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In-house testing for COVID-19: effects on length of stay, isolation and the need for inpatient rehabilitation

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ABSTRACT

Objective. The COVID-19 pandemic has strained healthcare worldwide. Its direct complications, management and prognosis have been described. Downstream effects, including length of hospital stay (LOS), implications on discharge planning, and effect of in-house testing require formal study. **Methods.** A retrospective cohort study of patients suspected of COVID-19 infection admitted at a metropolitan Australian hospital was conducted. Outcomes before and after availability of in-house COVID-19 testing were compared. **Results.** A total of 129 admissions were analysed. Indications for COVID-testing were dyspnoea (61.2%), fever (19.3%) and delirium (10.8%). All tested negative for COVID-19. Prior to in-house testing, mean LOS was 7.17 days (s.d. ± 4.2), and mean isolation of 1.8 days (s.d. ± 0.8). After availability of in-house testing, mean LOS was 4.78 days (s.d. ± 4.3) with mean isolation of 1.3 days (s.d. ± 0.9), both statistically significant differences. There were five inpatient falls, equivalent to 14.8 falls per 1000 patient/days. Twenty-two patients (17%) required subsequent sub-acute admission, 15 before in-house testing and five after ($P = 0.058$); however, a sub-group analysis for age >65 years was performed, and the results were significant ($P < 0.05$), showing all patients who required subacute admissions were aged >65. **Conclusion.** In-house COVID-19 testing is suggested to significantly reduce the duration patients spend in isolation and overall LOS in hospital. A shorter period of isolation and hospital LOS may reduce the need for subacute transfer in patients aged greater than 65 years, as well as the rates of inpatient falls. Large scale studies are needed to further elucidate these findings.

Keywords: COVID-19, deconditioning, geriatric medicine, inpatient rehabilitation, isolation precautions, pandemics, SARS-CoV-2, subacute admission.

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Introduction

The coronavirus 2019 pandemic has resulted in widespread death, economic strain and pressure on health systems. It has varying effects in its hosts, ranging from asymptomatic carriage to acute respiratory distress, multiorgan failure and death. The virus causes higher rates of mortality and morbidity in the elderly and comorbid and is transmitted via direct contact or inhalation of droplet particles.[1–3]

Public health measures used to limit the spread of SARS-CoV-2, the virus causing COVID-19, such as enforcing social isolation, are effective at limiting the spread of the virus but can result in deterioration in psychosocial and physical health. Studies have highlighted that during the COVID-19 pandemic the public has engaged in more unhealthy eating behaviours and more sedentary lifestyles with less overall physical activity.[4,5] The mental health implications of social distancing needed in global pandemics are well documented;[6,7] with increased social isolation, financial strain, loneliness, and exacerbation of pre-existing conditions being common. These unintended consequences of isolation coupled with less access to primary healthcare, may lead to an increase in

hospital presentations. Hence, there may be an increase in the number and length of stay (LOS) of patients being admitted to hospital during the COVID-19 outbreak period not directly linked to the number of positive cases within the community.

Increased hospital admissions during this period is problematic due to the increased risks associated with hospital-based COVID-19 isolation protocols. These protocols typically involve COVID-19 infected, or suspected, patients to be physically isolated without access to visitors. In addition, staff must wearpersonal protective equipment to prevent transmission. This generally involves single room isolation with the necessity for staff to wear personal protective equipment for every interaction with an isolated patient.

Pre-COVID-19 pandemic isolation studies have observed that physical isolation in hospital is associated with longer LOS, higher healthcare costs, reduced healthcare worker contact and overall reduced care provided to the patient.[6,7] Additionally, assessing patient needs from allied health and outpatient services such as post-acute care may be impacted leading to re-admission. In-hospital complications, such as pressure sores, have also been observed to be more common in isolated patients.[7] Allied health professionals typically have minimal interaction with COVID-19 suspected patients until a negative test has returned, so as to minimise the risk of virus transmission. This delay in assessment may lead to prolonged duration of stay and increase the likelihood of patients requiring a further sub-acute admission. Hence, longer duration of isolation can lead to concurrent patient risks.

The duration of isolation a patient is required to complete is directly related to how quickly a SARS-CoV-2 test result returns. Access to SARS-CoV-2 testing varies and has changed across the course of the pandemic. Initially most testing, performed using polymerase chain reaction (PCR), was performed at centralised sites with results sent to the requesting hospitals once available. This resulted in a significant delay awaiting results, with turnover time varying between 2 and 5 days. Many hospitals, including our study site, implemented in-house SARS-CoV-2 PCR testing, in laboratories within their own healthcare network, which reduced the testing time to 1–2 days. In SARS-CoV-2 negative cases, this can result in patients needing to spend less time in isolation. The broader effect that in-house SARS-CoV-2 testing has on total LOS and rates of subacute transfer have not been studied. Similarly, although it has also been observed that patients with dementia have increased LOS during both acute and subacute admissions,[8,9] the effect of isolation and SARS-CoV-2 testing has in this regard is uncertain.

At present there are no studies describing the effects COVID-19 isolation protocols have on LOS, re-admission rates, discharge destination, need for subacute admission, or falls. Studies have suggested reduced functional independence measure efficiency, a scale measuring the functional abilities of patients undergoing rehabilitation, and longer rehabilitation LOS for patients who have been treated under contact-precautions isolation. Contact-precautions is a less stringent model of isolation than COVID-19 precautions.[10] Hence, the aim of this study was to examine the effect of in-house testing for SARS-CoV-2 on total LOS and duration of isolation. Our secondary aim was to examine the effects in-house testing has on the need for subacute hospitalisation upon transfer from initial acute admission.

Methods

A retrospective cohort study of all inpatients admitted under COVID-19 precautions, under a General Medicine unit, at a 326-bed metropolitan Australian hospital was conducted over 6 weeks from 29 April to 9 June 2020. No patients were excluded. Patients were tested for SARS-CoV-2 according to hospital protocol based on the presence of specific symptoms; one or more of cough, coryza, fever or delirium which could not clearly be explained by another aetiology. Eight single rooms were used for physical isolation for suspected COVID-19 patients awaiting testing results. These rooms were located on a 'hybrid ward'; a ward comprising isolated patients awaiting SARS-CoV-2 testing and general medicine patients not requiring isolation. If physical isolation capacity was saturated, patients were either kept in the emergency department or were transferred to another acute hospital. Only patients admitted to the aforementioned 'hybrid ward' were analysed in this study. Initially, all SARS-CoV-2 testing was performed at an external central laboratory, using PCR testing. In the comparison group, SARS-CoV-2 testing became possible at an onsite, or 'in-house', laboratory using PCR and no further samples were sent to the centralised laboratory.

Data was collected by the primary investigator (CS) and two associate investigators (RC, EM). Investigators were not blinded. Data collected included: patient socio-demographics, diagnosis, Age adjusted Charlson Comorbidity Index (ACCI), individual LOS, discharge destination, falls, and 30-day re-admission rates. During Week 3 of data collection, SARS-CoV-2 testing became possible 'in-house' rather than referring tests to other sites, thus reducing SARS-CoV-2 testing time. This allowed for an analysis in the change of these variables prior to and after using in-house SARS-CoV-2 testing. With regard to falls and discharge destination, prior internal audit data from 2019 was obtained in order to make comparisons to pre-pandemic outcomes.

Data analysis

De-identified LOS data was transformed with logarithms to allow for parametric testing of significance using an independent *T*-test. Rates of inpatient falls were calculated per 1000 patient days. Categorical data of patient transfers to sub-acute care were calculated using chi-squared statistical

Table 1. Patient characteristics.

Characteristic	Total *n* (%)	Prior to in-house *n* (%) or mean (±s.d.) (*n* = 67)	After to in-house *n* (%) or mean (±s.d.) (*n* = 62)	*P*-value
Total (*n*)	129	67	62	
Age at admission (years)	76.3	76.6 (14.2)	76.0 (15.5)	0.90
Male sex	67F 62M (48.0% Male)	34F 33M (49.2% Male)	33F 29M (47.6% Male)	0.80
Presenting complaint				
Dyspnoea	60 (46.5)	28 (41.7)	32 (51.6)	0.30
Fever	26 (20.1)	15 (22.3)	11(17.7)	0.50
Delirium	14 (10.8)	6 (8.9)	8 (12.9)	0.50
Cough	8 (6.2)	2 (3.0)	6 (9.6)	0.10
Chest pain	4 (3.1)	3 (4.5)	1 (1.6)	0.30
Other	14 (10.8)	11 (16.4)	3 (4.8)	0.03
Mean ACCI	4.62 (2.1)	4.61 (2.2)	4.62 (2.1)	0.90
Discharge destination				
Home	73 (56.5)	39 (58.2)	34 (54.8)	0.70
GEM	22 (17.0)	15 (22.3)	7 (11.2)	0.06
RACF	12 (9.3)	4 (6.0)	8 (12.9)	0.18
BHH	2 (1.5)	1 (1.5)	1 (1.6)	1.0
Other	20 (15.5)	11 (16.4)	6 (9.6)	0.30

GEM, geriatric evaluation management; BHH, Box Hill hospital; RACF, residential aged care facility; ACCI, Age adjusted Charlson Comorbidity Index; Other, acute hospitals outside of healthcare network.

testing. Analysis was performed using STATA 16 (StataCorp, College Station, TX, USA). All analyses were performed with an alpha $P < 0.05$ when testing for statistical significance.

Ethics approval

Ethics approval for this study was obtained from the hospital-based ethics committee (REF LR20/082). Informed consent was not obtained as the data was collected retrospectively and no identifiable data was collected.

Results

Patient characteristics

Data from 129 hospital encounters, from 126 individual patients, were collected as part of this study. Patients' characteristics are presented in Table 1.

Length of stay

Mean LOS over the 6-week period was 5.72 (±5.6) days and mean length of isolation was 1.6 days (±0.9). Prior to in-house testing, mean LOS was 7.17 (±6.8) days, with a mean isolation of 1.8 (±0.8) days. Post introduction of in-house testing, mean LOS was 4.8 (±4.3) days and isolation 1.3 (±0.9) days. This difference in LOS and length of isolation were both statistically significant (Table 2).

Table 2. Comparison of outcomes before and after implementation of in-house testing.

Outcome	Before days mean (±s.d.)	After days mean (±s.d.)	Between difference group (days)	*P*-value
Length of stay				
All	7.17 (6.8)	4.78 (4.3)	2.4	$P < 0.05$
Dementia	6.1 (5.0)	4.5 (4.0)	1.6	$P = 0.17$
Age >65	6.9 (6.9)	5.1 (4.0)	1.8	$P < 0.05$
Length of isolation				
All	1.8 (0.8)	1.3 (0.9)	0.5	$P < 0.05$
Dementia	1.6 (0.7)	1.0 (0.8)	0.6	$P = 0.16$
Age >65	2.1 (0.8)	1.3 (0.9)	0.8	$P < 0.05$

Sub-group analyses of the LOS in 105 of patients over 65 years also showed a significant difference in LOS of 1.8 days for patients older than 65 years (6.9 ± 6.9 vs 5.1 ± 4.0, respectively, $P < 0.05$). However, there was no difference in the LOS in patients in this group with compared to the group without dementia (1.6 ± 0.7 vs

Table 3. Comparison of subacute transfer and 30 day re-admission before and after implementation of in-house testing.

Outcome	Before in-house testing (number of patients)	After in-house testing (number of patients)	Difference	*P*-value
Subacute transfer				
All	15	7	8	0.058
Age > 65	15	7	8	<0.05
Dementia	1	0	1	0.38
30-day re-admission	12	12	0	0.77

1.0 ± 0.8, respectively, $P = 0.159$). Sub-group analyses also showed a significant difference in LOS of 1.8 days for patients older than 65 years but no significant difference in LOS for those with and without dementia (Table 3).

Falls

There were five inpatient falls during the period assessed. This equates to a rate of 14.8 per 1000/patient days. On the same ward over the same time period in 2019 the rate was 6.69[11] per 1000/patient days. Previous studies have shown average rates of falls on medical wards to be 4.54 per 1000/patient days from a large database within the United States of America.[12] Due to the small number of patient falls, our analyses were underpowered to assess for significant differences between the isolation period and 2019.

Discharge destination

Over the period studied, 17% of patients required subacute transfer. This was not significantly different to the same period in 2019 (17% vs 16.6%, $P = 0.82$) and the implementation of in-house testing did not significantly affect rates of subacute transfer (22.3% vs 11.2%, $P = 0.06$); however, sub-group analysis showed a significant difference in the need for subacute transfer in participants older than 65 years (26.8% vs 11.9%, $P < 0.05$). This was not observed when a sub-group analysis was performed for those with and without a diagnosis of dementia ($P = 0.38$).

Re-admissions

The before and after in-house testing groups both had 12 episodes of re-admission within 30 days, which is not statistically significant ($P = 0.77$).

Discussion

This study showed that in-house SARS-CoV-2 testing significantly reduces both the total LOS and duration of isolation, when compared to centralised testing. A sub-group analysis has also suggested this to be true in the typically more medically frail and comorbid cohort of those aged greater than 65 years. An increased rate of falls in patients being tested for SARS-CoV-2 was also suggested, when compared to published data and ward data from previous years. However, given that the total number of falls observed was small, this observation may be of limited overall significance. Although in-house testing did not significantly alter the rates of subacute transfer overall, it was observed to significantly reduce the rates of subacute transfer in those older than 65 years, which is the cohort of patients typically more likely to require restorative care following an acute admission.

The COVID-19 pandemic has created unprecedented stress on healthcare systems. At the beginning of the pandemic, testing for SARS-CoV-2 was not widely available. In our region, there were only two centralised services capable of performing testing and hence there was significant delay in hospitals receiving results.[13] During this period, patients were treated in isolation, received less nursing and allied health supervision and were not permitted visitors.

Prolonged hospitalisation increase costs and hospital complications[14] and the addition of isolation is likely to compound this. With the demand for inpatient beds increasing, and supply decreasing or remaining stagnant,[15] it is important that LOS be optimised so as to reduce healthcare costs and ensure acute hospital beds are available when needed, such as during a pandemic.

Our study has shown that once in-house testing was possible, both the duration of isolation and total LOS were reduced. The only significant difference observed between the groups was in presenting complaints listed as ‘other’; a heterogeneous group of presenting complaints, individually too small in number to be analysed and unlikely to be related to any difference in observed outcomes. The reduced duration of isolation mirrors reduced testing result wait time as was expected; once a negative result was received, the patient could come out of enforced isolation. However, the difference in total LOS before and after the implementation of in-house testing (3 days) is greater than would be anticipated and cannot be wholly attributed to reduced duration of isolation and hence other factors must be at play.[10] There are several potential reasons for this observed increase in LOS.

First, prolonged isolation and delayed access to allied health may result in physical deconditioning, hence requiring longer LOS. This is reflected by the increased need for

subacute transfer observed in patients older than 65; however, this was not observed in younger patients. Alternatively, the delay in mobilisation and assessment by allied health staff, routinely done on medical wards early to facilitate appropriate discharge, may have been delayed due to isolation and inter-ward/unit transfer.

Second, the medical model of care with COVID-19 suspected patients was dramatically different to usual model of care. Patients were admitted to a COVID-suspected (CVS) unit in a 'hybrid ward' until a negative SARS-CoV-2 test result returned, at which point they were moved and care was taken over by a different, non-CVS medical unit comprising a new set of medical, nursing and allied health staff. The main role of the CVS unit was to assess and treat patients suspected of COVID-19 until their SARS-CoV-2 test returned. There may have been delays in investigation and management of typical non-COVID related medical issues, potentially the underlying reason for admission. Radiological investigations were also likely delayed due to disinfection protocols. In addition, restrictions of movement of staff and intrahospital specialty opinion could have been delayed by awaiting negative results before a patient could receive an in-person consult. Once patients received a negative SARS-CoV-2 test result, many possible barriers to timely investigation and management were likely minimised.

The mean age of patients in this study was 76 years. Elderly patients admitted to hospital are often medically complicated and require intensive medical and allied health assessment, both of which may be delayed or sub-optimally provided with protracted isolation. Contact isolation has also been associated with increased anxiety and depression,[8] which may worsen inpatient outcomes and participation with prescribed therapies. Additionally, elderly patients are known to decondition quickly, especially in hospital.[16] The published data regarding isolation and functional deterioration is scant, hence the importance of this study and the significance of our findings.

With regard to the need for subacute transfer, our study showed that there was no overall significant difference before and after the implementation of in-house testing ($P = 0.056$) nor compared to the same time period and ward in 2019 ($P = 0.82$). Sub-group analysis, however, did suggest that patients older than 65 years were more likely to require subacute transfer before the introduction of in-house testing. This could suggest that the longer time in isolation before in-house testing may result in functional and physical deconditioning in elderly patients, thus increasing the need for rehabilitative care.

In patients being treated under contact precautions, increased rates of supportive care failures, including falls, has been described,[17,18] but the underlying mechanism is unclear. Our study observed an increased rate of inpatient falls compared to both published data and previous rates on the same ward.[12] However, a low number of total falls means that this result needs to be interpreted with caution. Typical falls reduction strategies, including frequent observations in higher visibility areas, mobility alarms, delirium management strategies and early access to physiotherapy were greatly affected by the isolation required when awaiting testing results. Isolated patients also had delayed access to allied health which may have resulted in delayed identification of patients at-risk of falls and thus earlier intervention in this regard.

Limitations

This study was retrospective, conducted over a short period, with a relatively small number of patients, on just one ward. Numbers of falls and transfers to subacute were small; hence any difference observed needs to be interpreted with caution. We were unable to compare rates of falls pre- and post-in-house testing due to a small number of falls.

As the pandemic continued, the community was required to isolate at home for longer. Hence patients in our study may have been less physically active and have had less access to medical care than usual and may have already suffered from physical and functional deconditioning prior to their hospital presentations, potentially confounding our results.

All patients tested negative for SARS-CoV-2, hence this study does not specifically add to the growing knowledge of the virus. However, the results obtained can be extrapolated to help advise the wider hospital procedures and organisational processes used when managing recurrent waves during this current pandemic, and future pandemics, particularly when managing patients in isolation.

Conclusion

This study showed that in-house SARS-CoV-2 testing significantly reduces total LOS and duration of isolation, which ultimately reduces healthcare costs and improves service availability. It also showed an increased need for subacute transfer in patient over 65 years before the introduction of in-house testing. These findings have implications irrespective of the COVID-19 pandemic and can be used as evidence for implementation for in-house testing for other communicable diseases and indeed minimising duration of isolation in general. Falls were observed to happen more frequently in patients being tested for SARS-CoV-2 who are treated in isolation while awaiting results, however this observation is limited by low total number of falls. More research is needed to identify the reasons for increased LOS caused by contact isolation.

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Data availability. The data used to generate the paper are sensitive medical records and hence are not available for viewing.

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