Consensus statement: Safe Airway Society principles of airway management and tracheal intubation specific to the COVID-19 adult patient group

Background

An outbreak in Wuhan, China, in 2019 of the novel Coronavirus has led to a pandemic of COVID-19 disease. More than 80% of confirmed cases report a mild febrile illness, however, 17% of confirmed cases develop severe COVID-19 with acute respiratory distress syndrome (ARDS): 4% requiring mechanical ventilation and 4% having sepsis.(1)(2) Like other patient groups with ARDS, patients with severe COVID-19 are likely to be considered for emergency tracheal intubation and mechanical ventilation to support potential recovery from their illness.

From recent reported data in Wuhan and Northern Italy, at least 10% of reported positive COVID-19 cases require ICU involvement, many requiring urgent tracheal intubation for profound and sudden hypoxia.(2) As the incidence of COVID-19 infection rises in the community, an increasing number of patients who have mild or asymptomatic disease as an incidental comorbidity but are nonetheless infective, may still present for urgent surgery.

Risks to healthcare workers

Transmission of COVID-19 is primarily through droplet spread. These droplets are affected by gravity and may cause direct transmission from close contact or contribute to surface contamination (where the virus may remain active for hours to days).(3) However, coughing and some airway management procedures (see Table 1) can generate aerosols composed of smaller virus containing particles suspended in air. These airborne particles may travel greater distances and be inhaled, increasing the risk of transmission.

The process of caring for severe COVID-19 patients and performing aerosol-generating procedures (AGPs) in this group presents an increased risk of infection to healthcare workers.[4](4) During the SARS-CoV outbreak in Canada in 2002, half of all the SARS-CoV cases were nosocomial transmission to healthcare workers (HCWs). In addition to the personal health risks to infected HCWs, illness and quarantine procedures can diminish the available

resources to manage patients at a time of high demand. COVID-19 has now been classified as a high consequence infectious disease (HCID), emphasising the significant risk to HCWs and the healthcare system.(4)

Table 1: Aerosol generation during airway management

Aerosol generating procedures
• NIV or positive pressure ventilation bag-valve-mask • High flow nasal oxygen (HFNO) • Delivery of nebulised/atomised medications via simple face mask • Cardiopulmonary resuscitation (prior to intubation) • Tracheal suction (without a closed system) • Tracheal extubation
Procedures vulnerable to aerosol generation
• Laryngoscopy • Tracheal intubation • Bronchoscopy/Gastroscopy • Front-of-neck airway (FONA) procedures (including tracheostomy, cricothyroidotomy)

Procedures with an intrinsic risk of aerosol generation inevitably involve occurrence of gas flow (Table 1). Positive pressure ventilation during non-invasive ventilation (NIV) or when using a face mask or supraglottic airway are high risk for generating aerosols as the seal they generate is usually inferior to that achieved with a correctly placed & inflated cuffed tracheal tube.

In contrast, procedures which are merely vulnerable to aerosol generation (Table 1) do not inevitably involve gas flow. Generation of aerosols from these latter procedures requires an additional event that precipitates gas flow (coughing, positive pressure ventilation, suctioning). Laryngoscopy, tracheal intubation and bronchoscopy will only cause aerosolisation if coughing is precipitated or if performed in association with an aerosol generating procedure (e.g. suction). FONA may generate aerosol if the patient receives

concurrent positive pressure ventilation from above. Many of these precipitating events can be therefore prevented by adequate neuromuscular blockade and avoiding concurrent aerosol generating procedures, such that, if performed properly and without complications, they may not be aerosol generating.

The process of airway management is a high-risk period for aerosol-based transmission for the following reasons:

- Patient PPE must be removed.
- Clinicians are in close proximity to the patient's airway.
- Laryngoscopy and intubation are vulnerable to aerosol generation.
- Aerosol generating procedures may need to be performed.

Table 2 outlines the risks factors for aerosol generation during the process of airway management and associated protective strategies that can be adopted to mitigate them.

Table 2: Risk factors for aerosol generation

Risk Factor	**Protective Strategy**
Coughing	▪ Full PPE before entering intubation room and getting in close proximity to patient's airway. ▪ Minimise interval between removal of patient's PPE and application of face mask ▪ Good seal with face mask ▪ Ensure profound paralysis before instrumenting airway (adequate dose and time for effect). ▪ (see extubation section below).
Inadequate face mask seal during pre-oxygenation	▪ Well-fitting mask ▪ Vice (VE) grip or two-handed technique ▪ Manual ventilation device with collapsible bag* ▪ ETO_2 monitoring to minimise duration for which face mask applied by identifying earliest occurrence of adequate pre-oxygenation.

Positive Pressure Ventilation with inadequate seal	▪ Avoid PPV ▪ Good seal: o FM: as above o SGA: appropriate size, adequate depth of insertion, cuff inflation** o ETT: confirm cuff below cords, cuff manometry, meticulous securing of ETT. o Manual ventilation device with collapsible bag to gauge ventilation pressures* o Airway manometry to minimise ventilation pressures** o Minimise required ventilation pressures: paralysis, 45-degree elevation, oropharyngeal airway.
High gas flows	▪ Avoid HFNO, nebulisers and airway suction with an open system

*Only beneficial for clinicians with prior familiarity with these devices.

**Where relevant

Non-invasive ventilation (NIV) and High Flow Nasal Oxygen (HFNO) Therapy

There are limited data on the efficacy and safety of NIV and HFNO in the context of viral pandemics. Experience with Infuenza A (H1N1) showed that NIV failed in 57-85% of patients, with failing patients having a higher ICU mortality than those treated with invasive mechanical ventilation.(5)(6) Experience with the COVID-19 patient group in Wuhan showed a similar failure rate of NIV. Of 29 patients commenced on NIV at ICU admission, 22 (76%) went on to require invasive mechanical ventilation. The mortality rates for patients receiving NIV and invasive ventilation were strikingly similar (79% and 86% respectively).(7) Generally, it has been suggested that NIV should be avoided. During the SARS outbreak, there were reports of significant transmission secondary to NIV.(8) Not only does NIV present a higher risk of spread through mask leak, it can lead to delayed and expeditious tracheal intubation, which can increase risks to staff who more hurriedly prepare their PPE.(8)

In general ICU patients, HFNO has been found to decrease the need for tracheal intubation in acute hypoxaemic respiratory failure compared to conventional oxygen therapy, without impacting mortality.(9) Its utility in viral pandemics is unknown. A small cohort study of Influenza A patients showed that treatment with HFNO avoided intubation in 45% of patients, although almost all patients with a higher severity of illness eventually received invasive ventilation. (10) Reports in the online media suggest that NIV and HFNO are being used extensively in the COVID-19 patient group. This is likely in patients with milder disease, though this is unclear. If mechanical ventilators become scarce, these modalities might be used out of necessity. The potential advantages of using HFNO and NIV in these circumstances, however, need to be balanced against the risk of virus aerosolisation. Manikin studies suggest that dispersal of liquid from HFNO at 60L/min is minimal, and significantly less than that caused by coughing and sneezing, providing that nasal cannulae are well fitted. (11) (12)

The level of liquid dispersal in patients, and therefore the risk to healthcare workers of virus aerosolization, remains unclear. The risk of aerosolization from HFNO will depend on many variables, including duration of use, flow rate, patient coughing and cooperation, and the quality and fit of staff personal protective equipment (PPE). Other considerations when choosing between HFNO and intubation are patient factors such as illness trajectory, patient comorbidities and prognosis, resource factors (such as the availability of ventilators and other equipment), and the availability of staff to perform intubation (and care for the ventilated patient).

Until further data become available, it should be assumed that NIV and HFNO are AGPs. Patients receiving these therapies should be cared for in airborne isolation rooms and staff should wear full PPE (including N95/P2 masks) while in the patient room.

It seems clear from the available evidence that NIV and HFNO should not be used when the patient has severe respiratory failure, or a trajectory that suggests that invasive ventilation is inevitable. In such circumstances, patients should be transitioned from oxygen therapy via a simple facemask to intubation and invasive ventilation without delay.

The SAS Guidelines

In recent weeks, a small number of articles, guidelines and flow diagrams have appeared to aid the airway management of the COVID-19 patient group, based mainly on recent experiences in China, Hong Kong and Italy.(13)(14) We aim to rapidly distribute clear local recommendations to clinicians in emergency medicine, intensive care, anaesthesia and prehospital care in Australia and New Zealand to guide airway management of the adult COVID-19 patient group (patients with known or suspected COVID-19 disease).

Specifically, we aim to:

1. Recommend routine airway management practices that should also be adopted in the COVID-19 patient group.
2. Recommend principles specific to the airway management practices of the COVID-19 patient group.
3. Recommend standard airway rescue practices that should also be adopted in the COVID-19 patient group
4. Recommend a consistent but flexible approach to planned airway management practices in the COVID-19 patient group regardless of their location (prehospital, emergency department (ED), intensive care unit (ICU) or operating theatre (OT)).
5. Recommend safe practices for unplanned episodes of airway management (e.g. cardiac or respiratory arrest, other resuscitation scenarios) which may arise in any area.
6. Seek endorsement and distribution of these guidelines by all relevant Australian and New Zealand societies and speciality colleges with an interest in airway management. A common approach will allow early education and simulation training for all staff. Early education is paramount to improving compliance with the techniques, particularly the use of Personal Protective Equipment (PPE). A consistent approach will also improve safe and effective clinical practice during episodes of airway management involving collaboration between clinicians from multiple clinical disciplines, as well as for clinicians working between different sites.

This statement should be viewed as a living document that may need to be updated and revised as more information is acquired on the best practice of airway management in the COVID-19 patient group. Complementary resources such as cognitive aids, checklists and

educational videos will be published in the coming weeks. Implementation of the guidance provided in this statement and its adjunctive materials may need to be adapted to local policies and resources.

The challenges to the staff involved in the airway management of patients from this COVID-19 pandemic should be acknowledged. Examples are included in table 3.

Table 3: Staff challenges

▪ Variations to normal workflow
• Unfamiliar working environments
• Unfamiliar multidisciplinary teams
• Potential resource depletion
• Critically ill patients with limited physiological reserves
• Clinician stress and fatigue

General comments

1. Generic guidelines already exist for intubation of the critically ill patient and other patient groups.(15) The appropriate guidelines should be followed where they do not contradict specific recommendations for the COVID-19 patient group, outlined below.
2. Generic resources already exist to facilitate airway rescue and transition to the 'can't intubate can't oxygenate' (CICO) scenario.(16)(17) Many of these algorithms are similar in content.(18) These should be followed where they do not contradict the specific recommendations for the COVID-19 patient group, outlined below.
3. Generic checklists already exist for intubation of the critically unwell patient. These should still be used as a minimum, but consideration should be given to using a checklist which has been specifically modified for the COVID-19 patient group.
4. Early intubation should be considered to prevent the additional risk to staff of emergency intubation during severe hypoxia or cardiac/respiratory arrest, and to avoid prolonged use of high flow nasal oxygen or non-invasive ventilation.
5. Significant institutional preparation is required to optimize staff and patient safety in preparing for the airway management of the COVID-19 patient group. In addition to

clinical and support staff in intensive care, operating theatres and the emergency department, extensive liaison will be required with multiple other stakeholders, including but not limited to administration, infection control, engineering, sterilisation and equipment disposal services, procurement and education units.

6. The principles for airway management outlined below should be the same for both the COVID-19 patient group with mild or asymptomatic disease requiring urgent surgery and for critically unwell patients with ARDS.

Guiding principles

These recommendations have been developed according to the following general principles with the goal of maintaining staff safety while providing timely, efficient and effective airway management:

Table 4: Guiding principles for airway management of COVID-19 patients

1. Intensive Training
2. Early intervention
3. Meticulous planning
4. Vigilant infection control
5. Efficient airway management processes
6. Clear communication
7. Standardised practice

"Standardised practice" satisfies the following criteria:

- *Safe*: choose options that will not expose patient or staff to unnecessary risk
- *Simple*: straightforward solutions that can be executed efficiently
- *Familiar*: where possible rely on existing techniques that are familiar to the relevant clinicians
- *Reliable*: choose options that are known to be successful in the hands of the relevant clinicians
- *Robust*: choose options that will continue to fulfil the above criteria in the face of foreseeable variations in patient characteristics, environment and the availability of personnel and resources

Recommendations for airway management in the COVID-19 patient group

Environment for airway management

- Negative pressure ventilation rooms with an antechamber are ideal to minimise exposure to aerosol and droplet particles. Where this is not feasible, normal pressure rooms with closed doors are recommended.
- Positive pressure ventilation areas (common in operating theatres) must be avoided due to the increased dispersion of aerosolized virus.
- Some hospitals have created dedicated spaces for planned airway management of the COVID-19 patient group (e.g. airborne infection isolation rooms). The potential resource and ergonomic advantages of this approach need to be balanced against the implications of transporting potentially infective patients around the hospital and room cleaning between patients.
- The decision to move a clinically stable patient between two clinical areas prior to airway management should primarily be based on whether the destination environment will provide a more controlled situation, better equipment and/or more experienced staff to make the process of airway management safer (including less likely to generate aerosolized virus).

Equipment, Monitoring and Medications

General Principles

- Where an equivalent disposable item of equipment is available, this is always preferred over reusable equipment. Where disposable items are not considered equivalent, the time, resource and infection risk implications of sterilising reusable equipment should be considered on a case-by-case basis.
- Allocation of dedicated items of reusable equipment for use in the COVID-19 patient group is preferred where feasible.

Oxygen delivery & ventilation equipment – prior to intubation

- Oxygen can be administered via nasal cannulae, (standard or HFNO), simple facemask or non-rebreather mask, with the general principle that the higher the flow rate, the greater risk of virus aerosolisation.

- NIV should generally be avoided due to its unproven utility in ARDS and the risk or virus aerosolisation.

Oxygen delivery & ventilation equipment – during pre-oxygenation

- Pre-oxygenation should be performed using a well-fitting occlusive face mask attached to a manual ventilation device with an oxygen source.
- A viral filter **MUST** be inserted between the face mask and manual ventilation device to minimise aerosolisation. The viral filter should be applied directly to the face mask as an increased number of connections between the face mask and filter increase the opportunity for disconnection on the patient side, with subsequent aerosolisation of the virus.
- An anaesthetic machine with a circle system, a hand-held circuit (e.g. Mapleson circuit) or a self-inflating bag-valve-mask (BVM) attached to an occlusive face mask can be used as the manual ventilation device. While bag collapse when using Mapleson and circle systems provides a sensitive indication of face mask leaks (alerting to potential aerosolisation of the virus), this should only be a consideration in clinicians already familiar with these devices. For anaesthetists, manometry and ETO_2 monitoring are further advantages of using an anaesthetic machine for this purpose.
- Note that the rebreathing/non-rebreathing nature of the ventilation device should not be a consideration for any clinician group in choosing between these alternatives as once the viral filter is applied, no virus will enter the ventilation device. As such, the most important factor in choosing between these devices is prior familiarity.
- Non-rebreather masks provide sub-optimal pre-oxygenation and promote aerosolisation and are not recommended for this purpose.
- Nasal oxygen therapy (via standard or high flow nasal cannulae) should not be used during pre-oxygenation or for apnoeic oxygenation due to the risk of virus aerosolisation to the *Airway Operator*.

Oxygen delivery & ventilation equipment – post intubation

- Oxygenation and mechanical ventilation can be delivered using operating theatre (OT) anaesthetic machines or mechanical ventilators (in ICU or ED). While there are

advantages and disadvantages of both, the choice will likely depend more on their availability and the location of patient care rather than their individual characteristics.

Airway Equipment

To keep the main airway trolley outside the patient room, we recommend a pre-prepared 'COVID-19 intubation tray' (see table 5 for suggested contents) or a dedicated 'COVID-19 airway trolley'.

Table 5: Suggested contents of pre-prepared COVID-19 Intubation Tray

- Videolaryngoscope (with blade sized to patient)
- Hyperangulated videolaryngsocope (with blade sized to patient)
- Macintosh direct laryngoscope (with blade sized to patient)
- Bougie – straight +/- pre-curved*
- Stylet – malleable +/- pre-curved*
- 10ml syringe
- Tube tie
- Sachet lubricant
- Endotracheal tubes (appropriate size range for patient)
- Second generation supraglottic airway (sized to patient)
- Oropharyngeal airway and nasopharyngeal airway (sized to patient)
- Pre-packaged CICO kit with equipment for scalpel-bougie eFONA
- Large bore nasogastric tube (appropriate size for patient)
- Continuous waveform end-tidal CO_2 ($ETCO^2$) cuvette or tubing
- Viral filter

*At least one pre-curved introducer (bougie/stylet) must be available for use with hyper-angulated VL blade.

Supraglottic Airways

- Where a supraglottic airway is indicated, use of a second-generation device is recommended as its higher seal pressure during positive pressure ventilation decreases the risk of aerosolisation of the virus.

Videolaryngoscopy

It is recognised that videolaryngoscopes are a limited resource in many settings. Where they can be accessed:

- They should be immediately available in the room during tracheal intubation.
- A videolaryngoscope should be dedicated for use in the COVID-19 patient group.
- Disposable videolaryngoscope blades are preferred.
- Both Macintosh and hyperangulated blades ideally should be available.
- Hyperangulated blades should only be used by airway operators who are proficient in their use.

Suction

- Once the patient is intubated, closed suction systems should be used to minimise aerosolisation of the virus.

Miscellaneous

- A cuff manometer should be available to measure tracheal tube cuff pressure in order to minimise leaks and the risk of aerosolisation of the virus.

Equipment outside the room

- Cardiac arrest trolley
- Airway trolley
- Bronchoscope

Team

When assembling a team for intubation, you should:

- Limit numbers: only those directly involved in the process of airway management should be in the room.
- Use the most experienced available staff.
- Consider excluding staff who are vulnerable to infection from the airway team. This includes staff who are older (> 60yrs), immunosuppressed, pregnant or have serious co-morbidities.
- Allocate clearly defined roles:

We recommend the following team (see figure 1):

1. **Airway Operator.** Most experienced/skilled airway clinician to perform upper airway interventions. This may require calling for assistance of another clinician (e.g. a senior anaesthetist) within your hospital.
2. **Airway Assistant.** This should be an experienced clinician, to pass airway equipment to the Airway Operator, and help with bougie use and in bag-valve-mask (BVM) ventilation.
3. **Team Leader.** A second senior airway clinician to coordinate team, manage drugs, observe monitoring and provide airway help if emergency front-of-neck airway (eFONA) is required.
4. **In-Room Runner**. This team member is optional, depending on staff availability and stability of the patient.
5. **Door Runner** (in ante room or just outside patient room) to pass in any further equipment that may be needed in an emergency. This team member can also act as the PPE "Spotter" (see below)
6. **Outside Room Runner.** To pass equipment into ante room (dirty side), or directly to Door Runner if no ante room.

Figure 1: COVID-19 intubation team members

'Intubation teams' may be employed by certain hospitals. This would be at the discretion of individual hospitals and dependent on the number of cases and staff resources. This may improve familiarity, compliance and efficiency of processes around airway management in the COVID-19 patient group, including proper application/removal of PPE use amongst the staff. Evidence for the benefit of this strategy is not yet available.

Planning

- Meticulous airway assessment to be performed early by senior airway clinician and clearly documented.
- An individualised airway management strategy should be formed, based on patient assessment and the skill-mix of the team. This should include plans for intubation and airway rescue via face mask, supraglottic airway and eFONA, with defined triggers for moving between each.

- The ventilation plan should be discussed prior to intubation. This may involve protective lung ventilation, use of high PEEP, proning, and other strategies for refractory hypoxaemia including consideration of extracorporeal membrane oxygenation.

Communication

Clear communication is vital while managing the COVID-19 patient group due to the risk of staff contamination. At the same time, PPE may impede clear communication.

- Pre-briefing should occur, to share a mental model with the whole team prior to intubation. This should include (but is not limited to) verbalising role allocation, checking equipment, discussing any anticipated challenges, the airway management strategy, post intubation plans and PPE donning and doffing processes.
- Clear, simple, concise language should be used.
- Standardised language should be consistently employed; that is precisely defined, mutually understood and used to communicate key moments of situation awareness (critical language).(19)
- Closed loop communication should be encouraged.
- Speaking up should be encouraged.

Cognitive Aids

The incidence of errors during airway management is known to increase under stress, even when experienced clinicians are involved. Task fixation, loss of situation awareness and impaired judgement may arise.(20) The use of resources to support implementation of the airway strategy is particularly important in the COVID-19 patient group, where the challenges involved may consume significant cognitive bandwidth, even before airway management becomes difficult.

- Use of a 'kit dump' mat may facilitate preparation of equipment. Ideally this should be specifically modified for the COVID-19 patient group.
- Routine use of an intubation checklist, preferably specifically modified for the COVID-19 patient group, is recommended. (see figure 2)
- Familiarity, availability and use of a simple cognitive aid for airway rescue, that is designed to be referred to in real-time during an evolving airway crisis, is recommended.

Personal Protective Equipment (PPE)

- 'Buddy system': all staff should ideally have donning and doffing of PPE individually guided by a specially trained and designated staff member acting as a *"spotter"* before entering room. This may help protect task-focused staff from PPE breaches and may help mitigate the stress experienced by the intubating team.
- PPE for **Airway Operator, Airway Assistant** and **Team Leader (who may need to perform eFONA)**:
    - Impervious gown, theatre hat, shoe covers, N95 mask, consider face shield rather than goggles for eye protection, consider double gloves.
    - Outer gloves (if used) should be removed carefully after airway management is completed.
    - This level of PPE should also be worn for endotracheal tube repositioning/replacement, bronchoscopy and percutaneous dilatational tracheostomy.
- PPE for other team members.
    - Gown, gloves, N95 facemask, eye protection.
- Infection control and staff safety to remain top priority. Hand hygiene processes need to be vigilantly followed.
- Follow hospital and/or WHO guidelines for both donning AND doffing of PPE. (Shoe covers must be removed properly.)
- Recognise that doffing is a high-risk step for virus transmission to healthcare workers.

Process for Airway Management

Familiar, reliable techniques should be used to maximise first pass success, secure the airway rapidly and minimize risks to staff.

Pre-oxygenation

- Pre-oxygenation is particularly important as these patients will often desaturate quickly.
- In the period before the team enters the room to perform intubation, the patient's oxygen delivery should be maximised by placing patient in 45° head up position, and they should remain in this position for pre-oxygenation

- Prior to the team entering, a critically unwell COVID-19 patient may be receiving high flow oxygen via nasal cannulae, simple facemask or a non-rebreather mask. These devices should not be used for pre-oxygenation when the team is in position, due to the risks of virus aerosolisation.
- If the patient is receiving high flow nasal oxygen, it should be turned off prior to removal of patient face mask and nasal cannulae to minimise aerosolisation.
- Staff should maintain a minimum safe distance from the patient's airway until high flow oxygen has been discontinued.
- After removal of high flow oxygen or non-rebreather mask, pre-oxygenation should be commenced using the best available facemask device, with a viral filter applied directly to the mask (added connections increase opportunity for disconnection) and $ETCO_2$ in the system.
- After breaching minimum safe distance from the patient's airway and removing any PPE from the patient, minimise the time interval before application of the well fitted occlusive face mask. **A vice grip or two-handed jaw thrust technique is recommended to maximize the facemask seal and minimise gas leak after induction. (see figure 3)**
- Manual ventilation (which may cause aerosolisation of the virus) should be minimised unless required for rescue oxygenation.
- Continuous waveform capnography should be used if available. A triangular rather than square ETCO2 trace or a low numerical ETCO2 value during preoxygenation may indicate a leak around the face mask with aerosolisation of virus and should prompt interventions to improve the seal.
- Fully pre-oxygenate the patient. **A minimum of five minutes of pre-oxygenation is recommended** if ETO_2 is not available.
- The use of high flow nasal oxygen for apnoeic oxygenation during intubation is not recommended given the risk to staff due to aerosolisation of the virus.

Induction

- Use rapid sequence intubation (RSI) or modified RSI as the default technique unless concerns with airway difficulty make this inappropriate.
- Initial neuromuscular blockade can be achieved with rocuronium (>1.5mg/kg IBW) OR suxamethonium (1.5mg/kg TBW). Generous dosing promotes rapid onset of deep

neuromuscular blockade and minimises the risk of the patient coughing during airway instrumentation.

- The time between administration of neuromuscular blocking agent (NMBA) and laryngoscopy should be closely monitored to minimise apnoea time while ensuring adequate time is given for the NMBA to take effect **to avoid precipitating coughing**. The extended duration of action of rocuronium potentially provides an advantage over suxamethonium in the COVID-19 patient group, by preventing coughing and potential aerosolisation of virus should attempts at airway management be prolonged.

Intubation

- In clinicians proficient with its use, **routine use of a videolaryngoscope is recommended for the first attempt at intubation.**
- In addition to potentially contributing to first pass success, visualising the larynx using the indirect (video screen) view, **with the operator standing upright and elbow straight**, a videolaryngoscope maximises the distance between the airway operator's face and the patient. This should reduce the risk of viral transmission to the *Airway Operator.*
- The choice between a Macintosh geometry and a hyperangulated videolaryngoscope blade should be made according to the skill set and clinical judgement of the airway operator.
- Care should be taken to place tube to correct depth first time, to minimise the need for subsequent cuff deflations.
- Once the tube is placed, the cuff should be inflated before positive pressure ventilation is attempted.
- The viral filter should be applied directly to the end of the tracheal tube. Increasing the number of connections between the filter and the tracheal tube increases opportunities for disconnection and aerosolisation of virus.
- Cuff pressure should be monitored with a cuff manometer to ensure an adequate seal.

Face Mask Ventilation:

If rescue face mask ventilation is required, the following precautions should be taken:

- A two-handed jaw thrust technique is recommended (the Assistant is therefore required to squeeze the bag).
- Ventilation pressure should be minimised through ramping and/or early use of an oropharyngeal airway with low gas flows.

eFONA

- In a CICO situation, use of a scalpel-bougie eFONA technique is advocated to minimise the viral aerosolisation risk of high-pressure oxygenation via a small bore cannula.

Post intubation

- Unless single use, the laryngoscope blade should be bagged and sealed for sterilisation immediately after intubation according to ASNZ4187 standards.
- PPE should be removed as per local and WHO guidelines.

Extubation practices

Generic guidelines exist for extubation.(21) These should be followed where they don't conflict with the special considerations for extubation of the COVID-19 patient group outlined below. Patients should ideally be non-infective prior to extubation but this is likely to be unfeasible as resources are drained. Where this is achievable, however, standard extubation procedures apply. In situations where a patient is still at risk of viral transmission, the following recommendations should be observed:

1. Patients should ideally be ready for extubation onto facemask.
2. NIV and HFNO should be avoided where possible.
3. Two staff members should perform extubation.
4. The same PPE should be worn for extubation as is worn by the Airway Operator, Airway Assistant and Team Leader during intubation.
5. The patient should not be encouraged to cough.
6. A simple oxygen mask should be placed on the patient immediately post extubation to minimise aerosolisation from coughing.

Education

1. Early, department-based, interprofessional education is vital for ALL staff involved in the airway management of patients with COVID-19.
2. Regular and repeated education is strongly recommended.
3. Simulation-based education is strongly recommended.

4. Staff education on donning and doffing of PPE, accompanied by multimedia visual aids and supervised practise is strongly recommended.

Special Contexts

Immediate ICU care after intubation

- The viral filter may need to be changed after intubation.
- In a dry circuit, a combined heat-moisture-exchanger (HME) and viral filter can be left in place, but this means that nebulisers cannot be administered without breaking the circuit (to place a nebuliser between the patient and the HME).
- If the viral filter has been removed, the ventilator should be placed on standby and the tracheal tube clamped for all circuit disconnections (to minimise the risks of aerosolisation). Great care should be taken that ventilation is recommenced after the circuit is reconnected.

Urgent surgery in the COVID-19 patient group

These patients will have COVID-19 as an incidental comorbidity, unrelated to their need for airway management, and may have only mild/asymptomatic COVID-19 disease.

- If surgery is non-urgent it should be deferred until the patient is non-infective.
- Airway management in the COVID-19 patient group presenting for urgent surgery should follow the same principles outlined above with particular attention to the following issues.
    - Use a dedicated "COVID-19 theatre".
    - Use of a negative pressure operating theatre is ideal but these are uncommon. Most operating theatres have positive pressure. While this should ideally be avoided, it may not be able to be disabled and the high exchange rate of air in operating theatres limits dispersion of aerosols outside the theatre, despite the positive pressure. Speak to your engineering department about the best way to optimise theatre ventilation.
    - As there is little evidence to inform best practice, choice of anaesthetic technique and a particular airway type (face mask, supraglottic airway, tracheal tube) should primarily be based on the same principles as for non-COVID patients, with attention to the following considerations:

- Regional anaesthesia avoids airway management but leaves the airway open to the room for the duration of the procedure. Minimise supplementary oxygen unless required, minimise sedation (to decrease the risk of precipitating unplanned airway management) and maintain a safe minimum distance from the patient's airway.
- Where general anaesthesia is required, use of neuromuscular blocking agents (according to the principles outlined above) ensures apnoea and prevention of coughing during airway interventions, thereby minimizing the risk of aerosol generation while the airway management team is in close proximity to the patient's airway.
- Intubation maximises the seal around the airway, limiting aerosolisation with positive pressure ventilation but creates the issue of potential coughing with extubation. Prevention of this may require deep extubation, use of opioids, lidocaine or dexmedetomidine.
- Use of a supraglottic airway avoids the need for neuromuscular blockers and positive pressure ventilation, as well as decreasing the risk of coughing during emergence but may not create as good a seal around the airway as a tracheal tube. Conversely, the absence of neuromuscular blockade may increase the risk of coughing during airway management or during a case.
- Avoid positive pressure ventilation with a face mask or supraglottic airway due to the risk of aerosol generation with a suboptimal seal.

- As discussed above, staff not immediately involved with airway management should not enter the operating theatre until after the airway has been secured. This includes surgical staff.
- Recover the patient in the operating theatre to avoid exposure to other patients and staff.

Unplanned Airway Management (this includes Prehospital Airway Management)

These scenarios present great risk to staff, especially during cardiac arrest. Some guidelines have already been suggested in the UK.(22) We recommend:

- Appropriate PPE is rapidly allocated to staff at inpatient cardiac arrest calls (and prehospital sites). Processes must be put in place to ensure this is available.
- Early tracheal intubation by a skilled airway operator.

- Prior to intubation, first responders should only use the airway techniques they are experienced in performing. Positive pressure ventilation should be avoided wherever possible.
- Supraglottic airway placement is likely a better option than face mask ventilation (due to less aerosolisation of the virus) if immediate intubation is not possible.
- At any time, we recommend clinicians to avoid close contact with the patient's mouth (e.g. do not listen for breathing.)

References

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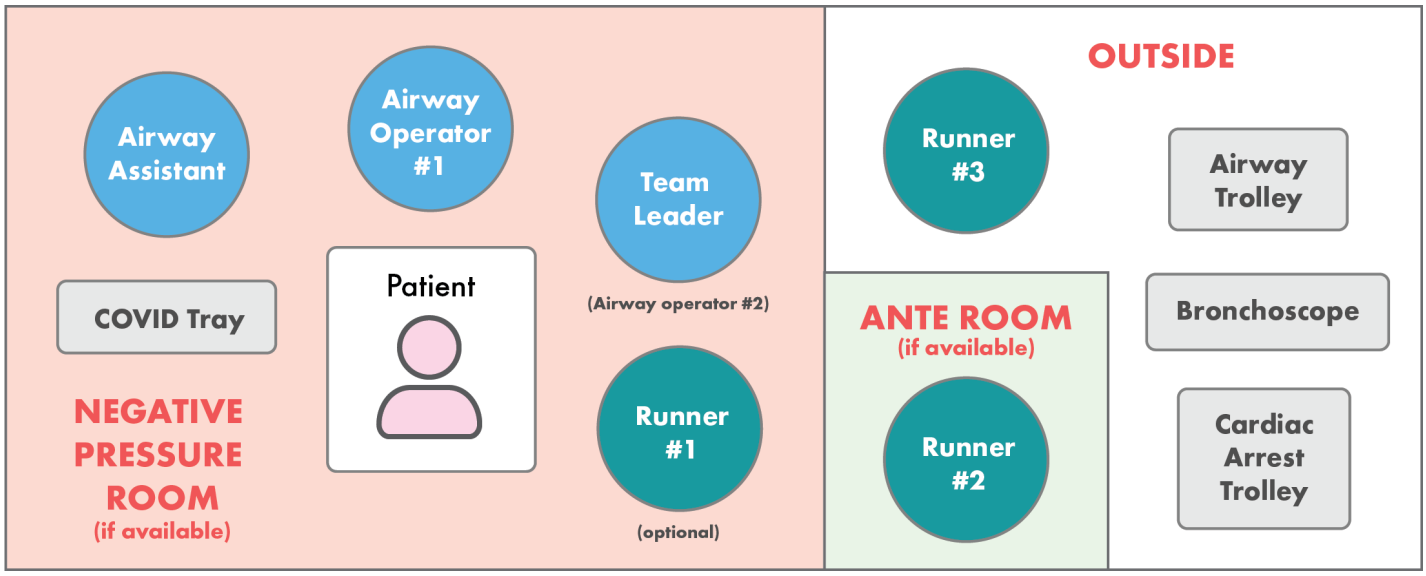
SAFE AIRWAY SOCIETY

COVID-19 AIRWAY MANAGEMENT

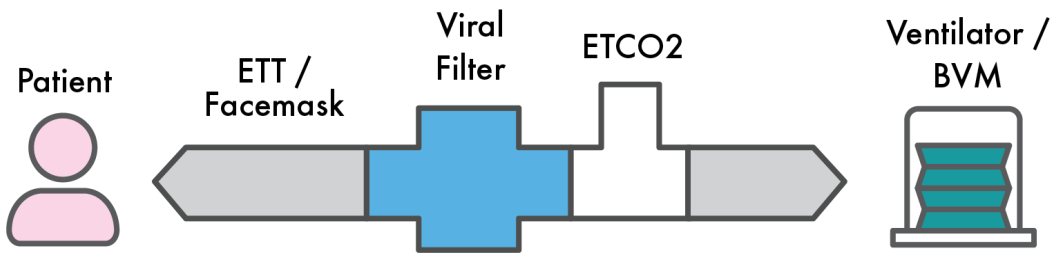
Team Members



COVID Intubation Tray

- ☐ Macintosh VL blade
- ☐ Hyperangulated VL blade (if available)
- ☐ Macintosh direct laryngoscope
- ☐ SGA (2nd generation)
- ☐ ETT (appropriate size range)
- ☐ Bougie / Stylet
- ☐ 10 mL syringe
- ☐ Tube tie
- ☐ Lubricant sachet
- ☐ Viral filter
- ☐ ETCO2
- ☐ NG tube (large bore)
- ☐ OPA + NPA
- ☐ Scalpel + bougie CICO kit

Circuit Setup



COVID-19 Emergency Intubation Checklist

SAFE AIRWAY SOCIETY

CHECK BEFORE ENTERING ROOM

Team

- ❑ Anaesthesia contacted if difficulty anticipated
- ❑ Team introduced:
  - Airway Operator
  - Airway Assistant
  - Team Leader/Drugs
  - In-room Runner: optional
  - Door Runner
  - Outside room runner
- ❑ Problems anticipated?

Patient

- ❑ ECG, BP, Sats
- ❑ Pre-oxygenation
  - FIO2 100%
  - Sitting position 45˚
- ❑ Haemodynamics optimised
  - Fluid bolus
  - Pressor

Drugs

- ❑ RSI drugs drawn up, doses chosen
- ❑ Rescue drugs
  - Metaraminol
  - Sugammadex
- ❑ Post intubation sedation plan
- ❑ Drug C/I or allergies?

Equipment

- ❑ 2 Laryngoscopes (tested)
- ❑ Tube chosen; cuff tested
- ❑ Bougie/stylet
- ❑ 10ml syringe
- ❑ Tube tie
- ❑ Lubricant
- ❑ i-gel sized to patient
- ❑ Scalpel
- ❑ Airway trolley/bronchoscope outside room
- ❑ ETCO2/
- ❑ Viral filter

FINAL CHECK IN ROOM

- ❑ Patient position optimal
- ❑ Fluid runs easily
- ❑ Suction working
- ❑ Facemask with viral filter connected
- ❑ ETCO2 trace
- ❑ O2 running at 15L.min^{-1}
- ❑ Guedel/nasal airways

❑ Airway plans:

- Plan A: C-Mac Video with bougie/stylet
- Plan B: i-gel
- Plan C: 2-hand facemask, 2-person +/- Guedel/NPA
- Plan D: scalpel/bougie/tube


2 HANDS
VICE GRIP
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