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Variations in COVID-19 airway management and preparedness among Victorian hospitals

Summary

The COVID-19 pandemic presents significant concerns surrounding the risk of transmission to health care workers involved in airway management of patients with suspected or known infection. Limited evidence has been available to guide the preparation of staff, intubation environments, team structure and personal protective equipment. Our study invited Victorian hospitals to complete a survey on their airway management practices and protocols, in order to assess the degree of variability in practice and preparedness. Twenty hospitals responded in September 2020, during Victoria's second wave of COVID-19. Forty percent had dedicated COVID-19 intubation teams, all including consultant anaesthetists. Seventy-five percent had negatively pressured dedicated intubation rooms. All provided airborne precautions including N95 masks for airway and cardiac arrest management of suspected or confirmed COVID-19 positive patients, with 35 per cent providing N95 mask fit testing and 15 per cent providing powered air purifying respirators or elastomeric respirators. Thirty-five percent provided airborne precautions for cardiac arrest management of patients not suspected to be COVID-19 positive. Significant inter-hospital variations were reported in airway management practices, such as pre-oxygenation, bag-mask ventilation, medications and techniques to minimise aerosolisation. Although some of this variation was likely due

to individual hospital infrastructure and resource limitations, it would be ideal to achieve a more consistent, standardised approach across Victorian hospitals. This study may highlight areas for improvement for some hospitals. These areas for improvement may include consideration of the establishment of COVID-19 intubation teams in at least major metropolitan hospitals, N95 mask fit testing and the use of airborne precautions for cardiac arrest management during times of increased community prevalence of COVID-19.

Introduction

The World Health Organization (WHO) declared the 2019 novel coronavirus (COVID-19) to be a pandemic on 11 March 2020¹. Despite recent experiences with disease outbreaks, such as influenza, EBOLA and Middle East Respiratory Syndrome Coronavirus (MERS-CoV), the combination of high transmission and mortality rates of COVID-19 made this pandemic an unprecedented event, for which most health care systems in the world were not adequately prepared^{1,2}.

Health care workers are at increased risk of developing the infection, due to their close contact with patients and each other, and their involvement in procedures that may increase the dispersion of contaminated fluid or aerosols^{3,4}. One study showed that one in ten health care workers who were involved in tracheal intubation of patients with suspected or confirmed COVID-19 subsequently reported a COVID-19

outcome, defined as either being diagnosed with new COVID-19 infection or requiring self-isolation or hospitalisation with new symptoms⁵. Hospitals around the world, including those in Australia, had to promptly develop airway management guidelines and protocols with very limited supporting literature at the beginning of the pandemic⁶. Several guidelines then gradually became available as new information emerged, to guide medical professionals on airway management of suspected and confirmed COVID-19 positive patients, including those released by the Safe Airway Society⁷, the Anesthesia Patient Safety Foundation⁸, the Australian Society of Anaesthetists³ and the Australian and New Zealand Intensive Care Society⁹. However, variations in practice among hospitals have been reported¹⁰.

Recent concerns have been raised about particular features of Victoria's health system, and whether this may play a role in the significantly higher incidence of COVID-19 that has been observed in comparison to other states¹¹. Most of the states in Australia have overarching health structures and central sources of guidelines and standards. In contrast, in Victoria there are six Primary Health Networks (PHNs) and 88 Local Health Care Authorities¹². Each of the PHNs operates as its own separate entity, making it challenging to integrate and share information and resources across different networks. The aim of this study was to examine how different hospitals in Victoria prepare, coordinate and conduct the airway management of patients with suspected or confirmed COVID-19. This information can be used as a reference for hospital staff who are involved in planning COVID-19 airway management.

Methods

After obtaining approval from Melbourne Health Human Research Ethics Committee (QA2020128), we invited the hospitals that are affiliated with the University of Melbourne to participate in this study¹³. We included all the adult hospitals that have both an anaesthetic department and an emergency department (ED). We excluded hospitals whose ED only caters for psychiatric patients. These inclusion and exclusion criteria were selected in order to encompass hospitals that would be expected to manage the airway of a COVID-19 positive patient requiring intubation. Twenty-nine hospitals were invited to be included.

An invitation email was sent to the directors of the anaesthetic departments of each of the 29 selected hospitals. They then nominated the most appropriate person to complete the pre-designed survey regarding the airway management of suspected or confirmed COVID-19 patients in their hospital. The nominated person was considered to be the leader or one of the leaders in the hospital, involved in the planning and development of the hospital COVID-19 airway management policies or guidelines. The survey consisted of questions regarding the presence and components of COVID-19 intubation teams, intubation environments, personal protective equipment (PPE), airway management equipment, staff preparation and airway management practices (see supplemental material). These questions were designed to allow comparison across these areas, in order to assess inter-hospital variation in practice. We contacted the nominated person via email. The survey was then completed via their preferred method (a phone call from one of the investigators

or self-completion and return by email). Consent was implied by their response to our email and the completion of the survey.

The survey took place during September 2020, coinciding with the declining phase of the second wave of COVID-19 cases in Victoria. There were 723 daily cases at the peak in July 2020. The first wave occurred in March 2020. Most hospitals had developed a policy on airway management of suspected or confirmed COVID-19 patients by the time the study was conducted.

Results from the survey were transferred to a standard spreadsheet (Excel; Microsoft, Redmond, WA, USA), and descriptive statistics were used to present all of the data.

Results

Of the 29 hospitals contacted, we received responses from 20 hospitals, giving a response rate of 69 per cent. This included 18 public hospitals (12 metropolitan, six regional) and two private hospitals (both metropolitan). All of the surveys were completed by consultant anaesthetists, three of whom were the director of the anaesthetic department. They were all involved in the development of local COVID-19 airway management policies.

Preparation of the intubation team staff for airway management of suspected or confirmed COVID-19 patients is shown in Table 1. Eight hospitals had established dedicated COVID-19 intubation teams, all of which included consultant anaesthetists, during both in-hours and after-hours periods. Of these eight teams, seven included one nurse only. Three included an ICU nurse, three included an anaesthetic nurse, one included an Emergency Department (ED) nurse and one included two nurses from either ICU, anaesthetics or ED. Ninety-five

Table 1: Preparation of intubation team staff for airway management of suspected or confirmed COVID-19 patients

Preparation and training	No. of hospitals (n = 20)
Intubation staff were fit tested quantitative:qualitative	7 (35%) 5:2
Use of cognitive aid for airway management	18 (90%)
Use of simulation training	17 (85%)
More than 80% of staff involved in intubation received formal training in:	
• donning/doffing	19 (95%)
• intubation of COVID-19 patients	19 (95%)
• extubation of COVID-19 patients	16 (80%)

percent of hospitals provided formal training for personnel involved in COVID-19 airway management, with 85% of hospitals using simulation for this purpose (Table 1). Ninety percent of hospitals used a cognitive aid to assist with airway management of these patients.

Most hospitals (18 of 20; 95%) provided dedicated COVID-19 intubation rooms, with 75 per cent of hospitals (15 of 20) having negatively pressured rooms for this purpose, frequently in the intensive care unit (ICU) and ED (Table 2). The median number of dedicated intubation rooms per hospital was three (ranging between 1 and 12). Seventy-five percent of hospitals reported the use of a dedicated COVID-19 airway trolley (or other transport means such as a container or bucket).

All of the hospitals had oropharyngeal airways, alternative facemasks/laryngeal masks/endotracheal tubes and equipment for front-of-neck access either immediately available in the room or closely available outside the room. Ninety-five percent of hospitals (19 of 20) had their videolaryngoscope and bougie inside the room. Only one hospital did not have a hyper-angulated

laryngoscope available. However, six of the hospitals (30%) did not have immediate access to a fiberoptic bronchoscope if required. A variety of protocols were used in different hospitals for both intubation and extubation procedures, as shown in Table 3.

In terms of PPE, all of the hospitals provided gowns, gloves, hats, N95

particulate respirator masks and face shields for the staff who were involved in COVID-19 airway management. Three hospitals (15%) provided the option of using powered air purifying respirators (PAPRs) or elastomeric respirators as an alternative to N95 masks. Neck covers were only used by three hospitals. Seven hospitals (35%) provided N95 mask fit testing (Table 1).

In regard to the cardiac arrest team for suspected or confirmed COVID-19 patients, 11 hospitals (55%) included an anaesthetic registrar or consultant. All of the 20 hospitals provided the same PPE that was worn by staff intubating suspected or confirmed COVID-19 positive patients. Only seven out of 20 hospitals (35%) had a similar requirement for airborne precautions including the use of N95 masks at the attendance of cardiac arrests of patients not suspected or known to be COVID-19 positive. All of these seven hospitals were metropolitan hospitals.

Table 2: General approach for the airway management of suspected or confirmed COVID-19 patients

Intubation team and environment	No. of hospitals (n=20)
Dedicated intubation team for COVID patients	8 (40%)
Same team during afterhours	4/8 (50%)
Dedicated intubation room(s)	18 (90%)
Dedicated intubation room(s) that are negatively pressured	15/18 (83%)
Dedicated intubation trolley	15 (75%)
Videolaryngoscopes available at all times	20 (100%)
Intubation practice	
Limit maximum oxygen flow	13 (65%)
Bag-mask ventilation not allowed	3 (15%)
Protocol for medications to be used	10 (50%)
Mandated clamping of endotracheal tube	15 (75%)

Table 3: Details of the protocols used for airway management of suspected or known COVID-19 patients

	Yes	No
Pre-oxygenation protocol	13 (65%)	7 (35%)
Limit to maximum of 4L/min	1	
Limit to maximum of 6L/min	10	
Limit to maximum of 15L/min	2	
BMV protocol	14 (70%)	6 (30%)
BMV not allowed	3	
Allowed if low SpO ₂	11	
• SpO ₂ < 80%	3	
• Anaesthetist's discretion	7	
• Life threatening situation	1	
Medication protocol	10 (50%)	10 (50%)
Induction agent protocolised	7	
• Ketamine	4	
• Propofol	3	
NMB protocolised	9	
• Rocuronium	6	
• Suxamethonium	3	
Opioid protocolised	5	
• Fentanyl	3	
• Alfentanil	2	
Extubation protocol	9 (45%)	11 (55%)
Plastic sheet	8	
Deep extubation	2	
NIV protocol*	14 (78%)	4 (22%)
Allowed	8	
Prohibited	6	
HFNP protocol	17 (85%)	3 (15%)
Allowed	13	
Prohibited	4	

*NIV protocol – two hospitals did not respond (n=18)

BMV = bag-mask ventilation; SpO₂ = oxygen saturation with pulse oximetry; NMB = neuromuscular blockade; NIV = non-invasive ventilation; HFNP = high-flow nasal prongs

Discussion

All of the 20 responding Victorian hospitals had a policy on airway management of suspected or confirmed COVID-19 patients. However, we found a noticeable amount of variation, not only in the intubation procedure protocols, but also in preparation, training, intubation environment, team structure and PPE use. Multiple factors could have potentially contributed to these variations. They include:

1. lack of evidence to guide a definitive protocol
2. different staff resource capacity
3. different levels of suspected and/or confirmed COVID-19 cases due to different geographic locations
4. environmental constraint
5. different levels of equipment supply and availability.

Moreover, the lack of an overarching health care structure, which would assist in the integration of resources and sharing of information among different health care networks in Victoria, may also have been a potential contributing factor.

It has been suggested that dedicated and experienced COVID-19 intubation teams, such as those using anaesthetists or anaesthetic registrars as lead intubators, may improve patient outcomes and staff safety¹⁴. This is understandably challenging for some regional hospitals, where the case load is low and resources are limited. Nonetheless, major metropolitan hospitals should consider establishing a COVID-19 intubation team, absent in more than half of the metropolitan hospitals in this study.

Several consensus guidelines specific to airway management of suspected and confirmed COVID-19 positive patients recommend that negative pressure rooms should be

used where possible during tracheal intubation of these patients, in order to minimise staff exposure to aerosol and droplet particles^{3,7}. This is obviously constrained by the hospital environment. The majority of the studied hospitals had dedicated COVID-19 intubation rooms, most of which were negatively pressured. However, we noticed that most COVID-19 intubation rooms that were located in the operating theatre environment were not negatively pressured. The Safe Airway Society consensus statement about principles of airway management and tracheal intubation specific to the COVID-19 adult patient group reports that positive pressure ventilation environments are common in the operating theatre and should be avoided⁷.

The use of airborne precautions is recommended in the intubation of high risk (suspected or confirmed COVID-19 positive) patients^{15,16}. It is reassuring that all hospitals provided N95 masks, gowns and eye shields for intubation of suspected and confirmed COVID-19 positive patients. Only a minority provided the option of the use of PAPRs or elastomeric respirators. The use of PAPRS or elastomeric respirators is controversial. A recent Cochrane review concludes that the use of a PAPR with coverall may protect against the risk of contamination better than an N95 mask and gown¹⁷. However, there are concerns regarding their supply and training in donning, doffing and cleaning. Similarly, most hospitals did not provide neck covers for use during intubation of these patients. Interestingly, studies using fluorescent markers as a surrogate measure for contamination have suggested that the neck may be a high risk setting for potential contamination during intubation¹⁸; however, most guidelines, including the WHO guideline, do not

recommend the use of head and neck covers in this setting¹⁹.

The Australian Guidelines for the Prevention and Control of Infection in Health care state that N95/P2 masks require formal fit testing, in order to identify suitable size and style of mask, and to ensure their correct use²⁰. Despite this, most of the hospitals included in this study did not provide N95 mask fit testing, which can be expensive and logistically challenging. It can also consume an extensive number of N95 masks, which may not be ideal during a pandemic²¹. However, this is likely to have improved as the Department of Health and Human Services (DHHS) has recently developed and supported the Respiratory Protection Program at various Victorian health services²².

In the management of cardiac arrest of patients suspected or known to be COVID-19 positive, it is reassuring that every hospital provided the equivalent PPE as that worn during airway management of this patient cohort, which is in keeping with recommendations from the DHHS²³. Unless there is clear evidence to the contrary, the Australian College of Emergency Medicine (ACEM) recommends that while there are high rates of community transmission of COVID-19 any collapsed or unresponsive patient should be assumed to be high-risk for COVID-19, and that airborne PPE should be worn²⁴. The significantly higher adaptation of this recommendation for airborne precautions in this setting in metropolitan hospitals, compared to regional hospitals, potentially reflects the higher prevalence of COVID-19 in the metropolitan regions.

One of the potential factors leading to variations in the COVID-19 airway management among different hospitals is the lack of evidence in literature to guide practices. One

major uncertainty or controversy is the degree of aerosolisation of COVID-19 during airway manipulation. This may have contributed to the inter-hospital variability seen in the limitation of oxygen flows for pre-oxygenation, the decision path and trigger for bag-mask ventilation, the protocolisation of drugs used on induction, the mandated clamping of the endotracheal tube for circuit disconnections, extubation practices and the use of high-flow nasal prongs and non-invasive ventilation. This cross-sectional study highlights a large variation in practice among hospitals, despite increasing numbers of publications that are emerging to provide more understanding about aerosol generation during airway management^{25,26}.

Limitations

There are several limitations in this study. It involved only 20 Victorian hospitals, which is a small sample size. However, we included all of the major metropolitan hospitals and many regional hospitals and we believe this is a reasonable representation of Victorian hospitals. There was a selection bias, as we included only the hospitals that responded to our email invitation. Inter-hospital variation in who was nominated to complete the survey and how this decision was made may be present. There is an assumption that individual hospital airway management practices align with their policies, where this may not be the case. Finally, this study is only a snapshot of practices across different Victorian hospitals in September 2020. There are constant changes in COVID-19 management guidelines and practices as new information continues to emerge. Nonetheless, this cross-sectional study highlights a large variation across different hospitals.

Conclusion

In conclusion, this study compared how different hospitals in Victoria prepare, coordinate and conduct the airway management of patients with suspected or confirmed COVID-19. We found inter-hospital variability in many areas. This study can be used as a reference and may potentially highlight areas for improvement for some hospitals. Further studies would be beneficial to investigate the reasons behind the variations, and to examine whether there is less variation in other states which have an overarching health care structure. We should also consider the implications of these differences, for example, potential differences in the quality of care of COVID-19 positive patients, potential differences in transmission risk within hospitals and staff wellbeing impacts regarding conflicting information and management of these patients in different locations.

Declaration of conflicting interests

There are no potential conflicts of interest with respect to this research, authorship, and/or publication of this article.

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Variations in COVID-19 airway management and preparedness among Victorian hospitals

Supplementary material

An audit on COVID-19 airway management across Victorian Hospitals

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1. General Information

Name of hospital:

- | | |
|---|---|
| ☐ Major metropolitan | ☐ Public – regional |
| ☐ Public – metropolitan | ☐ Private – regional |
| ☐ Private – metropolitan | |

2. Teams

2.1 Do you have a dedicated COVID-19 intubation team at your hospital?

- ☐ Yes ☐ No

2.2 If so, who makes up the team? (how many)

- ☐ ED consultant/registrar (..... /)
- ☐ ED nurse (.....)
- ☐ Anaesthetic consultant/registrar (..... /)
- ☐ Anaesthetic nurse (.....)
- ☐ ICU consultant/registrar (..... /)
- ☐ ICU nurse (.....)
- ☐ Others – please specify:

2.3 Are all members of this team included in the after-hours COVID-19 intubation team?

- ☐ Yes
- ☐ No (specify who is not in this team after hours)

2.4 Who makes up the Code Blue team for suspected/known COVID-19 patients?

- ☐ ED consultant/registrar (..... /)
- ☐ ED nurse (..... /)
- ☐ Anaesthetic consultant/registrar (..... /)
- ☐ Anaesthetic nurse (.....)
- ☐ ICU consultant/registrar (..... /)
- ☐ ICU nurse (.....)
- ☐ Orderly/theatre technician (..... /)
- ☐ Others – please specify:

3. Environment

3.1 Do you have dedicated Covid-19 intubation rooms in the hospital?

- ☐ Yes (How many and where:)
- ☐ No

3.2 If so, are these rooms negatively pressured?

- ☐ Yes ☐ No
- ☐ Others – please specify:

4. PPE

4.1 When intubating a suspected/known Covid-19 patient, which of the following PPE equipment is required to be worn at your hospital? (tick all that apply)

- ☐ Gown (long sleeved/short sleeved)
- ☐ Hat
- ☐ Neck cover
- ☐ Goggles
- ☐ Eye shield
- ☐ N95 mask
- ☐ P2 mask
- ☐ Powered Air Purifying Respirator (PAPR)
- ☐ Shoe covers
- ☐ Others – please specify:
.....

4.2 Does your hospital/department provide N95 mask fit testing for staff who are involved in intubation of suspected/known COVID-19 positive patients?

- ☐ Yes (quantitative/qualitative)
- ☐ No

4.3 Are the same protective equipment worn for attendance at cardiac arrests of patients suspected/known COVID-19 positive?

- ☐ Yes
- ☐ No (specify which of the items ticked above are **not** worn
.....)

4.4 Are the same protective equipment worn for attendance at cardiac arrests of patients **not suspected/known to be COVID-19 positive?**

- ☐ Yes
- ☐ No (specify which of the items ticked above are **not** worn)

5. Equipment

5.1 Is there a dedicated COVID-19 airway trolley in your hospital?

- ☐ Yes
- ☐ No

5.2 Regarding the following equipment, please select whether each are available during a suspected/known Covid19 intubation, in your department either:

a) in the room

b) outside the room or

c) not available.

Equipment	In the room	Outside the room	Not available
Alternative facemasks			
Guedels			
Videolaryngoscope			
Hyperangulated laryngoscope			
Alternative ETTs			
Bougie			
Stylet			
Alternative LMAs			
CICO kit: Needle cricothyroidotomy Scalpel/bougie Melker			
Fibreoptic bronchoscope			

5.3 Does your hospital/department use cognitive aid for airway management of suspected/known COVID-19 patients?

- ☐ Yes
- ☐ No

6. Preparation

6.1 Have the majority (>80%) of your team received formal training in (tick those that apply)

- ☐ Donning/doffing
- ☐ Intubation of a suspected/known COVID-19 positive patient
- ☐ Extubation of a suspected/known COVID-19 positive patient

6.2 Does your hospital/department use simulation training for management of suspected/known COVID-19 positive patients?

- ☐ Yes
- ☐ No

7. Practice

7.1 When inducing someone with suspected or known COVID-19 in your department, do you have a protocol for maximum oxygen flows to be used?

- ☐ Yes (please specify)
- ☐ No

7.2 When inducing someone with suspected or known COVID-19 in your department, do you have a protocol for medications to be used?

- ☐ Yes (please specify)
- ☐ No

7.3 When inducing someone with suspected or known COVID-19 in your department, do you have a protocol specifying whether/when you should bag mask ventilate (BMV)?

- ☐ No protocol
- ☐ Protocol – routinely BMV
- ☐ Protocol – never BMV
- ☐ Protocol – BMV only if oxygen saturations fall below a trigger
(specify)

7.4 When intubating a patient with known or suspected COVID-19 in your department, is a video laryngoscopy available for all intubations?

- ☐ Available at all times
- ☐ Limited availability
- ☐ No availability

7.5 When swapping between equipment for ventilation (e.g. between ventilators or self-inflating bag to ventilator), does your hospital/department mandate clamping of the ETT?

- ☐ Yes
- ☐ No

7.6 When extubating a patient with suspected or known COVID-19 in your department, does your hospital protocol recommend any of the following precautions?

- ☐ Plastic bag
- ☐ Plastic box
- ☐ Deep extubation
- ☐ Other (please specify)

7.7 When managing COVID positive patients in your department, does your hospital specify whether either of the following may be used if required?

- a) NIV
 - ☐ No protocol
 - ☐ Prohibited
 - ☐ Allowed
- b) HFNP
 - ☐ No protocol
 - ☐ Prohibited
 - ☐ Allowed