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BRIEF COMMUNICATION

Impact of SARS-CoV-2 transmission-based precautions on inpatient management of general medical patients

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Abstract

This audit reviewed the impact on access to routine medical care and adverse outcomes in patients with suspected SARS-CoV-2 infection managed on a 'COVID-19' (CV) ward compared with a general medicine ward at Box Hill Hospital, Victoria. Data were collected at two time points to capture changes associated with onsite testing. We found no healthcare delays from admission to CV wards and observed faster exits from CV wards with improved testing efficiency. This critical finding is relevant as Victoria manages a third wave of infections.

Cohorting or zoning has been widely adopted to group suspected or confirmed patients with SARS-CoV-2 infection in an attempt to limit exposure to other patients and healthcare workers (HCW), concentrate expertise and reduce wastage of personal protective equipment.[1–3] Adverse consequences of patients in transmission-based precautions for other conditions have been described, including a reduced number of visits from healthcare staff and increased hospital associated complications.[4]

Box Hill Hospital (BHH) is the major tertiary hospital of Eastern Health, in Victoria, Australia.[5] Victoria experienced two distinct outbreaks in 2020: March to April (daily case peak of 106) and June to September (daily case peak of 687).[6] During the 2020 outbreaks, BHH cohorted patients in accordance with Victorian Department of Health guidelines, and operated four COVID-19 (CV) teams split over two CV wards with a daily average of 13 patients admitted to the CV bed card in the months of April to June.[7] In comparison with international burden, most patients admitted to the CV wards were negative, with only three positive patients within these months.

We aimed to measure the impact of patient placement on the CV ward while awaiting SARS-CoV-2 test results on patient access to routine care. Measures from March 2020, when testing was performed externally, were compared with May 2020, when testing was performed in-house, to identify any change in testing turnaround times (TAT) and consequences of this on outcomes.

A retrospective audit was conducted using electronic medical records of 100 patients admitted to BHH from March to June 2020. The present study was approved by the Eastern Health Human Research Ethics Committee (QA20-113). Medical records were assessed for the first 25 patients admitted to a general medicine (GM) ward (GM1), and the first 25 patients admitted to the CV wards from 25 March 2020 (CV1). Participants in the CV ward groups were included if they were transferred to a GM ward once confirmed negative of SARS-CoV-2 infection according to local guidelines. Those transferred to non-GM wards or discharged home directly from the CV wards were excluded. The process was repeated from a start date of 25 May 2020 (GM2, CV2).

Abbreviations: BHH, Box Hill Hospital; CV, patients admitted to the 'COVID-19' ward; CV1, 'COVID-19' ward group 1 (March 2020); CV2, 'COVID-19' ward group 2 (May 2020); EMR, electronic medical records; GM, patients admitted to the general medicine ward; GM1, General Medical group 1 (March 2020); GM2, General Medical group 2 (May 2020); HCW, healthcare worker; LOS, length of stay; PCR, polymerase chain reaction; PPE, personal protective equipment; TAT, turnaround time; WHO, World Health Organization

Brief Communication
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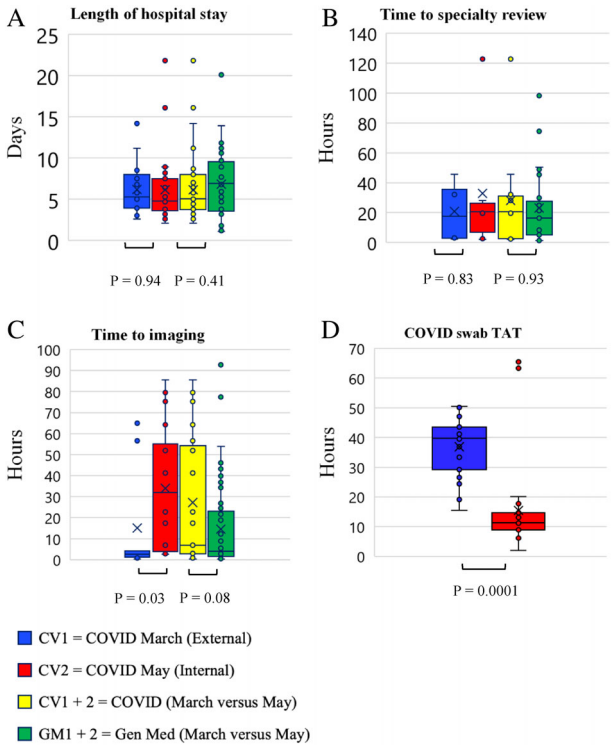

Figure 1 Box and whisker plots comparing (A) mean length of hospital stay, (B) medium time to specialty review, (C) medium time to imaging and (D) median COVID-19 (CV) swab TAT. Statistical comparisons were performed between CV1 and CV2 in all figures, and between CV1 + 2 and GM1 + 2 in figures (A) to (C), with *P*-values of differences between CV1 and CV2, and CV1 + 2 and GM1 + 2 demonstrated below the graphs. The X represents the mean and the line in the box represents the median.

Data collected included demographic information, presenting symptoms, medical history, total length of stay (LOS) (hospital admission to discharge), LOS on CV ward (hospital admission to transfer to GM ward), time to imaging (test request to image upload), time to specialty review (documented request to documented consultation) and time from admission to first allied health and pharmacy assessment. Morbidity and mortality were measured by number of representations to hospital and death within 30 days and 1 year.

In March 2020, SARS-CoV-2 polymerase chain reaction (PCR) testing was sent offsite twice daily. By mid-May 2020, PCR testing was performed onsite with continuous runs using the BD MAX™ SARS-CoV-2 and the Xpert® Xpress SARS-CoV-2 (Cepheid) platforms. The TAT was calculated from the time of first PCR order to the time the result was published.

Statistical analysis was performed using Stata 16.1 (StataCorp., College Station, TX, USA). Variables with a normal distribution were reported as means and compared using a two-sampled *t*-test with equal variance. Non-normally distributed data were reported as medians and compared using a Mann–Whitney *U*-test. A Kruskal Wallis H test was used to compare the representation rates. A *P*-value of 0.05 was considered significant.

The median participant age was 82.8 years and 54% were male (Appendix 1). The main comorbidities for both the CV and GM groups were hypertension and ischaemic heart disease, with heart failure and obstructive airways disease more prevalent in the CV groups and diabetes

Table 1 Summarised data of healthcare measurables between groups on the COVID-19 (CV) ward and the general medicine (GM) ward

Measurable	CV1	CV2	CV1 vs CV2 *P*-value	CV1 + CV2	GM1 + GM2	CV vs GM *P*-value
Length of hospital stay, mean (days)	6.20 (2.60–14.20)	6.12 (2.10–21.80)	0.94	6.16 (2.10–21.80)	6.80 (1.10–20.10)	0.41
Total number of specialty reviews	4	6		10	23	
Time to specialty review, median (h)	17.63 (2.32–45.55)	20.68 (2.15–122.88)	0.83	20.68 (2.15–122.88)	16.33 (1.22–98.32)	0.94
Total number of images	9	16		25	68	
Time to imaging, median (h)	2.63 (0.30–65.02)	31.96 (2.57–85.57)	0.03*	6.95 (0.30–85.57)	3.99 (0.30–93.37)	0.08
Total number pharmacy reviews	18	11		29	27	
Time to pharmacy review, median (days)	2.50 (0.30–6.60)	2.20 (0.10–14.80)	0.69	2.40 (0.10–14.80)	3.10 (0.10–23.70)	0.15
Total number allied health reviews	17	16		33	45	
Time to first allied health review, median (days)	1.40 (0.50–7.80)	1.60 (0.90–6.00)	0.93	1.50 (0.50–7.80)	1.30 (0.10–3.80)	0.20
Length of stay on CV ward, mean (days)	2.39 (1.00–4.80)	1.65 (0.80–4.40)	0.002**			
CV swab TAT (median) (h)	39.73 (15.42–50.45)	11.28 (2.02–65.43)	0.0001***			

Mean or median as specified with range in brackets (minimum value – maximum value). *, **, ***Significant values. CV1, COVID-19 ward group 1 (March 2020); CV2, COVID-19 ward group 2 (May 2020); GM1, General Medical ward group 1 (March 2020); GM2, General Medical ward group 2 (May 2020).

Table 2 Morbidity and mortality comparison between all four groups

Morbidity/Mortality	CV1	CV2	GM1	GM2	Comparison of all groups *P*-value
30-day representation to hospital (total)	2	7	5	5	0.84
30-day death (total)	1	0	1	0	–
1-year representation to hospital (total)	16	48	23	24	0.01****
1-year death (total)	3	1	1	0	–

****Significant values. CV1, COVID-19 ward group 1 (March 2020); CV2, COVID-19 ward group 2 (May 2020); GM1, General Medical ward group 1 (March 2020); GM2, General Medical ward group 2 (May 2020).

more prevalent in the GM groups (Appendix 1). The median TAT to SARS-CoV-2 PCR results in CV1 was 39.73 h, compared with 11.28 h in CV2 ($P = 0.0001$; Fig. 1D, Tables 1,2). The mean LOS on CV1 was 2.39 days, compared with 1.65 days on the CV2 wards ($P = 0.002$).

There was no significant difference in mean length of hospital stay and median time to specialty review between CV1 and CV2, and between CV and GM (Fig. 1A,B, Tables 1,2). Time to imaging was greater in CV2 compared with CV1 (median 31.96 vs 2.63 h; $P = 0.03$), but there was no significant difference in time to imaging in the combined CV groups compared with GM (median 6.95 vs 3.99 h; $P = 0.08$; Fig. 1C, Tables 1,2). There was no difference between time to first allied health review and pharmacy reconciliation between CV1 and CV2, and between the CV and GM groups (Tables 1,2).

A significant difference between all groups was noted between representation to hospital rates at 1 year ($P = 0.01$), but not at 30 days ($P = 0.84$; Tables 1,2). The 30-day and 1-year mortality rates were similar across groups (Tables 1,2).

Discussion

Cohorting of suspected and confirmed SARS-CoV-2 patients in hospitals is recommended by the World Health Organization and the Victorian Department of Health guidelines in an outbreak situation.[2,7] This audit found no delays to healthcare delivery associated with cohorting general medicine patients on CV wards while awaiting a negative result compared with those admitted directly to the GM wards. It also found that improved SARS-CoV-2 PCR TAT with onsite testing was associated with a faster transit of negative patients from the CV wards. Other significant findings were a longer time to imaging of CV2 patients, and a higher representation rate of CV2 patients at 1-year, but importantly no difference in mortality between CV and GM patients.

SARS-CoV-2 has led to healthcare delays in the emergency department, elective surgery and diagnosis of cancer internationally.[8,9] A study from Israel demonstrated SARS-CoV-2-negative patients in 2020 had a shorter LOS in hospital, but no difference in mortality rate compared with patients pre-pandemic.[10] To our knowledge, there have been no further studies investigating health delays and morbidity/mortality in negative SARS-CoV-2 patients admitted to CV wards. Poorer outcomes have been associated with patients in hospital isolation for other infectious diseases including less contact with HCW, higher rates of complications and increased psychological distress.[11] Delay to radiology has been reported in other conditions, such as colonisation with a resistant organism, due to contact precautions and enhanced cleaning.[12] These findings pertain to individuals in isolation rather than to cohorted wards. The longer time to imaging in CV2 could be a function of deliberate grouping non-urgent imaging in SARS-CoV-2 precautions at the end of the day, to facilitate streamlined infection control of the radiology equipment.[13] It is possible that requesting of imaging modalities requiring transport to radiology, as opposed to modalities that could be performed on the CV ward explains this, or paradoxically, the shorter TAT might have led to a strategy of awaiting clearance before imaging, delaying access. Additionally, the imaging modalities in each group differed (more computed tomography and ultrasound scans in CV2, while X-ray was more prevalent in CV1). The absence of difference in time to allied health and pharmacy review between CV and GM groups, and review by specialty team demonstrates fair clinician engagement with CV wards.

The TAT of SARS-CoV-2 tests significantly improved in May, reflecting the change in testing procedure from send-away to in-house testing. This was associated with shorter LOS on CV wards, pertinent in limiting exposure of these patients to infection risk, isolation and anxiety. This has been demonstrated previously in the United Kingdom, where SARS-CoV-2 point-of-care testing was compared with laboratory PCR testing in March and April 2020, showing a median TAT of 1.7 h compared with 21.3 h, with faster movement from cohorted

areas and no difference in morbidity or mortality.[14] Another Victorian Hospital demonstrated improved TAT of SARS-CoV-2 associated with onsite testing compared with offsite testing with quicker removal of isolation precautions, but did not investigate impact on morbidity or mortality.[15]

The CV2 group had a higher number of representations to hospital within 1 year compared with the other groups. This might be explained by the skewed selection of diseases that result in admission to a CV ward, namely chronic cardiac and pulmonary conditions known to result in frequent hospital readmissions. CV1 had the least number of representations in 1 year, which meant CV did not have a higher morbidity than GM and goes against the above hypothesis. Ten of the 48 representations in CV2 were attributable to a single patient, therefore it is more likely the small sample size meant that higher 'representers' skewed the results.

There are other limitations to the present study. The low numbers and use of non-parametric measures for some comparisons raise the possibility of type II errors. The multiple variables contributing to healthcare delay including fluctuation in patient numbers, staffing and resources, make it difficult to isolate significance in a single measure. The dates picked for this study were based around change in the testing procedure, which corresponded to different points in the community prevalence of SARS-CoV-2. Variables such as time to specialty review were based on staff documentation and may not accurately reflect the true time of review. Representations and deaths were only captured if they occurred within Eastern Health, and external deaths or representations were not captured.

Importantly, the present study demonstrated no delays to healthcare associated with admission to CV wards at BHH compared with GM wards. The findings of this study suggest cohorting can be done without compromising patient outcomes and offer insights on systems planning for ongoing pandemic management in hospitals. This information is applicable to other Australian hospitals with similar health resources and disease epidemiology, particularly to Victorian or New South Wales hospitals cohorting in current outbreaks at the time of writing. Further improvement of testing and TAT are a worthwhile investment of resources.

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Appendix 1. Additional data 1

Characteristic	CV1	CV2	GM1	GM2
Demographics				
Median age (years)	87.1	80.4	85.1	78.1
Female	7	11	15	13
Male	18	14	10	12
Presenting complaint				
Dyspnoea	16	8	2	2
Fever	11	12	4	0
Cough	15	7	1	0
Chest pain	2	2	0	1
Coryzal/rhinorrhoea	3	5	1	0
Myalgia	1	1	0	0
Comorbidities				
Hypertension	13	17	17	11
Ischaemic heart disease	10	4	5	6
Heart failure	9	3	4	4
Diabetes	4	4	8	9
Obstructive airway disease (COPD)	4	3	0	1
Asthma	2	0	0	1
Chronic kidney disease	1	3	5	1
History of cancer	7	4	2	6
Other cardiac disease	12	4	3	8
No. COVID-19 tests				
1	16	14		
2	8	11		
>2	1	0		
Ward-based data				
Documented family updates	46	36	30	33
Patients palliated	6	1	2	0
Medical emergency calls total	10	7	3	4
Discharge diagnosis				
Pneumonia/lower respiratory	10	3	1	0
Fluid overload	4	5	0	1
Exacerbation of COPD	2	0	0	0
Viral infection	2	4	0	0
Other	7	13	24	24
Discharge destination				
Home	10	18	13	16
Deceased	6	1	1	0
Nursing home	5	2	2	2
Rehab/subacute ward	4	3	9	3

COPD, chronic obstructive pulmonary disease; CV1, COVID-19 ward group 1 (March 2020); CV2, COVID-19 ward group 2 (May 2020); GM1, General Medical ward group 1 (March 2020); GM2, General Medical ward group 2 (May 2020).