ICU specialist the PEEP need to be increased to levels of up to 25 cmH2O. In patients who are hypovolaemic or have low cardiac output states, PEEP may contribute to further haemodynamic compromise with a decrease in venous return and cardiac output. This is generally corrected by the administration of an IV fluid bolus of 250 – 1000 ml NS.

Lastly set the I:E ratio : This is ratio of the time for inspiration to expiratory time. On the ventilator this may be adjusted directly or in some cases by adjusting the time taken for inspiration (Tinsp). For most patients an I:E ratio of between 1:1.5 and 1:2 is recommended. In patient with asthma or COPD longer expiratory times are required and the I:E is increased to a ratio of > 1:4. The settings are summarised below.

Lung Protective Strategy in COVID-19 : Ventilator Settings

* Ventilator Mode : AC or SIMV
* Tidal volume = 6 ml/kg based on lean body weight (Range for titration : 4 – 8 ml/kg)
* Respiratory rate = 10 breaths/minute. (Range for titration : 8 – 12)
* Begin with an inspired oxygen (FiO2) = 1.0
* Begin with a PEEP = 10 cm H2O (Range 10 - 25 cmH2O but get advice on this ASAP)
* I:E ratio = 1 : 2 (may also use 1:1.5)

1. Australian National COVID-19 Clinical Evidence Taskforce. Living Guidelines, November 2021. [Covid19evidence.net.au](http://covid19evidence.net.au/) [↑](#footnote-ref-1)
2. See Chapter 9 for a detailed discussion on the Advanced Non-invasive Therapies discussed below [↑](#footnote-ref-2)
3. Respiratory Network COVID-19 Clinical Intelligence Group. Clinical Practice Guide for Respiratory Support in Adults with COVID-19, 30th Sept 2021. [↑](#footnote-ref-3)
4. Australian National COVID-19 Clinical Evidence Taskforce. Living Guidelines, November 2021. [Covid19evidence.net.au](http://covid19evidence.net.au/) [↑](#footnote-ref-4)
5. Australian National COVID-19 Clinical Evidence Taskforce. Living Guidelines, November 2021. [Covid19evidence.net.au](http://covid19evidence.net.au/) [↑](#footnote-ref-5)
6. Respiratory Network COVID-19 Clinical Intelligence Group. Clinical Practice Guide for Respiratory Support in Adults with COVID-19, 30th Sept 2021. [↑](#footnote-ref-6)
7. Australian National COVID-19 Clinical Evidence Taskforce [Covid19evidence.net.au](http://covid19evidence.net.au/) [↑](#footnote-ref-7)
8. See Chapters 6 and 7 for detailed discussion of Endotracheal Intubation [↑](#footnote-ref-8)
9. See Chapter 10 for a detailed discussion on Mechanical Ventilation [↑](#footnote-ref-9)