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COVID-19 pandemic 2020 – A tertiary Melbourne hospital's experience

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Background - The COVID-19 pandemic has affected different parts of Australia in distinct ways across 2020 and 2021. In 2020, Melbourne was the epicentre of COVID-19. As one of the key

tertiary centres caring for the patients affected by the outbreaks, the Royal Melbourne Hospital managed the majority of the Victorian inpatient caseload.
Aims - to review the demographics, management and outcomes of patients with COVID-19 cared for by the Royal Melbourne Hospital services in 2020
Methods - A single health service retrospective cohort analysis of demographics, interventions and outcomes was conducted to characterise the RMH experience in 2020
Results – From January to December 2020, 433 patients required more than 24hours' admission. The demographics of affected patients and outcomes changed over the course of the study. Overall, 47% required oxygen (203/433), most frequently with low flow devices (nasal prongs or hudson mask) (36%, 154/433) and 11% (47/433) of patients required admission to intensive care. We recorded a 30-day mortality of 24% (104/433) mortality overall, rising to over 50% in patients aged over 80.
Conclusions – The experience of this health service in 2020 demonstrated changing demographics over time, with associated differences in outcomes; notably marked mortality in older populations, frequent complications and limited inter-site transfer possible with mobilized resources.

covid-19, retrospective studies, hospitalisation, australia, sars-cov-2

Introduction:

The SARS-CoV-2 virus has spread rapidly, with a global pandemic declared by the World Health Organization on March 11th 2020 (1). Australia recorded nearly 30,000 cases of COVID-19 and 910 deaths in 2020(2); the majority of these infections in Melbourne. The city controlled an initial "wave" of transmission, peaking in early April, before a second surge escalated to over 700 cases daily during July (2). Most of this second wave was focussed in areas of Melbourne's northern and western suburbs, with large clusters linked to public housing towers and residential aged care facilities (3). This presented particular challenges to hospitals providing care to these communities.

Existing services were remodelled to allow the health service to provide the most appropriate level of care wherever the individual was located, redistributing resources to avoid unnecessary transfer. Acute care was provided in traditional hospital settings, in sub-acute facilities, in Residential Care Facilities, and in patients' own homes. We provide a descriptive account of COVID-19 in an Australian population, detailing demographics, clinical course, and comparing outcomes across two distinct periods as managed by a Victorian public hospital and its affiliated services. Our aim is to provide local data to enable other health services to plan their own response as it is clear we will continue to see further waves of infection.

Methods:

A single-centre retrospective cohort study was performed of COVID-19 positive patients who received more than 24-hours of care between January 1st and December 31st, 2020, from Royal Melbourne Hospital (RMH) services. This included the City Campus, a 650-bed adult tertiary referral hospital; Royal Park Campus, a 100-bed subacute care centre for Geriatric Evaluation

and Management (GEM); and Hospital in the Home (HITH), an acute bed-substitution service. All patients had SARS-CoV-2 detected by PCR on nasopharyngeal swab either through RMH pathology services or externally as confirmed with the Department of Health (DH) Victoria. Patients were excluded from analysis if they were not considered active cases by the DH at the time of their care. Administrative and clinical data were collected manually from medical records and a database maintained by ward staff across all sites. Data were cross checked by the Business Intelligence Unit using extractions of coding data to collect any missed cases.

Admissions were divided in two six-month blocks (admission date January 1st to June 30th and July 1st to December 31st) broadly representing "Wave 1" and "Wave 2" of infection. Locations of care were documented for each patient, with a primary site assigned to patients who received care across multiple locations reflecting the majority of their COVID-related management. Descriptive statistics are presented detailing demographics, comorbidities, markers of disease severity, treatments, and outcomes.

Comorbidities were counted according to a modified Charlson Comorbidity Index (CCI) (4,5), and a Rockwood Clinical Frailty Score (CFS) (6) was calculated for each patient. Duration of and greatest oxygen requirement was detailed in accordance with the WHO "Ordinal Scale for Clinical Improvement" (7). Complications were noted as recorded by the treating team including hyperglycaemia, delirium, and Intensive Care Unit (ICU) admission.

Discharge destination was documented as a marker of disease outcome; "other hospital" includes transfers outside of RMH including to other ICUs, acute ward beds and non-RMH sub-acute settings.

This study was conducted with ethical approval from the RMH Human Research Ethics Committee (QA2020135).

Results:

Between January and December 2020 RMH provided 750 episodes of COVID-19 related patient care. 46 patients presented more than once; 27 were admitted on a subsequent presentation. Of the 692 individual patients, 203 were discharged home from the emergency department, 50 required less than 24 hours' care, 3 were cleared by the DH as no longer infective, 2 were transferred to other hospitals directly from presentation and 1 patient died in the emergency department. Of the remaining 433 patients who had multi-day stays, 223 required acute hospital admissions, with 210 others receiving care in alternative settings, as represented in **Figure 1**. Less than 15% of all admissions required care in more than one setting.

The median age for the entire cohort was 69 years, with 59% females. Whilst the median comorbidity (modified CCI) was only 1, the median CFS was 3 (interquartile range of 1-6). There

were 7 pregnant women, only one of whom required oxygen. Most patients (67%) acquired coronavirus locally, 30% contracted coronavirus as residents of aged care facilities, and a small proportion (3.5%) of cases were acquired overseas.

The cohorts cared for in Wave 1 and Wave 2 were distinct, see **Table 1**. The first wave comprised a high proportion of overseas acquired illness (45% of admissions in Wave 1, 0.2% of Wave 2), was much younger (median age 57 compared with 73; p=0.002) and less frail (median CFS of 1 in Wave 1 vs 4 in the Wave 2; p<0.0001). In Wave 1, 19% (6/31) of patients were aged over 70 years, while in Wave 2 greater than 50% of patients were aged 70 years or older (209/402, 52%).

In Wave 2 the patients cared for by RMH were distributed among three sites of care: a ward based "Acute" hospital setting; acute care provided in a traditionally sub-acute GEM ward; and a Hospital in the Home ("HITH") group, comprising a group cared for in their own private homes ("HITH-OP") and within Residential Aged Care (Nursing Home) Facilities ("HITH-NH"). Distribution of cases to sites of care was determined by the assessing clinicians. Some elderly patients were admitted directly to GEM as the bed occupancy climbed, while patients considered unlikely to require increased supports were cared for by HITH. Of the 128 aged care residents who received COVID-related care through RMH, 47% (60/128) remained in their residential facilities and received care under HITH.

The median age of the group cared for in Acute wards was younger than those cared for in geriatric or HITH-NH (median age 63 vs 86; p<0.0001 with Kruskal-Wallis test for multiple comparisons), and older than the median age of the HITH-OP group (median age 43; p<0.0001). Similarly, both the Acute and HITH-OP group were significantly less frail and had fewer comorbidities.

For patients cared for primarily in an acute hospital setting, the median length of stay (LOS) was 6 days; longer in Wave 2 than Wave 1 (median LOS 7 vs. 4 days; p=0.02). One patient had a length of stay of 64 days, 10 patients were admitted for over 28 days and 21% (41/198) of acute hospitalisations had a duration of over 2 weeks.

Forty-seven patients were admitted to intensive care in total (24% of all acute patients), six in the first wave, 41 in the second. Of these 47 ICU patients, 28 (59.6%) required intubation, seven (14.9%) required tracheostomy and three (6.4%) required re-intubation after initial extubation. The mean age of ICU admitted patients was 55 ± 16. Nine ICU admitted patients died during their hospital admission (19%).

Respiratory failure was common; 47% (201/428) of the entire cohort required oxygen, increasing to 61% (120/198) in the acute hospital group. The median duration of oxygen requirement was 4 days, ranging to a maximum of 51 days, with 29% requiring over 7 days'

oxygen-therapy (58/201). Most patients requiring oxygen (72/120, 60%) were managed with low-flow devices (nasal prongs or Hudson mask; WHO level 4). The second most common form of delivery was endo-tracheal tube at 22.5% (27/120), followed by high-flow nasal prongs (21/120, 17.5%).

There was a difference in prescribing patterns between the first and second wave - see **Table 2**. Antibiotics were prescribed for 65% (20/31) of Wave 1 patients and 23% for Wave 2 (92/402) (Fishers exact test; p<0.0001). In the second wave, 83% (125/151) of oxygen-requiring patients received dexamethasone, with a smaller proportion also receiving remdesivir (41/151, 27%). As compared to those who did not receive dexamethasone, those given dexamethasone had a higher rate of delirium (29% vs 16%; p=0.003. Fisher's exact test), and hyperglycaemia (23% vs 5%; p<0.0001).

Half of all patients (218/433) were discharged home, to crisis accommodation, or to hotel isolation. 77 patients (18%) returned to pre-existing residential aged care facilities, and 17 (4%) were transferred to these facilities for the first time. Twenty-five patients (6%) were transferred to other hospitals for capacity reasons and 1 patient remained admitted in a sub-acute hospital setting at time of writing.

Ninety patients (21%) died during their admission, and 14 further deaths were recorded within 30 days after discharge (11 in aged care facilities, 3 at other hospitals). Overall, 30-day mortality was 24% (104/428). No deaths occurred during the first wave.

Mortality rates rose with age (median age of deceased patients 86 vs 61; p<0.0001) with 80% of recorded deaths occurring in those aged over 80, see **Figure 2**. Increased frailty (median CSF 6 in those who deceased during admission vs 1 in survivors; p<0.0001) and higher burden of comorbidity (median score 2 vs 1) were also associated with mortality. Five deaths were recorded in people below the age of 65: two were nursing home residents, one patient had advanced pulmonary fibrosis, one had pre-existing severe liver disease and one patient was receiving palliative care for metastatic malignancy prior to infection. Notably, there were no deaths in the HITH-OP group.

Discussion:

The Royal Melbourne Hospital's management of COVID positive patients demonstrates that re-organisation of existing models of care can successfully deliver care for COVID patients with minimal patient transfer. We highlighted the changing treatment strategies and demographics between the two waves of infection in Melbourne in 2020 and the dramatic disparity in outcomes resulting from these differences. That HITH services may care for both individuals in their own homes and provide support to nursing homes has the potential to reduce strain on

acute services. Similarly, switching from a sub-acute to an acute model reduces patient movement without sacrificing care.

The populations we describe varied both between waves of infection, and between sites of care. Patients admitted in wave 1 were younger, less frail and with less comorbidity, had high rates of acquisition overseas, and recorded no deaths.

There was a reduction in antibiotic usage over time, and the advent of alternate therapeutic options such as dexamethasone (8) and remdesivir (9) was observed.

Oxygen was frequently required, however most patients needed low-flow delivery (76%), with only 13% of all patients requiring intubation. Despite this, nearly a third of patients who required oxygen did so for a week or more. This, coupled with extended admissions of up to 60 days, suggest persistent effects of COVID despite optimal care delivery, as well as demonstrating the complexity of discharging patients who required ongoing isolation.

High rates of hyperglycaemia and delirium were observed in the second wave, associated with corticosteroid use. Disease and patient factors are likely contributors; even without the influence of corticosteroid use, COVID-19 has been shown to have a higher inpatient complication rate than seasonal influenza (10), especially in an older cohort (11,12). This finding highlights the complexity of caring for an older population with significant underlying frailty. Interestingly, in the preliminary report of dexamethasone use in COVID-19, mortality benefit was significant for those under, but not over 70 years(8). While this would not suggest that these therapies not be used, it does imply that any treatment plans should include specific protocols to prevent, detect and treat these complications.

Care of elderly patients requires a careful assessment of the individual's goals of care. This description highlights that many patients infected with COVID-19 were not suitable for ICU care. The involvement of geriatric care services, capacity building to enable care within nursing homes supported by HITH services, and inpatient palliative care were important parts of the RMH response in Melbourne in 2020.

The disparity between this cohort's mortality rate and those in published literature may be attributed to variation in baseline health of the studied population(13–16). In the early months of the pandemic in China, a case fatality rate in hospitalised COVID-19 patients of just 3.6%, with a median age of 41 was reported (17). The first 393 cases in New York had a median age of 62 years and reported 10% mortality (although notably 90 of the 130 intubated patients remained mechanically ventilated at the time of publication) (18). In the ACTT-1 trial of remdesivir, 36% of participants were aged over 65 years, compared to more than 50% in our cohort with a mortality of 15.2% in placebo group (9). The RECOVERY trial of dexamethasone

had a population similar to ours, with a mortality for the usual care group of 26% and the treatment group of 23%(8).

The rapid shift in models of care adopted by this hospital reflects the challenge of sustaining hospital capacity with a sudden surge in patient numbers during an outbreak and providing needs-specific care to diverse patient groups. The extensive care requirements and high complication rates detailed here highlight how quickly hospital capacity might have been exceeded if caseload had been higher. The management of mild cases in community settings allowed for admissions of selected patients, mostly those requiring oxygen and additional therapies. In addition, the substantial public health actions taken in Victoria to reduce community transmission were vital for preventing overwhelm of the acute care system, especially during the second wave of COVID-19 in Victoria.

Notably, this study is limited to a single centre, and as such details a very specific cohort. The retrospective nature of the study limits the conclusions that can be drawn, and relies on accuracy of documentation. Whilst difficult to show definitively, it is likely that early in the pandemic the threshold for admission was lower as the teams lacked local experience and capacity was not limited. As experience grew and alternate models of care developed, only the sickest patients were admitted to hospital. This is reflected in the mortality rate reported and is not representative of COVID-outcomes in the community.

Conclusions:

Cohorts such as this contribute to identifying the risk factors for severe disease, vulnerable groups and the intensity of care required. Our key findings include frequent respiratory failure requiring predominantly low-flow oxygen, high rates of hyperglycaemia and delirium likely associated with corticosteroid therapy as well as marked mortality in frail and older patients.

We have detailed two different experiences of COVID-19 in a tertiary hospital in Melbourne in 2020 – an initial small wave of mostly returned travellers, early in the global experience, and the much larger second wave with a greater proportion of older and more frail patients.

The epidemiology of COVID is rapidly changing, and the third wave in 2021 is again different with sustained community transmission among a younger population in the context of high vaccination rates in the elderly. Models of care need to be flexible, rapidly scalable and increasingly sustainable as the case load and mix changes. There will likely be an ongoing need for tertiary level care for a large case load as SARS-CoV-2 is now endemic and as public health interventions are relaxed with achievement of vaccination targets.

Importantly, we have shown that with appropriate planning, care can often be provided where the patient is, while reflecting on a wide range of outcomes and care requirements in a potentially protracted illness.

Acknowledgements

5 of the included patients have already been described by RMH ICU as part of SPRINT-SARI (19) and 106 are included in a review of COVID-19 in a geriatric population (8). 58 are included in a description of palliative care provision(20).

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Background - The COVID-19 pandemic has affected different parts of Australia in distinct ways across 2020 and 2021. In 2020, Melbourne was the epicentre of COVID-19. As one of the key tertiary centres caring for the patients affected by the outbreaks, the Royal Melbourne Hospital managed the majority of the Victorian inpatient caseload.
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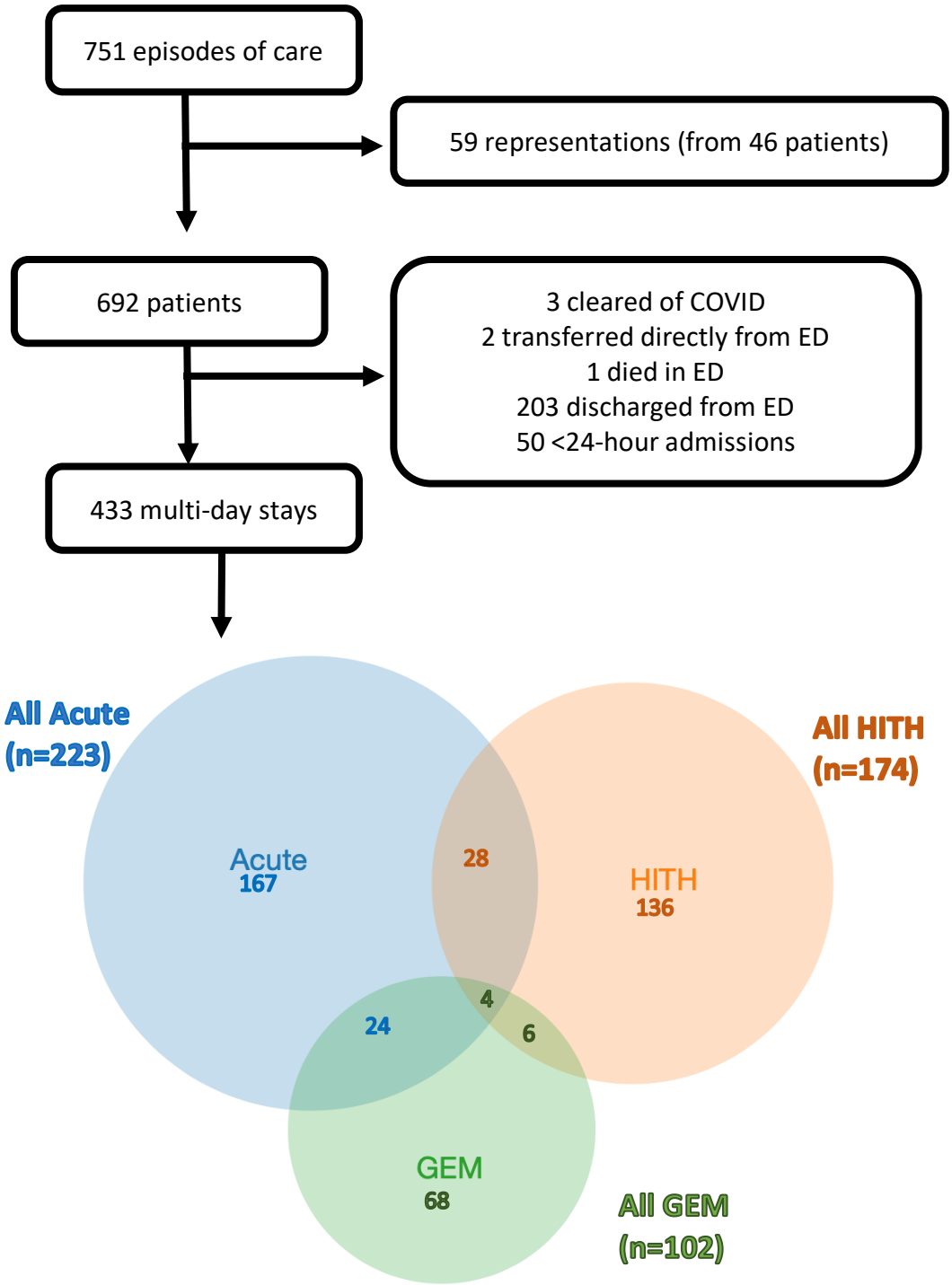

Figure 1
Included patients and locations of care (RMH 2020).
Note: All ICU admitted patients were within the "Acute" group. ED, Emergency Department; GEM, Geriatric Evaluation and Management ward; HITH, Hospital in the Home.

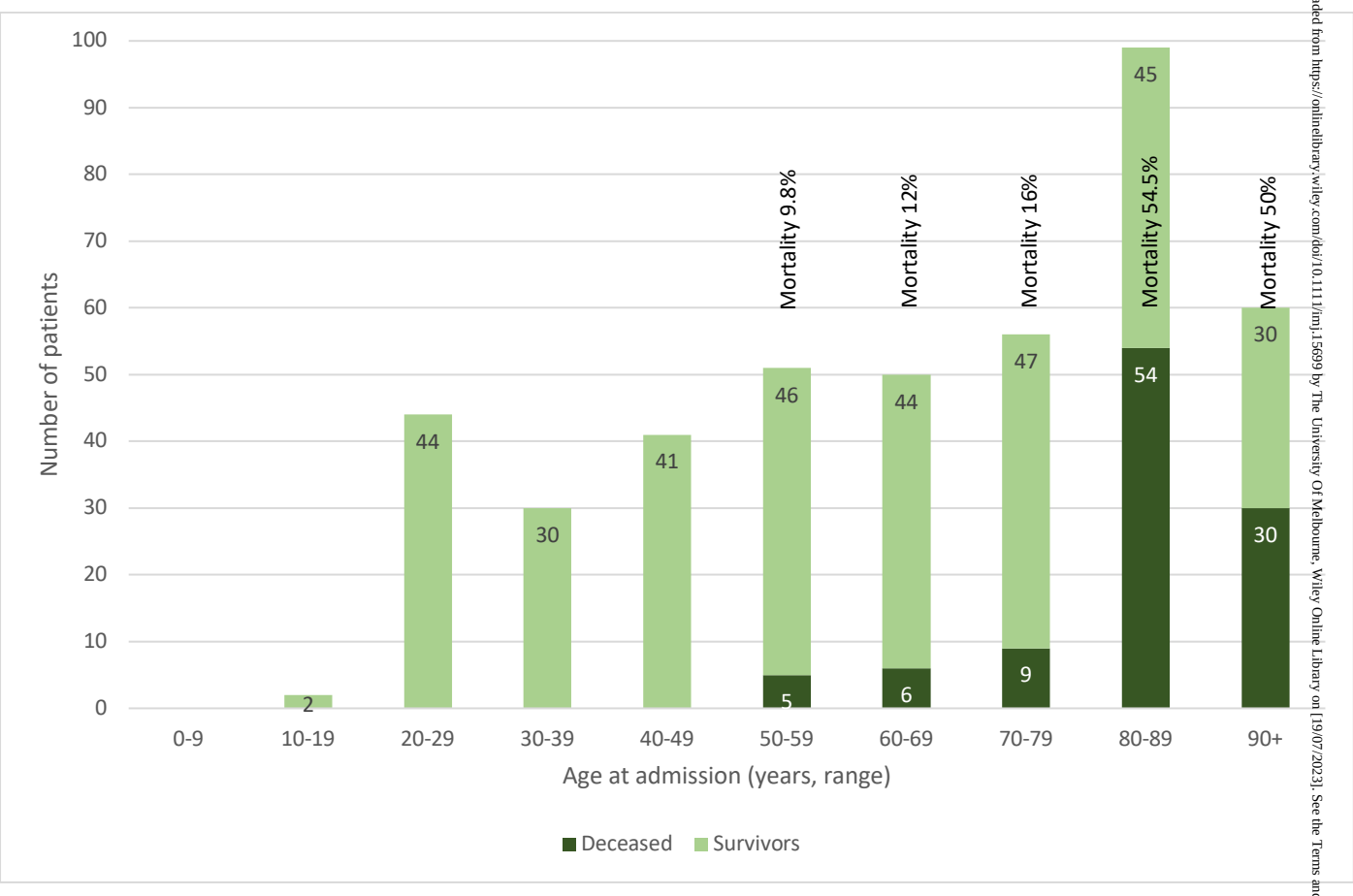

Figure 2
Mortality within 30-days by Age (decade) at Admission.

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	ALL PATIENTS	Wave 1 total	Wave 2 total	Wave 2 Acute ward	Wave 2 GEM	Wave 2 HITH-OP	Wave 2 HITH-NH
Number of patients (% of all patients)	433 (100%)	31 (7%)	402 (93%)	176 (41%)	86 (20%)	83 (19%)	59 (14%)
Female Sex (%)	254 (59%)	18 (58%)	236 (59%)	89 (51%)	51 (59%)	61 (73%)	37 (63%)
Patient Factors							
Median Age in Years (IQR)	69 (48,86)	57 (39.5,66.5)	73 (49,86)	66 (46,81)	86 (80,90)	42 (29,55)	87 (79,92)
Median Modified Charlson Comorbidity Index (IQR)	1 (0-2)	0 (0-1)	1 (0-2)	1 (0-2)	2 (2-3)	0 (0-0)	2 (1.5-3)
Median Frailty Score at admission (IQR)	3 (1-6)	1 (1-2)	4 (1-7)	2 (1-6)	7 (6-7)	1 (1-1)	6 (6-7)
Acquisition							
Overseas travel (%)	15 (3.5%)	14 (45%)	1 (0.2%)	1 (0.6%)	0	0	0
Aged Care Home Resident (%)	128 (30%)	0	128 (32%)	43 (24%)	26 (30%)	0	59 (100%)
Other source (%)	290 (67%)	17 (55%)	273 (68%)	132 (75%)	60 (70%)	83 (100%)	0

Table 1

Demographics of patients by Time (Wave 1 January –June and Wave 2 July-December) and Site of Care.

GEM, Geriatric Evaluation and Management Ward; HITH-OP, Hospital in the Home, Outpatients (private residences); HITH-NH, Hospital in the Home, Nursing Home (residents of aged care facilities).

Treatments and Outcomes	Number (%) (n=433)
Peak Oxygen requirement	
- No supplemental oxygen	230 53%
- Nasal Prongs or Hudson Mask	154 36%
- High flow nasal prongs	22 5%
- Intubation and mechanical ventilation	27 6%
Therapies:	
Dexamethasone	155 36%
Remdesivir	42 10%
Antibiotics	112 26%
Complications:	
Hyperglycaemia	46 11%
Delirium	90 21%
Outcomes:	
ICU admission	47 11%
Mortality within 30 days	104 24%
- Acute ward n=205	39 19%
- Geriatric ward n=86	37 43%
- ICU n=47	9 19%
- HITH NH n=59	27 46%
- HITH OP n=83	0
Discharge destination:	
- Home	203 47%
- Aged care home (pre-existing)	77 18%
- Aged care home (new)	17 4%
- Hotel (for isolation)	11 3%
- Crisis accommodation	4 1%
- Discharge against advice	2 0.5%
- Other hospital transfer	25 6%
- Death as inpatient	90 21%

Table 2

Interventions, treatments and outcomes – pooled data from Wave 1 and 2.

GEM, Geriatric Evaluation and Management Ward; HITH-NH, Hospital in the Home, Nursing Home (residents of aged care facilities); HITH-OP, Hospital in the Home, Outpatients (private residences).

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