Clinical Paper

Outcomes of older COVID-19 patients in Acute Care at Home, Southern HSC Trust, Northern Ireland, from March - June 2020

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ABSTRACT:

Introduction: The older population has been most affected by COVID-19, with mortality rates of around 27%. The Acute Care at Home (ACAH) team aims to improve outcomes in the older population by preventing hospital admission or facilitating early discharge, allowing patients to be treated in their own environment. During the COVID-19 pandemic, the ACAH team administered oxygen therapy, antibiotics, anticipatory medications and other vital interventions to combat the ill effects of COVID-19.

Method: An observational approach has been used in this study. Patients were included if they were admitted to ACAH during March-June 2020 for treatment of COVID-19. Biochemistry, oxygen saturations and co-morbidities are among the studied parameters. Lymphocyte count and serum magnesium were compared with a non-COVID-19 cohort. Trends within parameters and associated mortality were analysed and tabulated.

Results: 70% of admissions were lymphopenic, whilst 54% were hypoxic. There was a 28-day mortality rate of 35%, with an 18% increase in mortality rate when comparing residence in long-term care facilities (LTCF) to personal residence. All patients had existing co-morbidities.

Conclusion: The data indicates that hypoxaemia, hyperferritinaemia and hypermagnesaemia are associated with early mortality in the older population infected with COVID-19. National Early Warning Score and frailty score are predictive of mortality in this cohort, with higher scores correlating to worse outcomes. Those living in LTCF are at an increased risk of mortality. However, ACAH mortality rates are comparable to those admitted to hospital, validating the concept of ACAH. The highlighted trends can be used to improve outcomes in future admissions.

Key Words: Covid-19, older population, mortality, acute care at home, Southern HSC Trust Northern Ireland.

Introduction:

Over 2 million people worldwide have died from COVID-19 [1]. Mortality is highest among older populations, with a case fatality rate of up to 27% [2]. Older people have experienced increasing anxiety about hospital admissions and death [3]. This paper presents data and findings recorded by the Acute Care At Home (ACAH) Team in the Southern Health & Social Care Trust in Northern Ireland. It is a multidisciplinary team led by Consultant Geriatricians, treating older people in the community. Acute care is provided to patients within their own homes or within a long-term care facility (LTCF). Each patient is assessed comprehensively. Treatments include intravenous (IV) fluids, antibiotics, pain relief and home-oxygen therapy. Ultimately, ACAH aims to prevent hospital admission or facilitate early discharge from secondary care. During the first wave of the COVID-19 pandemic, data was collected on COVID-19 patients admitted to ACAH: patient demographics, alongside information about their presentation, co-morbidities, blood results and clinical outcome. This paper analyses the data collected in search of trends.

Method:

Data were collected retrospectively, for the time period of March to June 2020, using two electronic information management systems routinely used within ACAH; Northern Ireland Electronic Care Record (NIECR) and PARIS. ACAH doctors suggested certain parameters for analysis from their clinical experience. Microsoft Excel was used to collate this data and trends within the population were identified and assembled in a results sheet. Information gathered includes patient demographics, COVID-19 PCR result, place of residence, frailty score, presenting complaint, past medical history, smoking status and biochemistry results at different stages of patient care.

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Outcomes of older COVID-19 patients in Acute Care at Home,
Southern HSC Trust, Northern Ireland, from March - June 2020

163

Biochemistry results on admission included:

- Lymphocyte percentage (reference range 20-40%)
- Lymphocyte count (reference range 0.9-2.9 x10⁹/L)
- Lactate dehydrogenase (LDH) (reference range 135-214 U/L)
- Ferritin (reference range 30-400 ug/L)
- D-dimer (reference range 0-0.5 mg/L)
- Serum magnesium (reference range 0.7-1.0 mmol/L)
- Haemoglobin (reference range 115-160 g/L)
- Platelet count (reference range 150-450 x10³/mL)
- Total white cell count (reference range 4-11x10⁹/L)
- Serum albumin (reference range 35-50 g/L)
- Alanine aminotransferase (ALT) (reference range 0-33 U/L)

Estimated glomerular filtration rate (eGFR) and oxygen saturation were recorded on admission and on discharge, with the lowest result during admission also being recorded. Creatinine and C-reactive protein (CRP) were measured on admission and on discharge, with the highest result of each during admission also being recorded. If a patient had an acute kidney injury (AKI), according to the AKIN classification [4], this was also recorded. The need for supplemental oxygen, antibiotics, subcutaneous/IV fluids and palliative medications were also recorded.

Patients were counted as deceased if they died during admission or within two weeks of discharge, which was considered to be in line with the national UK practice of being within 4 weeks of a positive COVID test*.

Patients were included in the study if they met the following inclusion criteria:

1. Admitted to ACAH between 1ˢᵗ March 2020 and 30ᵗʰ June 2020 AND;
2. Positive COVID-19 PCR OR;
3. Negative COVID-19 PCR but clinically symptomatic (with fever, cough, dyspnoea or hypoxia) and treated as COVID-19*.

If a patient received multiple admissions during this time period, these were recorded as separate entries.

Data were also collected from a pre-pandemic population so comparisons of certain parameters could be made. This population encompassed ACAH patients between 1st March 2019 and 30th June 2019. It was assumed that these populations were demographically similar as the acceptance criteria to receive care from the team remained the same.

Patients consented to their NIECR and PARIS being accessed by healthcare professionals and their anonymised data being used for research purposes.

Results:

123 admissions met the inclusion criteria. Of these, 92 (74.8%) received positive COVID-19 PCR tests and 31 (25.2%) received negative COVID-19 PCR tests, but were clinically treated as COVID-19. The age range of patients was 23-98 years old, including 115 (93.5%) patients over the age of 65. 88 (71.5%) patients were permanent residents of nursing homes, 26 (21.1%) were cared for at home, 4 (3.3%) were in supported living, 3 (2.4%) were in elderly mentally infirm units and 2 (1.6%) lived in residential homes.

The 28-day mortality rate was 35%, with 45% of those living in LTCF recorded as deceased, compared to 27% of patients living in their own homes.

44 (36%) patients had three or less co-morbidities and 79 (64%) had more than three co-morbidities. 46 (37.4%) patients were current or ex-smokers and 77 (62.6%) were non-smokers.

Table 1 Common presenting complaints by percentage

Presenting complaint	Percentage of patients (%)
Low oxygen saturations	54
Decreased oral intake	46
Cough	42
Fever	35
Dyspnoea	33
Neurological symptoms	25
Lethargy	24

The most common presenting signs and symptoms are shown in Table 1. 54% of patients had low oxygen saturations, defined as saturations of <94%, with 54% of those patients requiring supplemental oxygen and only 36% of those put on supplemental oxygen having returned to their normal levels on discharge. Less common reasons for referral included hypotension, decreased mobility and agitation, with only 2.5% of patients describing a loss of taste and smell (ageusia and anosmia) on admission.

The biochemistry results of the patients on admission to ACAH are recorded in Table 2 . Notably, 70% of patients had below the normal range of percentage lymphocytes, while 37% were below the normal range of absolute lymphocyte count and were therefore lymphopenic. Furthermore, 63% of patients had a raised CRP beyond the normal range. Also, 33% had a raised ferritin level and 66% had a raised D-dimer. Haemoglobin was low in 40% of patients and albumin had dropped below normal in 20% of patients.

Furthermore, 44.7% of patients required subcutaneous fluids, while 15.4% required IV fluids. 72.3% required antibiotics during their admission to ACAH. Ceftriaxone was the most common antibiotic prescribed, with 43.1% of all patients receiving ceftriaxone only, while 11.3% received a combination. 45.5% of patients were prescribed palliative/anticipatory medication.

Table 2 Biochemistry results on admission of COVID-19 cohort

Test	Reference Range	Range of abnormal results	Low	Normal	High	Not recorded
Total White Cell Count	4-11 x10^9/L	L: 2.9-3.8 H: 11.3-37	6 (4.9%)	85 (69.1%)	26 (21.1%)	6 (4.9%)
Percentage Lymphocytes	20-40%	L: 1.8-19.8 H: 40.3-56.1	86 (69.9%)	31 (25.2%)	2 (1.6%)	4 (3.3%)
Absolute Lymphocyte Count	0.9-2.9 x10^9/L	L: 0.18-0.89 H: 4.09	45 (36.6%)	73 (59.3%)	1 (0.8%)	4 (3.3%)
CRP	0-30 mg/L	32.27 - 450.13	N/A	42 (34.1%)	77 (62.6%)	4 (3.3%)
Ferritin	30-400 ng/mL	420.1 - 6747	2 (1.6%)	67 (54.5%)	41 (33.3%)	13 (10.6%)
D-dimer	0 – 0.5 mg/L	0.52 – 16.82	N/A	11 (8.9%)	81 (65.9%)	31 (25.2%)
Serum Magnesium	0.7-1.0 mmol/L	H: 1.01 - 1.72 L: 0.53 – 0.67	9 (7.3%)	74 (60.2%)	18 (14.6%)	22 (17.9%)
Haemoglobin	Females: 115-160g/L Males: 130-180g/L	H: 168 (F) L: 56-127 (M), 87-114 (F)	50 (40.6%)	66 (53.7%)	1 (0.8%)	6 (4.9%)
Platelets	150-450 x 10^9/L	H: 453-630 L: 74-149	14 (11.4%)	95 (77.2%)	8 (6.5%)	6 (4.6%)
Albumin	35-50 g/L	L: 9-34	25 (20.3%)	88 (71.5%)	0 (0%)	10 (8.2%)
ALT	M: <50 U/L F: <35 U/L	H: 42-333	0 (0%)	84 (68.3%)	18 (14.6%)	21 (17.1%)

For certain biochemistry results, comparisons were made between the COVID-19 cohort and a non-COVID-19 cohort from 2019. When studying lymphocytes, 37% of those with COVID-19 were lymphopenic, compared to 28% of those without COVID-19. In regards to serum magnesium, more patients in the ACAH COVID-19 population had high magnesium (16.0%) than in the ACAH non-COVID-19 population (5%). Furthermore, 29% of COVID-19 patients who were recorded as deceased had hypermagnesaemia, compared to only 6% who survived.

Table 3 presents the percentage of patients deceased by the end of the study and their corresponding National Early Warning Score (NEWS) on admission to ACAH. Generally, as the score increases, the greater the percentage of patients deceased. 100% of patients admitted with a score of 12 or above had died by the end of the study period. NEWS of 7 confers an uncharacteristically low mortality rate of 11% due to the low number of patients with this score.

Table 4 represents the percentage of the deceased population who had abnormal biochemistry and oxygen saturations. Notably, 65% of the deceased population had low oxygen saturations, 63% had a low eGFR and 53% had a high creatinine.

Furthermore, the distribution of D-dimer results within the ACAH patient cohort is seen in Figure 1 (reference range

Outcomes of older COVID-19 patients in Acute Care at Home,
Southern HSC Trust, Northern Ireland, from March - June 2020

165

Table 3 NEWS on admission and the corresponding mortality rate

NEWS	Mortality rate
1	9%
2-3	34%
4-6	52%
7	11%
8-10	64%
>10	100%

Table 4 Percentage of deceased population and abnormal parameter

Abnormal parameter	% of deceased population
Raised ferritin	47
Low oxygen saturations	65
Lymphopenia	43
D-dimer <0.5mg/L	27
D-dimer >2 mg/L	46
Low eGFR	63
High creatinine	53
Hypermagnesaemia	29

0-0.5mg/L). The 28 day mortality rate of the patients with a D-dimer >0.5 mg/L was 27% (23/85). However, there is a stark rise in mortality rate when D-dimer rises above 2 mg/L, with 45.8% of patients being recorded as deceased.

Clinical Frailty Score is a graded scale from 1 to 9 which can categorise patients from very fit, 1, to terminally ill, 9. Frailty is defined by the World Health organisation as "a progressive age-related decline of body functions resulting in vulnerability and reduced resilience to physical and mental stressors with an increased risk of negative health outcome"[5]. This study found that 47.6% of people who had a clinical frailty score of greater than or equal to 7 were deceased, compared to 25% of those who had a frailty score of less than 7.

Discussion:

The findings have demonstrated many trends in the presentation of COVID-19 within ACAH patients. 64% of patients had more than three co-morbidities, with 100% having at least one. This indicates that having co-morbidities increases the likelihood of requiring medical admission when infected with COVID-19. A 2020 study by Ejaz et al concluded that the presence of co-morbidities, particularly COPD, hypertension, diabetes and heart disease, is linked to more severe symptoms and a higher mortality rate due to COVID-19, when compared to their counterparts without co-morbidities[6].

On analysis of ferritin levels, it was discovered that 47% of the deceased patients had an abnormally high ferritin level. Another study by Cheng et al, 2020, concluded that ferritin levels were significantly increased in more severe COVID-19 patients when compared with non-severe COVID-19 patients [7]. Furthermore, it has been shown that those with at least one co-morbidity, of which 100% of the patients in this study had, are more likely to have a high ferritin level. Consequently, these patients are more likely to have clinically severe COVID-19 [7].

45% of those living in LTCF were recorded as deceased, which is quite disproportionate compared to 27% of those living in their own homes within the same time period. Research conducted by The European Centre for Disease Prevention and Control (ECDC), published in June 2020, revealed that LTCF across Europe, including the UK, were home to 31-66% of all COVID-19 related deaths, with the average in Scotland being 46% [8]. As the ages and co-morbidities of patients living at home are comparable to those in LTCF, this could indicate that there are higher mortality rates when
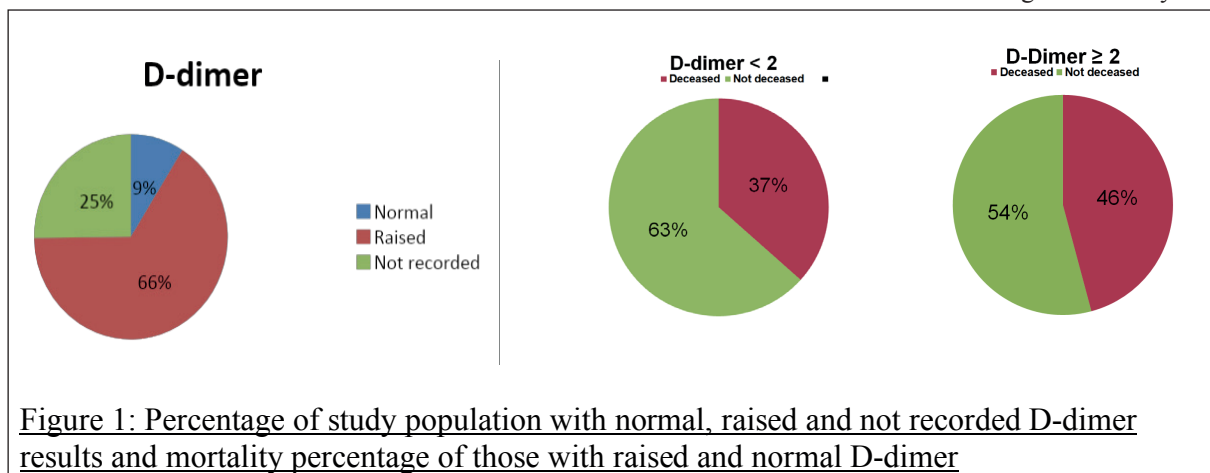

Figure 1: Percentage of study population with normal, raised and not recorded D-dimer results and mortality percentage of those with raised and normal D-dimer

living in a LTCF, compared with at home, when infected with COVID-19. There may be many different reasons for this, such as LTCF staff not being appropriately trained in infection control measures, a greater number of people coming in and out of LTCF, resulting in greater infection risk, and a lack of personal-protective equipment (PPE).

Furthermore, 65.3% of those who were recorded as deceased had low oxygen saturations (<94%). It has previously been discovered that hypoxaemia is independently associated with higher mortality when infected with COVID-19 [9]. Supporting this, a 2020 paper by Mejía et al discovered that an oxygen saturation below 90% on admission is a strong indicator for mortality in patients with COVID-19 [10]. These findings suggest that hypoxaemia may be a reliable indicator of mortality in COVID patients.

Moreover, 43% of deceased patients were lymphopenic. This may be due to the COVID-19 virus directly targeting lymphocytes or lymphatic organs, but many reasons are possible. However, it has been concluded that lymphopenia is a reliable indicator into the severity of COVID-19 within hospitalised patients [11]. 28% of patients admitted to ACAH for reasons other than COVID-19 were lymphopenic compared to 37% of those admitted with COVID-19 in the same time period.

64% of patients who had a NEWS of 8-10 on admission were deceased by the end of the study. This rose to 100% when filtered to a score of greater than 10. This strongly indicates that the NEWS is a reliable prognostic indicator for deterioration of COVID-19 patients. Several other studies have gathered similar conclusions, which would encourage early interventions to resolve the affected parameters, in an effort to prevent fatal outcomes [12].

When looking at the incidence of ageusia or anosmia within this population, it was discovered that 97.5% of people had an intact sense of taste or smell on admission. This contradicts the findings of other studies such as the 2020 paper by Lee et al which found that 15.3% of people had either anosmia or ageusia in a population of 3,191 [13]. It has been shown that these symptoms are beneficial when diagnosing COVID-19, especially at earlier stages of the disease [13]. Perhaps, in an older cohort with COVID-19 anosmia and ageusia are less common. However, the reduced incidence in this cohort could be due to under-reporting as many patients had a history of dementia or presented with delirium and may have been unable to alert staff of these symptoms.

It has been widely reported that coagulopathy is common in critically ill patients with COVID-19 and associated with cardiovascular events and poor outcomes [14]. Raised D-dimer values (>2 mg/L) have an associated increased mortality where P=0.041 as shown in a study by Yao et al, which supports the results of this study, where 45.8% of those with a D-dimer >2 mg/L were deceased, compared to 27% of those with a D-dimer >0.5 mg/L [15]. This suggests there is an association with mortality and D-dimers above 2 mg/L.

Moreover, when incorporating clinical frailty scores, there is a 22.6% increase in mortality rate in clinical frailty scores of greater than or equal to 7, compared to those less than 7. This would indicate that an increased frailty score is associated with a higher mortality in patients with COVID-19, as reported by Hägg et al, suggesting that frailty scores can help to identify those at risk of mortality, in order to prevent adverse outcomes [5]. However, a systematic review conducted by Cosco et al, 2020, included 2 studies out of 26 in which mortality was disproportionately high in the fitter population and less severe than expected in frail groups [16]. This suggests that caution should be exercised when applying prognostic significance to frailty scores alone, in the context of older people with COVID-19 [16].

63.3% of those who were deceased at the end of the study had a low eGFR and 53.1% had a high creatinine. This is similar to findings in other studies such as the 2020 study by Cheng et al. which found that deterioration was more likely in those who had kidney disease [17]. Elevated serum creatinine was also an indicator for admission to the intensive care unit. Overall, reduced kidney function was associated with an increased risk of death. Therefore, it is important to monitor those with altered kidney function in order for early intervention to take place and improve outcomes [17].

The majority of ACAH patients infected with COVID-19 had a normal magnesium level. 16% of patients with COVID-19 had hypermagnesaemia, compared to 5% within the non-COVID-19 comparison group. A study of 65,974 hospitalised patients in 2015 found that high magnesium was associated with respiratory disease, which supports the findings of this paper [18]. This is thought to be due to the anti-inflammatory, immunomodulation and airway relaxation properties of magnesium, therefore the body reactively increases magnesium levels to reduce inflammation, suggesting it is a response to severe infection rather than a cause of severe disease [18]. This may be particularly relevant in the 'cytokine storm' seen in Covid-19 infection. For example, a study by Tan et al found that significantly fewer Covid-19 patients required supplemental oxygen therapy when treated with magnesium, as magnesium is thought to relax the airway [11]. Furthermore, a higher proportion of ACAH COVID-19 patients who were deceased by the end of this study had hypermagnesaemia when compared to those who survived. Cheungpasitporn et al also found that hypermagnesaemia carries a comparatively worse prognosis when compared with hypomagnesaemia, as magnesium seems to rise in more severe COVID-19 [18]. All of this information suggests that hypermagnesemia may be seen as a response to more severe infection rather than hypermagnesaemia causing respiratory distress.

Conclusion:

In conclusion, trends within the ACAH COVID-19 population are largely supported by other literature. Hypoxaemia is an early indicator of mortality, as is high ferritin and high magnesium. NEWS score is an effective early warning

Outcomes of older COVID-19 patients in Acute Care at Home,
Southern HSC Trust, Northern Ireland, from March - June 2020

167

indicator and a higher score on admission is associated with an increased mortality rate. Perhaps increased intervention in those patients with higher NEWS scores can improve outcomes. A positive correlation was found between higher frailty score and increased risk of mortality, indicating early recognition of a higher/increasing frailty score could allow for intervention in order to help improve patient outcomes. Regular COVID-19 testing of patients and staff in LTCFs, correct use of PPE and review of its availability could also help mitigate the risk within this vulnerable group. Furthermore, COVID-19 positive patients in LTCFs were remotely monitored for deterioration by the ACAH team, which allowed for early intervention. This likely resulted in improved outcomes, which has also been recommended in published literature[19].

The results of this study validate the concept of ACAH. Despite ACAH treating patients who were on average older and who had a higher frailty score, the mortality rate was only 2% higher than that in UK hospitals during a similar time period[20]. Whilst being similarly effective as hospital admission, ACAH allowed these patients to remain in their own home with their families or normal caregivers, mitigating the risk of hospital admission in older people. At a time when patients were often unable to have visitors, this is an important factor to consider. Many of the patients cared for were, by their own decision, not for transfer to hospital. This meant that ACAH was their only way to access acute medical care and prevent early and potentially unnecessary palliation in some cases, proving the value of the service, especially throughout the ongoing challenges of COVID-19.

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