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PERSONAL VIEWPOINT

Impact of COVID-19 on an Australian intensive care unit: lessons learned from South Australia

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Abstract

The scale of the COVID-19 pandemic represents unprecedented challenges to healthcare systems. We describe a cohort of 18 critically ill COVID-19 patients – to our knowledge the highest number, in a single intensive care unit in Australia. We discuss the complex challenges and dynamic solutions that concern an intensive care unit pandemic response. Acting as the State's COVID-19 referral hospital, we provide local insights to consider alongside national guidelines.

The scale of the COVID-19 pandemic represents an unprecedented challenge to healthcare systems worldwide. On 16 March 2020, South Australia officially declared a Public Health Emergency, and the Royal Adelaide Hospital (RAH) – an 800-bed quaternary referral

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centre, with a 48-bed intensive care unit (ICU) – was designated the receiving COVID-19 hospital for the State.[1,2]

On 24 March, the first critically ill COVID-19 patient was admitted to the RAH ICU, with 17 more admitted over the following 20 days – to our knowledge, the highest number in a single centre in Australia. We summarise and share our early experience managing a cohort of COVID-19 patients in ICU.

Planning for a pandemic

A COVID-19 ICU leadership team was convened, and pandemic response organised according to the 'Prevention, Preparedness, Response and Recovery' model, adopted by the SA State Emergency Management Plan.[3] Key portfolios were shared amongst the consultant group, and included development of clinical guidelines (based on established evidence-based care of critically ill patients, plus emerging evidence specific to patients with COVID-19); education and training; staffing, credentialing and rosters; staff welfare; personal protective equipment (PPE) protocols; procurement (pharmacy, equipment and PPE); communications; ethics; research and data collection.

The RAH ICU adopted a 'Command and Control' structure: reporting vertically to the RAH Executive, Central Adelaide Local Health Network, and South Australian COVID-19 Command Centre; and interfacing horizontally with colleagues from Infectious Diseases, Infection Control, Acute and Urgent Care, and other clinical disciplines. A Command and Control structure can threaten frontline autonomy and flexibility to respond to a changing clinical environment. To maintain responsiveness during the uncertain and dynamic course of the COVID-19 pandemic, rapid access to, and feedback from, senior decision-makers is essential.

The RAH ICU estate was reviewed with senior engineers. Forty-eight ICU beds were available, comprising five 'Class N' negative pressure rooms (with antechambers for applying PPE), and 43 'Class S' standard side rooms.[4] A dedicated 'pandemic ventilation mode' prevented recirculation of potentially contaminated air throughout the ICU.

The RAH COVID-19 patient cohort

Between 24 March and 13 April, the RAH admitted 65 patients with COVID-19, with 18 (28%) critically ill patients managed in the ICU. Patients were referred to ICU if requiring >4 L/min oxygen to maintain normal haemoglobin-oxygen saturation levels, or if ICU admission was indicated by conventional criteria. Patients were confirmed to have SARS-CoV-2 based on a positive RT-PCR from a nasal and/or throat swab.

Table 1 Clinical characteristics, ICU therapies and outcomes

Characteristic	Patients (*N* = 18)
Median age (IQR) (years)	67 (60–73)
Sex, *n* (%)	
Male	14 (78)
Female	4 (22)
ICU therapy†, *n/N* (%)	
High-flow nasal oxygen	14/18 (78)
Non-invasive ventilation	0/18
Invasive mechanical ventilation	8/18 (44)
Prone positioning	5/8 (63)
Extracorporeal membrane oxygenation	0/18
Vasoactive therapy	11/18 (61)
Continuous renal-replacement therapy	4/18 (22)
Outcomes‡	
Median length of stay (IQR) (days)	
In hospital	13 (11–17)
In ICU	4 (2–14)
In hospital, survivors	13 (10–25)
In ICU, survivors	3(2–14)
Median duration of mechanical ventilation (IQR), (days)	11 (8–13)
Extubation, *n/N* (%)	3/8 (38%)
Died in ICU, *n* (%)	4 (22)
Discharged from ICU, *n* (%)	13 (72)

†Therapies received at any time during the index ICU admission. High-flow nasal cannula was used with a maximum of 30 L/min flow. ‡Based on a censor date of 23 April 2020. ICU, intensive care unit.

Demographics, ICU therapies and outcomes of this patient group are described in Table 1.

Our cohort of critically ill COVID-19 patients had similar characteristics to those described elsewhere, with comparable rates of mechanical ventilation (44% of ICU patients), prone positioning (63% of ventilated patients) and mortality (50% of ventilated patients).[5,6] Significant comorbid disease was present in 75% of those who died, including ischaemic heart disease, hypertension and diabetes.

Practicalities of caring for COVID-19 patients

Infection control precautions make routine clinical care difficult. Donning and doffing PPE was rehearsed, and supervised clinically by a 'buddy' system, but it remains complex and time-consuming. Patient–clinician communication is hampered by the use of N95 masks, and staff communication is limited by the need for isolation rooms, with antechambers. As a result, even the most basic clinical task can be arduous.

All ICU staff underwent PPE training and mask-fit testing. This developed and maintained staff competence, and ensured adequate mask-fit, across a variety of models. N95 masks and visors were not changed when caring for consecutive COVID-19 patients, in an effort to conserve supplies.

We sought to make every patient interaction as time and resource efficient as possible: five-lumen central venous catheters were placed, to minimise the need for further intravenous cannulation; infusion formulations were reviewed, to minimise syringe changes; prescriptions were rationalised to once-daily, where possible; and therapeutic modalities which required infrequent laboratory testing were preferred to those requiring more frequent testing (i.e. heparin-based anticoagulation was preferred to citrate for renal-replacement therapy). Whiteboards allowed effective communication through glass, when electronic methods were unavailable or unreliable.

Therapeutic procedures were enacted early and followed locally developed COVID-19 specific protocols.[7] Intubations were semi-elective using a four-person team in the patient's room with support staff outside. Turning patients prone required six staff, plus 'runners' outside. Procedures were undertaken in negative pressure rooms, with patients subsequently moved to standard rooms if required. Despite extensive training and simulation, we found all procedures to be time-consuming, and markedly complicated emergency interventions. We intend to deploy dedicated intubation and 'proning' teams if the number of patients with COVID-19 escalate.

We initially supported hypoxic COVID-19 patients not requiring immediate intubation with high-flow nasal oxygen rather than non-invasive ventilation (NIV). The unintended consequence was that NIV became perceived as 'unsafe', with concerns about virus aerosolisation. Subsequently, when case definitions for COVID-19 broadened and patients suspected of having COVID-19 presented with concomitant indications for NIV (e.g. acute pulmonary oedema or chronic obstructive airways disease), there was heightened staff anxiety around offering NIV despite appropriate PPE and circuit modification. This was exacerbated by the number of stakeholders involved (Emergency Department, Thoracic Medicine, ICU), and highlighted to us the importance of a clear coordinated approach.

Caring for the families of patients with COVID-19

As the incidence of COVID-19 diagnosis increased in South Australia, the RAH adopted a strict 'no visitors' policy for patients with suspected or confirmed COVID-19. For dying patients, two visitors at a time were admitted – for mutual support – although neither was allowed to enter the patient's room. Relatives with symptoms consistent with COVID-19 infection were not allowed to visit, while those under quarantine required screening. Many patient families and ICU staff found this distressing.

Telephone calls were made to families twice daily, with at least one from an ICU doctor. We established videoconferencing with families, using secure Healthdirect VideoCall software. Communicating bad news through this medium, at physical distance, and frequently with families who were themselves in self-isolation or quarantine with COVID-19 infection, was frequently emotionally challenging. The RAH ICU has established a bereavement follow-up service that has been shown to support bereaved family members at the end of life.[8] Our unpublished observations indicate that the support and feedback provided by the follow-up service were particularly valued both by loved ones, and staff, facing the challenge of end-of-life care for patients dying from COVID-19.

Information management and communication

Clear, consistent and reliable communication is a major challenge in the face of a rapidly evolving global health emergency, especially when new information (of variable quality) emerges daily. Staff frequently felt information 'overloaded' from both institutional and external sources, and the problem of a COVID-19 'infodemic' is emerging as a significant issue.[9] Furthermore, differing opinions and recommendations between hospital departments and health jurisdictions caused significant confusion and anxiety. In response, we sought to build trusted local sources of reliable information, building on the ANZICS COVID-19 guidelines.

The RAH ICU established a secure departmental 'DropBox', with access restricted to ICU staff. This allowed for live updates of relevant ICU guidelines and policies by senior clinicians, with real-time 'push' notifications sent to linked mobile devices. We established a secure 'WhatsApp' group of all ICU medical staff to share promptly important communications (but not patient or confidential information). In addition, an ICU COVID-19 dashboard was established, and succinct daily briefs cascaded by email to all members of the multi-disciplinary team.

We embraced institution-based teleconferencing to conduct meetings, allow governance activities to continue and provide on-going education to trainees with minimal disruption to intensive care training.[4] However, when

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questions about the adequacy of PPE made national news, the limits of electronic communication became clear.[10] Reassurance and explanation were best provided face-to-face, through trusted trainee–supervisor relationships.

Staff welfare

The COVID-19 pandemic provoked a variable degree of anxiety and fear amongst ICU staff.[4]

Staff were invited to highlight concerns, in confidence, to the senior clinical leadership team and higher risk individuals were redeployed to non-COVID-19 areas of the ICU. Unfortunately, such distinctions are not always clear-cut owing to the frequent need for ICU staff to attend to patients elsewhere in the hospital, and the frequently changing 'suspected COVID-19' case definition.

In tandem, a dedicated roster of staff willing to be deployed to confirm and suspected COVID-19 areas brought clear benefits, with continuity of care and consolidation of key skills (e.g. turning patients prone). This is clearly a stressful role, and we sought to limit the number of shifts worked in our 'COVID pods', avoided rostering inexperienced staff, and made confidential counselling services available to all.

Nosocomial healthcare worker infection was treated as a sentinel event, and staff involved were supported, including with funded quarantine arrangements. Notably, infection of one ICU Registered Nurse – with no known community contact with COVID-19 disease – led to 26 other healthcare professionals being required to enter 14-day quarantine.[11] Unsurprisingly, this again caused significant anxiety within our ICU. The impact of quarantining staff can clearly have major implications on resources, and we were fortunate to have several medical and nursing staff available to cover resulting staffing gaps. Ensuring separation of staff working in COVID-19 and non-COVID-19 clinical areas may reduce the impact of any future nosocomial infection on staffing.

Support of the community

The support and behaviour of the wider community are vital.[4] State health authorities deployed clinical pathways to triage all suspected COVID-19 cases to the RAH. Patients self-presenting to other hospitals in the region were risk-assessed and transferred to the RAH. Our ICU treatment guidelines and early clinical experience was shared across the State.

The RAH ICU has been generously supported by the people of South Australia – including with cards from schoolchildren, letters of thanks from families affected and support from local businesses. These personal messages, and those from the hospital executive and members of government, provided valued support and helped morale during these challenging times.

Conclusion

As South Australia's COVID-19 referral hospital, our experiences provide practical and local insights to consider alongside national guidelines. We rapidly recognised the complexity of managing uncertainty, and the importance of a coordinated and dynamic response, as we prepared for the unknown burden of critically ill patients with COVID-19.

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