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Title	Early clinical response to a high consequence infectious disease outbreak at the Royal Melbourne Hospital Emergency Department – insights from COVID-19.
Authors:	

Abstract

Australian hospitals are currently preparing to manage patients with coronavirus 2019 (COVID-19), and a potential surge of patients. In this article, we describe the strategic approach of The Royal Melbourne Hospital to triage and screen patients who have presented at risk during the early phases of COVID19 importation into the country. Elements of this approach may be of value to other organisations producing their own triage and clinical algorithms for this outbreak.

Introline

This article describes the early approach of a metropolitan emergency department to COVID-19.

Introduction

Coronavirus 2019 (COVID-19), caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), emerged in China in late 2019.[1] COVID-19 is one example of a high consequence infectious disease (HCID) that may present to an Australian hospital. These infections are uncommon in Australia and are almost always cases where infection was imported from overseas. Less frequently, there is onward local transmission, such as during the influenza A(H1N1)pdm09 pandemic (2009).

HCIDs present unique challenges to Australian hospitals. Their rarity leads to unfamiliarity and loss of institutional knowledge between events. Many hospitals operate at near maximal capacity between outbreaks and have limited surge capacity[2]. Protocols designed to manage single patients require adaptation to situations where larger numbers of patients require isolation, assessment and testing for infection.

While every Australian hospital has a mass casualty or disaster protocol, these are developed for "All Hazards" and may not address problems specific to HCIDs: the need to rapidly identify and isolate potentially infectious patients to prevent nosocomial transmission; the complexity of rapid triage and assessment on frequently evolving epidemiological and clinical grounds; the difficulty of differentiating HCIDs from more common but clinically similar conditions[3]; the absence of rapid diagnostic tests to aid clinical decision making; and the potential for a prolonged surge for weeks to months during which time the workforce may be affected by both infection and absenteeism.

Here we describe the strategic approach of The Royal Melbourne Hospital (RMH) to triage and screen patients who have presented at risk (or concerned that they are at risk) during the early phases of COVID-19. Our resources may be of value to other organisations refining their triage and clinical algorithms.

The Royal Melbourne Hospital Response

RMH is an adult tertiary referral centre and the designated state-wide provider for quarantinable diseases. The ED treats over 80,000 patients annually.

From January 6, 2020, we instituted tools to identify at triage those patients with risk factors for COVID -19 and rapidly isolate them. Initially there was capacity to assess patients in one of three existing negative-pressure rooms. On January 25, the first patient with COVID-19 in Australia was confirmed, who had arrived in Melbourne on a flight from Guangzhou. The Victorian Department of Health and Human Services (DHHS) informed all passengers on the flight of their possible contact with the case, leading to a significant surge in presentations to RMH.

Table 1 presents an overview of the challenges in managing HCIDs, and details of our coordinated approach. Key components that can be utilised by other services are detailed below.

Governance

Unlike other major incident responses, which tend to be short-lived, response to an outbreak requires a sustained response that will inevitably impact other clinical services. A governance process that includes executive sponsors and senior clinical leaders is essential. The RMH COVID-19 response leveraged existing Code Brown (external emergency) Pandemic Sub-plan and Clinical Code Yellow (internal infectious disease emergency) plans as a governance framework. A governance group including medical and nursing executives, and senior clinicians from ED, Infectious Diseases (ID), Infection Prevention Services (IPS) and Microbiology meet regularly.

A single 'standard operating procedure' exists on our hospital intranet that provides all clinically relevant information for frontline healthcare workers (e.g. Personal Protective Equipment (PPE) guidelines, current case definitions, patient assessment algorithms). It is updated frequently given the dynamic situation, and so functions as a 'living' document for staff. This provides 24/7 access to an authoritative source that supports junior and senior staff alike to feel confident in their practices and approach.

Infrastructure

Establishment of a "Fever Clinic"

A particular design feature that may be adopted by other facilities is the rapid establishment of an out-of-department "fever clinic". In response to the first surge of patients, we rapidly repurposed the nearby hospital transit lounge (which was closed for the weekend), into a fever clinic (see figure 1). The clinic received its first patient within two hours of notification from DHHS of the first local case. In its first seven days, we assessed 109 patients. We discharged over 90% of patients within 4 hours of arrival. We retain this model, as patient numbers continue to increase.

In this model of care, patients are physically segregated from the rest of ED into a dedicated rapid assessment and treatment space from their arrival, limiting exposure to other patients. The main benefit of this approach is that cases yet to be identified can be an important contributor to nosocomial transmission, and so early separation and detection is vital.[8,9] However, immediate recognition of cases is difficult due to unfamiliarity with the disease, overlap in clinical presentation with more common illnesses, and due to patient wait times.

Our fever clinic model of care was based on the success of this model in Toronto and Taiwan during the SARS outbreak[4], where no transmission was reported in these facilities, despite hospital exposure being implicated in the majority of cases in these regions (e.g. the presumed source of exposure for 72% of patients in Toronto[5,6]). It has also been reported as an effective strategy for triaging patients in Wuhan for COVID-19[7]. Similar approaches appear to have been used in other countries, but detailed descriptions are not yet available in the literature. In Australia, segregation of major incident patients was exemplified by the Royal Darwin Hospital, which functioned as the forward receiving hospital for medically-evacuated patients during the 2002 Bali Bombings[8].

Benefits include:

1. protecting an existing environment for the maintenance of business continuity,
2. facilitating protocoled interventions for spatially-clustered groups of patients,
3. providing a physical location to send additional "disaster resources" without cluttering areas of core business,
4. enhancing record-keeping.

Limitations of our approach are the additional staffing required, operational impact of loss of transit lounge, staff unfamiliarity with the location of resources (such as resuscitation trolleys), and a slightly further distance from resuscitation bays if patients deteriorate. We were also concerned about the potential risk of stigmatisation of patients who are seen to be segregated from the main ED waiting room cohort.

Implementation of Electronic Self-Registration and Self-Screening

A surge related to an emerging infectious disease provided our clerking department with a confluence of unique administrative and logistical challenges. These included:

- A high proportion of patients came from a non-English speaking background.
- Contact tracing and follow-up requires accurate registration and an extended suite of contact details, but usual disaster response medical records protocols generate only anonymised patient registrations
- Non-clinical staff (ward clerks) unfamiliar with PPE would be required to extensively interview patients to confirm details at some point.
- Patients came in bursts, producing delays in registration.
- Manual screening paperwork and registration papers provide a potential fomite for disease transmission.
- Our ED is paper-free under usual circumstances.

We developed a novel solution to this problem, leveraging the fact that over 91% of Australian citizens, and over 96% of Chinese citizens own a smartphone[9,10] and converted an

initial paper-based bilingual screening tool to an online one. This is hosted using the REDCap™ electronic data capture tool.[11,12]

Patients are directed to a secure website optimised for use on a smartphone. The registration portal is free to use. They answer questions regarding their epidemiological risk (such as a detailed travel history, or being a healthcare worker), clinical risk factors (such as being immunocompromised) and symptoms. Results are immediately fed to remote clinical computers where ward clerks can register the patient without direct patient contact, and clinicians can see screening information prior to their clinical encounter.

While not yet tested under a pandemic scenario, we anticipate this method of self-registration may be particularly useful in the event of a significant surge in patient numbers. Triage sieve and sort of patients can be rapidly undertaken by clinicians who are fed real-time registration data. Compared with usual mass casualty principles, the inclusion of epidemiological data in the e-tool is valuable for triage in this setting to screen out the relatively high proportion of patients with perceived, but not actual epidemiologic risk factors.

Our REDCap infrastructure is available in appendix 1 for adaptation by other health services.

Conclusion

The importation of emerging infections into Australia is rare, and onward transmission is rarer still. As RMH received a surge in patients who required screening for COVID-19 relatively early during the current outbreak, our recent observations may provide opportunities for other hospitals to enhance their preparedness and response plans. We prioritise prevention of nosocomial transmission (using a scalable, separated fever clinic) early planning for worsening surge (adopting scalable solutions) and clear clinical governance (providing malleable and accessible centralized resources) .

References
References should be in Vancouver style and should **not** appear as endnotes. References to material on the Internet should include the organisation, the page title, the article title and the author (if there is one) as well as the URL and the month the page was visited (see examples here).

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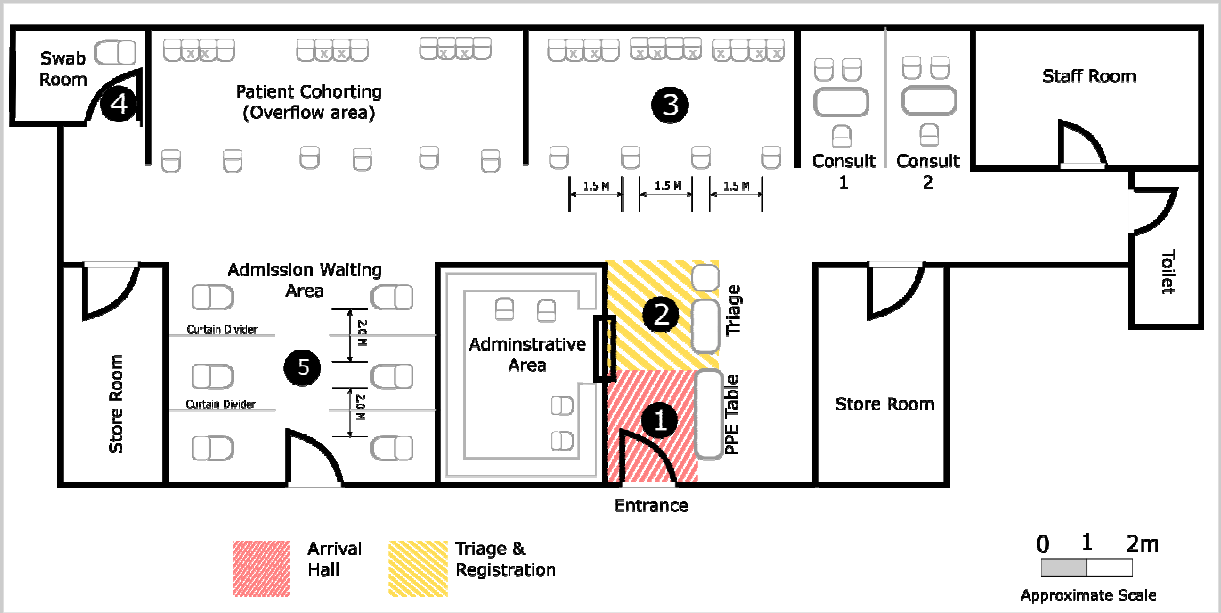
Table 1. Elements of the RMH clinical response.

Element of response	**Challenges**	**Approach used.**
Clinical Governance	Multiple clinical units involved, with tangible impacts on business as usual activity and frequent changes to the model of care and the expectations	Where possible, we operated within existing plans and policies. Daily executive and head of unit level huddles were instituted initially and then stepped down to weekly as needed, producing hospital agreement on messaging and expectations of all teams and sharing of information between Executive, ID, IPS, and EM. Within ED and ID clinical units COVID-19 multidisciplinary working groups were formed.
Infrastructure	A space needed to be sought to accommodate the extra patients while maintaining infectious isolation amongst them and between them and the rest of the ED census.	A graduated response used with existing ED negative pressure rooms used for small numbers, a cohort sub-waiting area created when several patients were present in ED at once, and a separate fever clinic created in the nearby transit lounge used for surge response
Infection prevention and control practices	Transmission dynamics are incompletely understood and there is a risk of nosocomial amplification (especially during aerosolizing procedures).	Education sessions, posters, and videos used to reinforce PPE training, nebulisers removed from dedicated treatment space, hand sanitiser stations, PPE stations and infectious waste bins deployed and a standard operating procedure (SOP) employed for aerosolizing procedures (see appendix 1)
Clinical care (including triage, assessment, and testing)	There is rapidly evolving understanding of clinical and epidemiological characteristics of the disease. Staff lack familiarity with the disease and with the roles performed (concierge nurse, fever clinic doctor) while the normal ED and hospital functions need to continue alongside.	Creation of SOP including clinical algorithms for triage, assessment, and biologic sampling as a 'living' document hosted on the hospital intranet, and updated as needed and used as a single source of truth for clinical staff. Gradual transition to algorithm driven assessment by junior medical staff to free up senior staff for unwell patients. Action cards with role descriptions were provided in the SOP for all fever clinic staff.
Communication with patients	Most patients were initially Mandarin speaking.	Bilingual signage (English and Mandarin) deployed in the fever clinic and bilingual patient resources and screening questionnaire generated. Discharge information sheets specific to different tiers of risk were translated into Chinese and provided to all patients discharged from fever clinic.
Human resources	Maintenance of staff competence and confidence essential for safety and prevention of absenteeism	Regular education sessions to provide updated clinical information and epidemiology, train in PPE, and answer questions

Table 1. Elements of the RMH clinical response.

Photographs, graphs and illustrations



Legend	Design features
1	**Arrival Hall** • Single entrance. • Staged area for donning of mask and hand disinfection
2	**Patient Identification** • Patient registration occurs inside fever clinic • Vital signs and physiologic triage occurs • Structured epidemiologic and symptom screening (either paper or digital) is provided
3	**Patient cohorting and assessment waiting area** • Patients are seated in designated areas with 1.5m space between patients, unless they are a cohort (family, partners) in which case they can sit together • Treating clinician undertakes initial assessment.
4	**Biological sampling** • Optimised airflow • Dedicated room with door.
5	**Disposition** • Suspected COVID-19 patients moved to area with more physical separation • Patient exits via exit corridor (disinfecting hands and removing PPE).
General	• All signage and written information bilingual • Use of bilingual staff when available. • Water and toileting facilities available for patients in fever clinic • Airflow optimized by buildings and maintenance department • SOPs for PPE and cleaning of space.

Figure 1: Floor plan of RMH fever clinic and guiding principles for a ‘fever clinic’.

Appendix 1

Standard Operating Procedure (SOP) for advanced airway management in patients with suspected COVID-19

Your safety is the priority - this SOP aims to guide you as to how to remain safe but provide effective care for your patients. Take time to ensure your PPE is on appropriately.

1. It is essential to plan ahead as the procedures take time to prepare for.
2. If patient meets the case definition for the COVID-19, **and** is haemodynamically unstable, **or** appears to have ventilation issues they need to be moved to R2 (preferably) or cubicles A28 or A25 with negative pressure isolation activated.
3. Escalate to EPiC and FC immediately.
4. Apply O2 via NRB at 15L **but do not** attempt any other airway manoeuvres.
5. Powered Air Purifying Respirator (PAPR), also known as Jupiter hood, trained personnel are the **only** staff members who should undertake further airway management - i.e. NIV, HFNP O2 or intubation/ventilation.
6. The EPiC or FC will inform the Emerging Infectious Diseases Team to attend ED to undertake advanced airway management. If there is to be a delay with this, contact ICU to assist (both ICU nursing and ICU medical staff are trained in the use of the PAPR).
7. Plan early and ensure patient has standard monitoring, 2 x IV access, airway equipment, drugs, ventilator and suction checked.
8. Apply a minimum of 5 minutes of NRB Oxygen at 15L (if not already on) and have nasal prongs available for apnoeic oxygenation once modified RSI started.
9. Ensure high efficiency hydrophobic filter (such as Ultipor BB25) interposed between facemack and breathing circuit or between facemask and BVM.
10. Plan for mRSI as these patients will likely have a high alveolar-arterial gradient and need rapid intubation with high first attempt success rate. The use of high dose Rocuronium (1.5mg/kg Ideal Body Weight) to achieve paralysis as quickly as possible and to avoid the oxygen consumption associated with Succinylcholine and fasciculations is highly suggested.
11. Ensure airway check list is completed prior to drug administration.
12. Intubate and confirm correct position of tracheal tube and connect to mechanical ventilator.
13. All airway equipment must be sealed in double bags before being removed for decontamination and disinfection.
14. All surfaces should be wiped down with Green Clinell wipes.
15. PAPR suit doffing should occur as per usual operating procedures for same.
16. Once patient moves to definitive disposition the room should have a Green Clean.

Advanced Airway Management Flowchart

Stay Safe and Plan Ahead

Patient meets criteria for COVID-19
and requires ventilatory support

Apply O2 via NRB at 15L
Do not attempt any other airway manoeuvres

Inform EPiC and FC.
PAPR ED Team to be called in.
Contact ICU if any delays with PAPR
ED Team arrival.

Institute NIV, HF O2,
Intubation/Ventilation as per other
high risk respiratory illness patients.

Double bag disposable equipment prior to
decontamination and disinfection.
Wipe surfaces with green clinell wipe
PAPR suit should be doffed as per usual
procedures.
Room needs green clean once empty.