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Impact of Lockdowns on Critical Care Service Demand in a Metropolitan Hospital in Melbourne Australia

Abstract

Background: There is a growing recognition of impact of lockdowns on non-COVID-19 demand for critical care services. Whilst a reduction in demand has been postulated, there remains a paucity of quantitative data on the extent and nature of this reduction.

Aim: This study aims to quantify the impact of lockdown on critical care services, namely Emergency Department (ED), Intensive Care Unit (ICU), Medical Emergency Team (MET), and Emergency Theatre (ET) demand, during the lockdown in Victoria, Australia.

Methods: This is a single-centred, retrospective observational study on critical service demand, comparing activity levels during the lockdown (31 March to 27 October 2020) with the matched time period from 1 year prior.

Results: There was a reduction in presentations to ED (27.2%), MET calls (27.4%), ICU patient episodes (14.5%), and ET bookings (5.8%). There was an unexpected increase in ICU admissions for metabolic diagnoses, comprising drug overdoses and diabetic ketoacidosis, and a reduction in respiratory ICU admissions. There was a reduction across all ED triage categories, which included triage 1 and 2 patients, indicating a reduction even in life-threatening and emergency presentations.

Conclusion: Lockdowns lead to a significant reduction in ICU, MET call and ED demand, and to a lesser extent ET demand. This pattern should be should be considered in surge capacity and workforce redeployment planning. There are also impacts on public health epidemiology, with potential adverse consequences on mental health and chronic disease management. Further research on the impact of lockdowns on long-term disease outcomes is needed.

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Introduction

Governments around the world have employed lockdowns to curb the spread of COVID-19. Lockdowns, defined as society-wide interventions aimed at limited human movement and interaction, have been used as a means to slow disease transmission whilst expanding capacity for testing and caring for COVID-19 cases (1,2). The Victorian state of Australia experienced a rising number of COVID-19 cases in early to mid-2019, leading to the implementation of a lockdown from March 31 to October 27. Restrictions during this period included restrictions on social gatherings, dining and shopping; additional restrictions on exercise, travel distance and curfews were applied to varying degrees.

It is increasingly recognised that lockdowns have impacts on non-COVID-19 aspects of healthcare systems, including changes in health service demand and disease epidemiology (3,4). However, the quantitative impact of the lockdown on unplanned critical care demand remains unclear. Reports of changes in critical service service demand internationally (5–7) have been confounded by high numbers of COVID-19 presentations straining the health system, making it challenging to distinguish the impact of lockdowns on non-COVID-19 critical care caseload. The Australian setting provides a opportunity to examine this phenomenon as natural experiment, given the low incidence of COVID-19.

Understanding the overall impact of lockdowns on critical services demand is essential to surge capacity planning, particularly if workforce redeployment is required (8). This facilitates the application of principles of equity and distributive justice to ensure that redeployment does not adversely affect patient care across various critical care services (9). In addition, understanding the impact of lockdowns on the epidemiology of critical care presentations provides insight into the unanticipated impact of lockdown on population health, allowing for targeted interventions to mitigate these risks.

We undertook this study to examine the impact of lockdown on critical care service demand on a healthcare service that was not overwhelmed by COVID-19 patients. This was defined as unplanned ICU patient activity, MET call volume, ED presentations, and Emergency Theatre (ET) bookings. We also aimed to examine the epidemiology of presentations to critical services, based on diagnoses or urgency of presentations.

Methods

Setting

This was a retrospective study of the impact of lockdown measures on emergency and critical care services at Northern Health, a University affiliated hospital located in metropolitan Melbourne, Australia. Annually, Northern Health manages over 94 000 admissions, 99 000 ED presentations, 1000 ICU admissions and 3300 Medical Emergency Team (MET) call-outs.

Study periods

A “lockdown” was defined as the application of significant restrictions on social activity and mobility and was taken as beginning on 31 March 2020, with data extracted to 27 October 2020.

The Northern Emergency department had to implement service restrictions for 5 weeks beginning 6th July 2020 due to staff furloughs for infections or being close contacts of positive cases; data from this period were excluded as part of a sensitivity analysis.

The impact of the lockdown was assessed by comparing activity levels during the lockdown period (31 March to 27 October 2020) to a matched period from 1 year prior (31 March to 27 October 2019).

To evaluate for any trends in activity levels in the 6 months preceding the lockdown, activity levels during the 6 months immediately pre-lockdown (28 Oct 2019 to 30 March 2020) was compared with the same period from 1 year prior (28 Oct 2018 to 30 March 2019).

Data extraction

ICU activity and diagnostic information were obtained from data routinely collected for submission to the Australia New Zealand Intensive Care Society (ANZICS) Adult Physiology Database (APD); integrity of this data is maintained by a dedicated team of local ICU data managers who review and verify the data before submission.

Daily ICU activity was reported as the number of patient episodes per day, defined as the number of unique patients who were in the ICU within each 24 hours period. Admission diagnostic data was analysed according to the existing APACHE diagnostic categories within the ANZICS APD. MET activity was obtained from data routinely collected as part of the Northern Health MET registry. Data on emergency presentations and emergency theatre bookings were provided by the decision support unit at Northern Health. Emergency theatre bookings were presented as category 1 to 5, in alignment with the Victorian government framework for emergency surgical prioritisation (10).

Ethics approval was obtained from the local Human Resource Ethics Committee for the study.

Statistical Analysis

Data were analysed using SPSS 27 for Windows. A Shapiro-Wilk test was performed to assess for normality of continuous data. Normally distributed continuous data were reported as means, and compared using a t-test. Non-normally distributed cata were reported as medians, and compared using a Mann-Whitney U test. Categorical data were reported as proportions.

Changes in ICU diagnostic categories, triage category and emergency theatre categories were analysed using a Chi-square test. Where a Chi-square test was significant, standardised residuals (SR) were calculated, with an SR equal or greater than +/- 2.0 taken as significant. A p value of <=0.05 was taken to be statistically significant, except where Bonferroni correction was performed to account for multiple analyses.

Results

Between 28 October 2018 to 27 October 2020, a total of 2 239 ICU admissions, 4 847 MET calls, 204 248 ED presentations, and 13 959 ET bookings were identified for analysis.

There was a reduction in unplanned demand across ED, ICU, MET and ET services during the lockdown when compared to the matched time period from 1 year prior (Figure 1). There

was a reduction in ED presentations by 27.2% ($p<0.001$), ICU daily patient episodes by 14.5% ($p<0.001$), MET calls by 27.4% ($p<0.001$), and ET bookings by 5.8% ($p=0.024$). On sensitivity analysis of ED presentations with the exclusion of the 5-week service restriction, there was 22.9% reduction in presentations ($p<0.001$).

There was no evidence of a change in activity levels in the 6 months pre-lockdown (28 October 2019 to 30 March 2020) for any of the services, when compared to the same time period from 1 year prior (Supplementary Table 1).

There was a small reduction in ICU patient age and ICU length of stay during the lockdown, as compared to the matched time period (Table 1). There was no change in patient illness severity, ICU or hospital mortality. There was a change in the diagnostic categories for ICU admissions (X^2 =22.9, p= 0.011), with an increase in metabolic diagnoses (SR = 2.3) , comprising primarily of diabetic ketoacidosis and drug overdoses, and a drop in respiratory diagnoses (SR = -2.0), even when COVID-19 admissions were included (Table 2).

The reduction in ED activity occurred proportionately across all triage categories, with no evidence of redistribution of caseloads between categories (p = 0.99) (Figure 2). There was a redistribution of triage codes for ET bookings(X^2 = 361.4, p < 0.001), driven primarily by a decrease in category 4 bookings (SR= -10.3), with a corresponding increase in category 5 bookings (SR =8.5) and to a lesser extent category 3 bookings (SR = 2.2) (Figure 3).

Discussion

In this single-centred restrospective cohort study, we demonstrated a reduction in critical care service demand during a lockdown, specifically unplanned ICU patient episodes, MET calls, ED presentations, and to a lesser extent, ET bookings.

Our findings are consistent with reports of reductions in ED presentations (6,11) as well as emergency surgery volume (12,13). However, these reports are from settings with a higher incidence of COVID-19, making it difficult to distinguish the effect of lockdowns from stress on the health system. Within Australia, there has been limited data, with a single report on reductions in ED presentations in a New South Wales jurisdiction (14). Young et al has also reported a reduction in unplanned ICU admissions during the national lockdown in New Zealand (15).

Whilst lockdowns have traditionally been conceptualised as a method of reducing infectious disease spread and to “buy time” to active surge plans (16), the demonstrated reduction in unplanned critical service demand effectively creates additional capacity and should be considered in healthcare modelling and planning. The corollary should also be considered - the lifting of lockdown measures may create a rebound demand on critical care service demand, particularly as healthcare service activity such as elective surgery is resumed, and would need to be monitored and evaluated.

We have demonstrated that lockdowns may have unanticipated impacts on the epidemiology of ICU admissions. Changes in the distribution of ICU admission diagnoses are supported a growing body of evidence on the impact of lockdowns on community health. In particular, the unexpected increases in drug overdoses reflects a potential impact on mental health and is supported by evidence of adverse impacts of lockdowns on mental health (17). The increase in admissions for diabetic ketoacidosis could also be related to a negative impact on chronic

disease management – whether it be related to altered health-seeking behaviour leading to late presentations, or inadequate access to primary care physicians (3). The reduction in respiratory admissions has also been observed in paediatric populations (5,18), and could be attritubed to the impact of social distancing on the spread of respiratory infections.

The reduction in ED presentations occurred across all triage categories, including life-threatening and emergency triage 1 and 2 categories. Whilst concerns have been raised on delayed health-seeking for medical emergencies (7), this finding suggests that the reduction in presentations were not solely due to changes in health-seeking behaviour but also true changes in overall disease incidence. Although this is reinforced by public data that has not indicated an unexplained increase in deaths over the lockdown period (19), a rise in excess deaths from various conditions post-lockdown suggest a long-term impact on public health outcomes(20).

The impact on overall emergency surgical demand was limited, indicating the need to maintain adequate surgical capacity during pandemic response planning. Of note, the urgency of a large proportion of these surgeries had changed, driven primarily by a drop in category 4 and an increase in category 5 bookings. It is unclear if this is due to a change in triage practice to account for uncertainty in surgical capacity, or an actual change in the nature of conditions requiring urgent surgery. The former consideration is consistent with concerns regarding delays in emergency surgery during the COVID-19 pandemic (21) and would have marked implications, as delays in urgent surgery may contribute to worse outcomes (22), necessitating further investigation into surgical outcomes related to the lockdown.

This study has several limitations, including limited generalisability due to its single centred nature. However, Northern Health is a high-volume metropolitan health service provider, and our findings are likely to apply to other similar services. National trends utilising registry data such as the ANZICS APD registry may be an avenue to validate these findings across other jurisdictions.

The impact of lockdowns on long-term chronic disease outcomes and mental health has not been assessd in this study. There is evidence of an increase in excess death post-lockdown, particularly due to cancer and Alzheimer's disease (20); this could be a reflection of the changes in surgical triage and chronic disease management identified in this study, and would need to be investigated further. The datasets utilised in this study also do not provide adequate diagnostic information to assess changes in mental health and self-harm presentations; this would need to be further evaluated given the observed increase in ICU admisisons for drug-overdoses.

Lastly, there was a severe influenza season in the winter of 2019, which may have led to an increase in critical care service demand relative to 2020 (26, 27). The general reduction in demand across all services, as well as the reduction a number of non-respiratory ICU admissions, suggests that non-influenza diagnoses had reduced as well; this would need to be evaluated using longer-term data.

Conclusion

We have found an overall reduction in critical care service demand during periods of lockdown, although this was less pronounced in emergency theatre demand. The reduction in unplanned ICU activity creates additional surge capacity, whilst the reduction in activity in

other critical care services highlights the potential avenues for equitable workforce redeployment if required. A disproportionate increase in ICU admissions for drug overdoses and diabetic crises suggest unintended consequences on mental health and chronic disease management, highlighting the need for further research on the impact of lockdowns on long-term disease outcomes.

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Table 1: Characteristics of ICU patients during lockdown and matched period

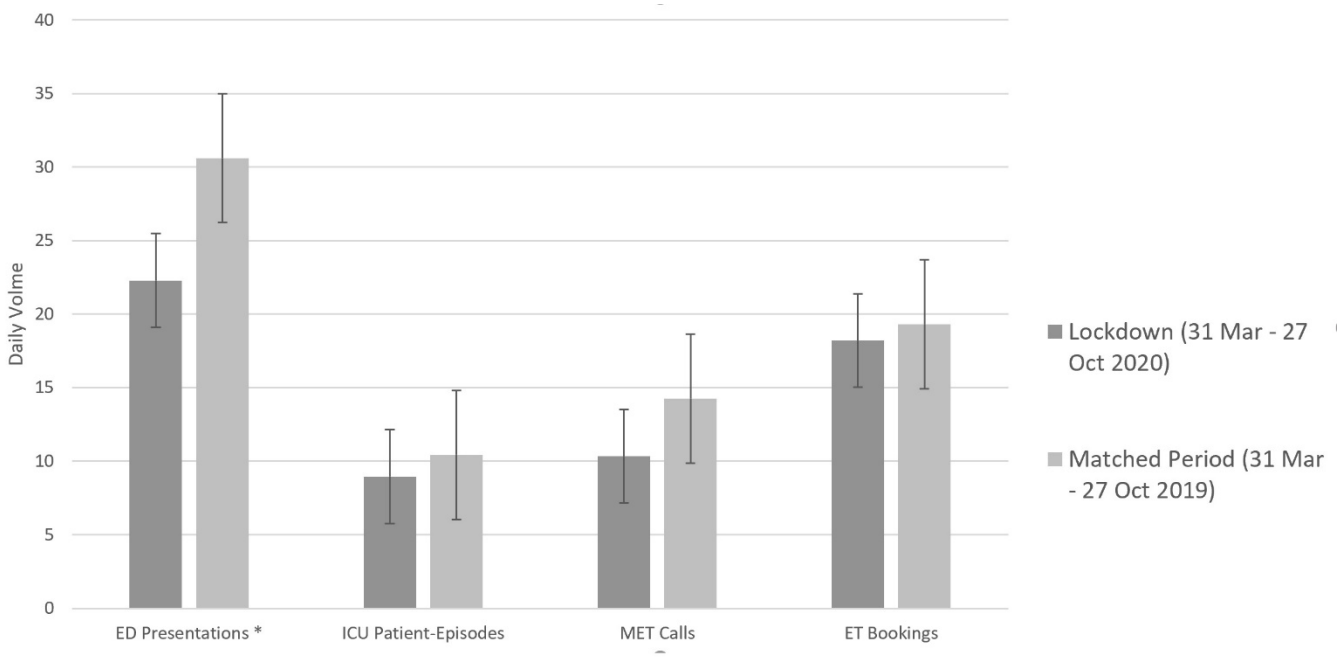
	Lockdown 31 mar – 27 Oct 2020	**Matched period 31 Mar – 27 Oct 2019**	**p-value***
N	567	691	
Age, median (IQR)	57.1 (41.0 – 70.9)	63.3 (45.5 – 75.3)	**<0.001**
Gender male (%)	55.8%	53.9%	
APACHE Score (Median, IQR)	49 (33-67)	52 (45-75)	0.05
Source of Admission	58.1% Emergency department 22.2% Ward 18.3% Operating Theatre 1.2% Other Hospitals	55.1% Emergency department 19.5% Ward 16.0% Operating Theatre 8.1% Other Hospitals	
Invasive ventilation	31.9%	32.8%	
ICU length of stay, hours, median (IQR)	29.0 (16.9-56.6)	35.1 (19.9-64.1)	**0.01**
ICU Survival	92.1%	90.6%	
Hospital length of stay, days, median (IQR)	6.3 (IQR 3.3 – 13.0)	6.4 (3.5-11.8)	0.77
Hospital Survival	88.4%	87.4%	

Table 2: ICU Admission APACHE Diagnostic Categories During Lockdown and Matched Period

Diagnostic Category	Lockdown period (31 mar – 27 Oct 2020)	%	Matched Period (31 Mar – 27 Oct 2019)	%
N	567		691	
Cardiovascular	109	18.6	140	19.4
Gastrointestinal	24	17.7	27	17.9
Gynaecological	9	1.6	10	1.8
Haematological	5	1.3	2	0.4
Metabolic	100	15.8	76	10.4
Drug overdose	53	8.3	49	6.1
Diabetic ketoacidosis	27	4.2	14	1.7
Other	20	3.3	13	2.6
Musculoskeletal/Skin	15	2.8	15	2.7
Neurological	56	8.8	70	10.0
COVID-19 related	1		-	
Renal/Genitourinary	25	5.0	18	3.1
Respiratory	98	16.0	167	21.8
COVID-19 related	24		-	
Sepsis	108	9.5	144	9.8
Trauma	18	3.0	22	2.7

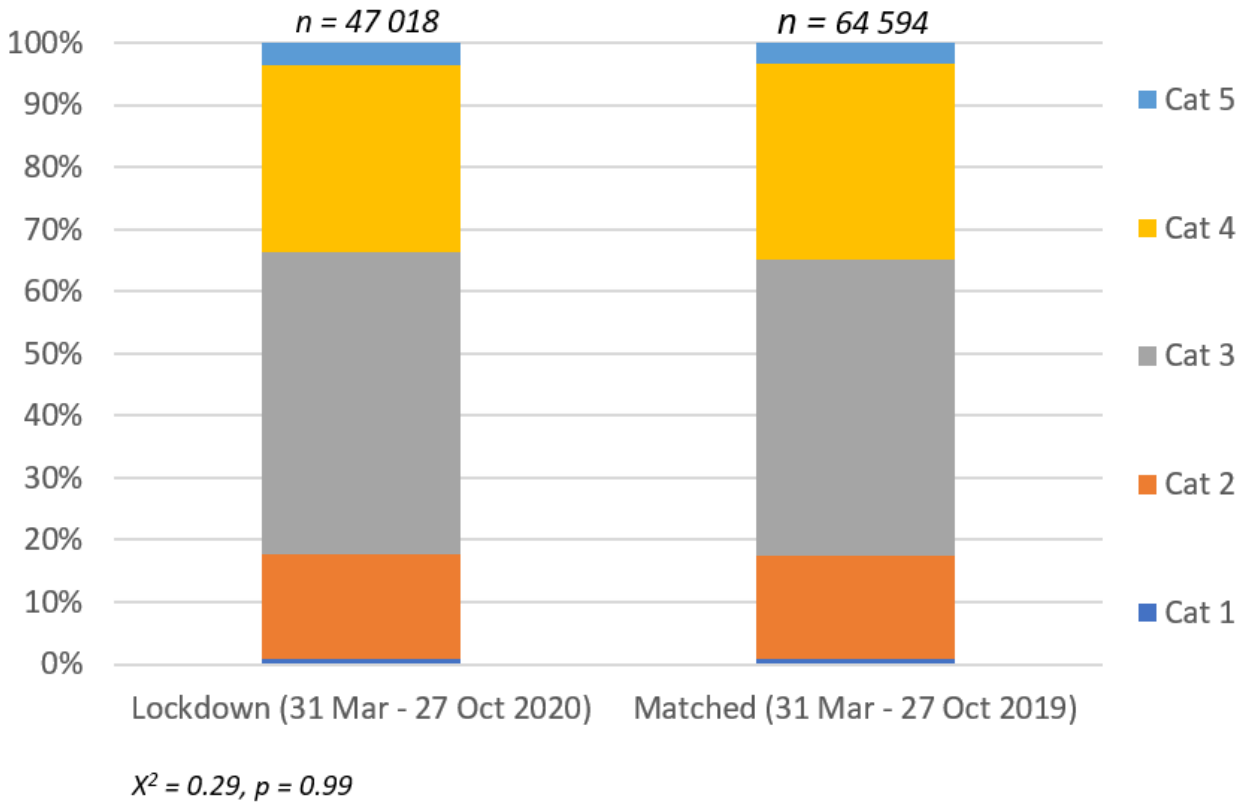
$X^2 = 22.9$, $p = 0.011$

Figure 1: Change in Critical Care Service Daily Demand Between Lockdown and Matched Time Period. Error bars indicate standard error.



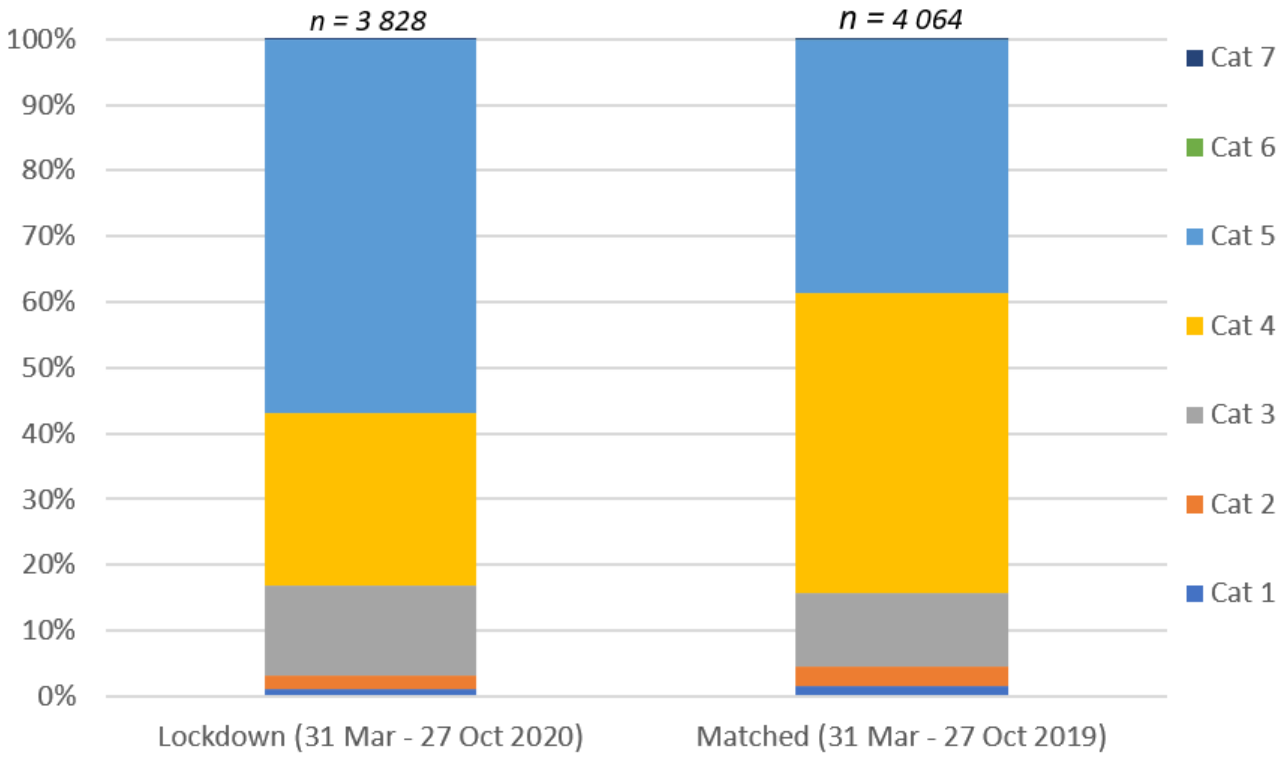
**Daily ED Presentations are indexed by 10*

Figure 2: Changes in ED Triage Categories between Lockdown and Matched Time Period



$X^2 = 0.29, p = 0.99$

Figure 3: Changes in Emergency Theatre Booking Categories between Lockdown and Matched Time Period



$X^2 = 361.4,\ p = < 0.001$

Supplementary Table 1: Daily Critical Service Demand in 6 Month Period Pre-lockdown (28 Oct 2019 – 30 Mar 2020)

	Pre-lockdown (28 Oct 2019 – 30 Mar 2020)	Time-matched period (28 Oct 2018 – 30 Mar 2019)	Relative change (% with 95% CI)*	P
ICU activity (patient episodes/day)	9.8	9.6	-1.7% (-4.0 to 7.3%)	0.56
MET activity (MET calls/day)	11.9	11.7	1.8% (-6.0 to 9.7)	0.64
ED activity (presentations/day)	302.4	297.1	1.8% (-0.03 to 3.6)	0.054
Emergency Theatre activity (bookings/day)	19.5	19.5	-0.4% (-6.1 to 2.9)	0.89

Title

Impact of Lockdowns on Critical Care Service Demand in a Metropolitan Hospital in Melbourne Australia

Running Head: Impact of Lockdowns on Critical Care Services

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Author Contributions

Sing Chee TAN – conceptualisation, methodology, data curation, analysis, writing (original, review and editing)

Anthony CROSS – conceptualisation, methodology, writing (review and editing), supervision

Angaj GHOSH – methodology, writing (review and editing)