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RESEARCH ARTICLE

Malaysia's Geriatric Acute Medical Take for COVID-19: An Observational Retrospective Cross-Sectional Analysis on Older Persons with COVID-19 and the Factors Associated with Adverse Outcomes and Survival

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Abstract

Background: Malaysia is one of the countries hardest hit in the Asia Pacific region by the coronavirus disease (COVID-19) with harmful implications. As part of the contingency plan for the COVID-19 pandemic, a geriatric acute medical take was established in the Cheras Rehabilitation Hospital for the isolation, admission and management of older adults with COVID-19 from the greater Kuala Lumpur area. This unique 150 bedded facility was the first in Malaysia and remains the very few in the region to exclusively manage and provide holistic care to older adults with COVID-19. Focused Comprehensive Geriatric Assessment (CGA) and geriatric management principles were essential in the review and treatment plan of patients.

Objectives: To determine the clinical characteristics of patients admitted to the geriatric acute medical take for COVID-19.

To review the factors associated with severe illness; COVID-19 Category 4 or 5.

To evaluate the factors associated with 30-day all-cause mortality.

To assess the factors associated with 6-month survival.

Methods: All older adults age 65 years and above admitted for COVID-19 from January till November 2021 were included in this retrospective cross-sectional analysis. Variables for vulnerability namely the oldest old age group (age ≥ 80 years), cognitive impairment (4AT score ≥ 4), severe functional impairment (Katz Index ≤ 2), frailty with dependence (Clinical Frailty Scale ≥ 5), multiple co-morbidities (Charlson Comorbidity Index ≥ 3) and NHS COVID-19 Decision Support Tool (points ≥ 9) were tested for association with severe COVID-19 disease (Category 4 or 5) and 30-day all-cause mortality with Odds Ratio (OR) and its corresponding p values reported. Any statistically significant factors were then tested with multiple logistic regression. The Kaplan-Meier curve was used for survival analysis in patients who had 6-month survival with the destination of the discharge as the influencing factor with the Log-rank comparative statistic test.

Results: 943 patients were included in the study. Patients' mean age was 76.4 years (standard deviation [SD]:6.7) with significant co-morbidities being hypertension (69.7%), diabetes mellitus (46.4%) and ischemic heart disease (13.8%).The majority of patients (90.5%) were community-dwellers and 15.9% of them were diagnosed with severe COVID-19 pneumonia. Multivariate analysis performed with logistic regression confirmed age ≥ 80 years (OR 1.60, p-value 0.019) as the factor for vulnerability associated with severe COVID-19 clinical stage. The male gender (OR 2.50, p-value 0.019), severe functional impairment (OR 3.43, p-value 0.015), and severe COVID-19 clinical stage

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(OR 3.74, p-value < 0.001) were the factors for vulnerability associated with 30-day all-cause mortality from multivariate analysis with logistic regression. Discharge to a rehabilitation centre showed the best median survival time of 14 days of hospital stay (Standard Error [SE] 0.11, 95% Confidence Interval [CI] 10.88-17.12).

Conclusion: This study has shown that advanced age ≥ 80 years, male gender, severe functional impairment, and severe COVID-19 clinical stage were associated with adverse outcomes and 30-day all-cause mortality. Geriatric rehabilitation has proven to improve survival. The focused CGA and geriatric management principles which were incorporated in the review and management of patients have successfully identified vulnerable patients for rehabilitation and improved their outcomes and survival. Further analysis is required to compare the outcomes of this study with a centre without focused geriatric care.

Keywords

COVID-19, Older adults, Acute medical take, Geriatric medicine, Rehabilitation

Abbreviations

COVID-19: Coronavirus Disease; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2; CGA: Comprehensive Geriatric Assessment; CFS: Clinical Frailty Scale; NMRR: National Medical Research Register; RT-PCR: Reverse Transcriptase Polymerase Chain Reaction; RTK: Rapid Test Kit; CCI: Charleston Comorbidity Index; MEAG: Moral and Ethical Advisory Group; ICU: Intensive Care Unit

Introduction

The coronavirus disease (COVID-19) is an infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS CoV-2). Most patients with COVID-19 present with respiratory symptoms of cough, runny nose, sore throat, shortness of breath, and fever. A confirmed case of COVID-19 is defined as a person with a positive Nucleic Acid Amplification Test (NAAT); RT-PCR, Rapid Molecular, and Gene X-pert; a person with a positive SARS-CoV-2 RTK-Ag and meeting either the probable case definition or suspected criteria; or an asymptomatic person with a positive SARS-CoV-2 RTK-Ag and who is a contact of a probable or confirmed case [1].

Malaysia is one of the countries hardest hit in the Asia Pacific region with harmful implications to the economy and the healthcare system [2]. The older persons or geriatric population is defined as those aged 65 years and above. As a rapidly aging nation, Malaysia has 7% or more of the total population age 65 and above; reaching 14% by the year 2044 to become an aged nation. By the year 2056, the country will become super-aged with the share reaching 20% [3].

Older persons with COVID-19 are more vulnerable to higher mortality especially those with comorbidities such as diabetes mellitus, hypertension, cardiovascular disease, renal disease, and chronic respiratory disease [4]. The mortality caused by COVID-19 is substantially higher in those aged 65 years and above with the oldest old (aged 80 years and above) having the highest number of deaths per 100,000 people. In October 2021 when the COVID-19 vaccination was just introduced, the mortality rate for those unvaccinated aged 65 to 79 years was 52.03 and those unvaccinated aged 80 years and above were 72.26. By December 2022 when most people in the population have been vaccinated with bivalent booster, the mortality rate was 0.68 for those aged 65 to 79 years and 4.18 for those aged 80 years and above [5,6]. Older adults tend to have more co-morbidities and could have "geriatric giants" of cognitive impairment, incontinence, immobility, iatrogenesis, malnutrition, and postural instability. These giants need to be addressed during admission to prevent adverse clinical outcomes and prolonged hospitalization which may further strain the limited healthcare resources during the pandemic.

As part of the contingency plan for the COVID-19 pandemic, a geriatric acute medical take was established in the Cheras Rehabilitation Hospital for the isolation, admission, and management of acutely ill older persons with COVID-19 from the greater Kuala Lumpur area which include the Federal Territories of Kuala Lumpur and Putrajaya, and the state of Selangor; catering to a population of close to 7 million people. This unique 150 bedded facility is the first in Malaysia and remains the very few in the region to exclusively manage and provide holistic care to older persons with COVID-19.

Patients were quarantined and treated according to the local health guidelines with patients in Category 4 and above requiring any form of oxygen therapy provided with corticosteroids [6]. Patients with poor prognoses were provided palliative or end-of-life care within the vicinity with constant updates to the next of kin. Patients who required intensive care or any form of mechanical ventilation were referred to tertiary centres namely Kuala Lumpur General Hospital or Sungai Buloh Hospital.

In addition to the standard protocol of care, geriatric-specific parameters namely screening for delirium or cognitive impairment, baseline physical function, degree of frailty, the burden of co-morbidities, and polypharmacy were assessed during admission. The patients who were found to be more vulnerable based on the geriatric-specific assessments were treated holistically with the involvement of the interdisciplinary group of geriatric-trained doctors, nurses, nutritionists, physiotherapists, and occupational therapists to address the geriatric-related issues to prevent adverse clinical outcomes. After the quarantine period, each patient was provided with a detailed discharge plan. Those evaluated as having unresolved geriatric issues were transferred to the geriatric rehabilitation wards of Cheras Rehabilitation Hospital or Kuala Lumpur General Hospital for further rehabilitation and recuperation. This arrangement provided a clear step-down pathway

and continuation of care for the patients to recover to the best of their potential before discharge.

This cross-sectional study aims to provide insight into the patient's clinical characteristics and geriatric-related adverse outcomes in Malaysia's first and exclusive geriatric centre for COVID-19 [7]. The data from this study could provide awareness of issues related to older persons with COVID-19 and be the foundation for further programmes or studies for the management of acutely ill older persons in a quarantine facility.

Objectives

To determine the clinical characteristics of patients admitted to the geriatric acute medical take for COVID-19.

To review the factors associated with severe illness; COVID-19 Category 4 or 5.

To evaluate the factors associated with 30-day all-cause mortality.

To assess the factors associated with 6-month survival.

Methodology

This is a cross-sectional retrospective observational analysis.

Patients aged 65 years and above with a confirmed diagnosis of COVID-19 were included in the study. All patients had their demographics documented and were evaluated for physical symptoms and signs of COVID-19 on admission. The severity of the disease (COVID-19 clinical stage) was recorded. As part of the focused Comprehensive Geriatric Assessment (CGA), they were also assessed for the geriatric-specific parameters of cognitive impairment/delirium (4AT score), baseline function (Katz Index), frailty (CFS-Clinical Frailty Scale), comorbidities (Charlson Comorbidity Index), and polypharmacy (5 medications or more). Patients were also evaluated with the COVID-19 Decision Support Tool. The geriatric-specific parameters were assessed and recorded on admission. Destination on discharge was also documented. All clinical and geriatric-specific parameters were evaluated by trained medical officers/ geriatric specialty physicians, supervised by the consultant geriatrician(s), and recorded in the medical notes. 30-day all-cause mortality was obtained from the death registry. Data for the study were retrospectively retrieved from the medical records and mortality data from the National Death Registry.

This study is registered on the National Medical Research Register (NMRR ID-22-01277-IHU [IIR]) and has ethical approval from the Medical Research and Ethics Committee of the Ministry of Health Malaysia (Date of Approval 3 August 2022).

Study population

Older adults who were admitted to the geriatric acute medical COVID wards of Cheras Rehabilitation Hospital from January 2021 to November 2021.

Inclusion criteria: Patients who were 65 years and above with a diagnosis of COVID-19 were diagnosed via the Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) test which detects the presence of SARS-CoV-2 Deoxyribonucleic Acid (DNA) or Rapid Test Kit (RTK) which detects the antigen of SARS-CoV-2.

Exclusion criteria: Patients with incomplete medical records and who were less than 65 years admitted with COVID-19 as the caregiver for an older patient were excluded.

Data collection

Demographics: The patient's age, gender, ethnicity, and source of referral (either from the clinic, quarantine centre, or other hospitals) were recorded.

Geriatric-related assessments

Patients included in the study were evaluated on admission for:

a) **Cognitive impairment/delirium:** With the *4AT assessment tool*; a rapid 4-item assessment test with a score of 1-3 signifying possible cognitive impairment, a score of 4 and above signifying delirium [8]

b) **Baseline function:** With the *Katz Index of Independence in Activities of Daily Living*; a 6-item assessment on basic activities of daily living, with a high score of 6 signifying the patient as independent and a low score of 0 signifies the patient as very dependent [9]

c) **Frailty:** With the *Clinical Frailty Scale (CFS);* description of the patient's level of frailty with CFS 1 being Very Fit, CFS 8 Very Severely Frail, and CFS 9 being Terminally Ill [10].

d) **Co-morbidities:** With the *Charleston Comorbidity Index (CCI);* a validated and widely used tool to predict 10-year survival in patients with multiple comorbidities with higher scores indicating poorer survival [11].

e) **Polypharmacy:** Is defined as the current intake of 5 or more medications [12].

f) **COVID-19 decision support tool:** Developed by the United Kingdom's Moral and Ethical Advisory Group (MEAG) in conjunction with the Intensive Care Society, proposed a scoring system incorporating age, frailty, and co-morbidities during the first wave of the pandemic in 2020 to triage patients because of limited healthcare resources. Patients with 8 points or fewer were prioritized for Intensive Care Unit (ICU) admission; those with more than 8 points were directed to care outside an ICU setting, and in the limiting

case offered only palliative interventions. Points were allocated in part based on age (with older patients given more points), co-morbidity, gender (women were given a one-point 'discount'), and frailty based on the CFS. The rationale of the tool was to direct ICU treatment towards those who, based on the emerging epidemiological data about mortality rates, were most likely to survive in a COVID ICU setting. Older, frailer, ill, or male patients showed lower survival rates in such resource-limited settings [13].

Factors for vulnerability: For the study, the presence of delirium/cognitive impairment (4AT ≥ 4) [8]; severe functional impairment (Katz Index ≤ 2) [9]; frailty with dependence (CFS ≥ 5) [10]; multiple co-morbidities (CCI ≥ 3) [11]; polypharmacy (≥ 5 medications) [12]; and COVID-19 Decision Support Tool Score ≥ 9 [13]; age ≥ 80 years [14-16]; male gender [15,16]; were considered as factors for vulnerability.

Clinical features of COVID-19

The following clinical parameters of COVID-19 were documented:

(a) Clinical symptoms on presentation

(b) Clinical staging of COVID-19 [1]:

Clinical stage	Clinical features
1	Asymptomatic
2	Symptomatic, No pneumonia
3	Symptomatic, Pneumonia
4	Symptomatic, Pneumonia, requiring supplemental oxygen
5	Critically ill with multiorgan involvement

***As COVID-19 is a dynamic disease with varying clinical stages during the course of illness, the most severe COVID-19 clinical stage recorded during hospital stay was considered for data analysis.*

(c) Severe COVID-19 is defined as clinical stage 4 or 5

Length of stay: Defined as inpatient days from the day of admission till the day of discharge, demise, or transfer out to another health facility.

Destination on discharge: The destination upon discharge from the study site after the quarantine period.

30-day all-cause mortality: Defined as any mortality within 30 days from the day of admission.

6-month survival: Patients who are still alive after 6 months from the admission date.

Statistical analysis

Descriptive data were expressed as mean ± standard deviation (SD). Univariate logistic regression was performed on the factors for vulnerability associated with severe COVID-19 and 30-day all-cause mortality with Odds Ratio (OR) and its corresponding p values reported. Any statistically significant factors were then tested with multiple logistic regression. The Kaplan-Meier curve was used for survival analysis in patients who had 6-month survival with the destination of the discharge as the influencing factor with the Log-rank comparative statistic test. Data analysis was done using IBM SPSS Software version 27. A value of $p < 0.05$ was considered statistically significant.

Results

A total of 1057 patients were recorded during the study period from January 2021 to November 2021. Among them, 943 were included in the study according to the eligibility criteria.

The patients' mean age was 76.41 (SD 6.65). There were slightly more females (59.7%). The majority of patients (90.5%) were community-dwelling and 98.4% were directly admitted from the primary care assessment centres of the District Health Office (Table 1).

The mean length of stay was 6.99 days (SD 3.26) with the mean Katz Index of 5.29 (SD 1.71), CFS 4.32 (SD 1.26), CCI 4.14 (SD 1.31), 4-AT 0.87 (SD 1.60) and COVID-19 Decision Support Tool score of 11.1 (SD 3.34) respectively. Majority of the patients (61.2%) do not have polypharmacy (Table 1).

Hypertension (69.7%), diabetes mellitus (46.4%), and ischemic heart disease (13.8%) were the more common comorbidities (Table 2).

Most patients presented with symptoms of cough (52.3%), fever (36.7%), runny nose (17.9%), sore throat (10.4%), and lethargy (9.4%) (Table 3).

The majority of the patients (45.8%) had COVID-19 clinical stage 3. 38.3% of them had a mild illness (Stage 1 or 2) while the remainder 15.9% had severe COVID-19 (stage 4 or 5) (Table 4).

After the quarantine period, most patients (86.7%) were discharged home and 8.0% to a nursing home. 2.7% of them died during their hospital stay. 1.3% of them were transferred out to tertiary centres for intensive care and the other 1.3% were provided with further inpatient rehabilitation. Not all patients returned to their previous place of residence after the quarantine period. Most patients (93.9%) admitted from home were discharged back. 1.3% were discharged to nursing home and stepped down to the rehabilitation ward respectively. 1.4% required transfer to the tertiary centre for intensive care and the remaining 2.1% died during hospital stay. For those admitted from nursing home, most (69.9%) were discharged back to nursing home. 21.5% were discharged home, 7.5% died in

Table 1: Demographics and geriatric-specific parameters of patients.

	Mean	Standard Deviation	Minimum	Maximum
Age (years)	76.41	6.65	65	104
Length of Stay (days)	6.99	3.26	0	32
Katz	5.29	1.71	0	6
CFS	4.32	1.26	2	9
CCI	4.14	1.31	1	10
4AT	0.87	1.60	0	12
COVID-19 Decision Support Tool	11.1	3.34	4	26

Gender	Male	Female		
	380 (40.3%)	563 (59.7%)		
Ethnicity	Malay	Chinese	Indian	Others
	508 (53.9%)	316 (33.5%)	112 (11.9%)	7 (0.7%)
Place of residence before admission	Home	Nursing Home		
	850 (90.1%)	93 (9.9%)		
Source of referral	District Health Office (Community)	Other hospitals		
	98.4%	1.6%		
Polypharmacy	Yes	No		
	38.8%	61.2%		

Table 2: Comorbidities of patients.

Comorbidities	Frequency (%)
Hypertension	657 (69.7)
Diabetes Mellitus	438 (46.4)
Ischemic Heart Disease	130 (13.8)
Heart Failure	16 (1.7)
Bronchial Asthma	27 (2.9)
Chronic Lung Disease	19 (2.0)
Chronic Kidney Disease	32 (3.4)
Liver Disease	3 (0.3)
Stroke/Transient Ischemic Attack	63 (6.7)
Dementia	36 (3.8)
Infectious Diseases Including HIV/ Viral Hepatitis	1 (0.1)
Osteoporosis	12 (1.3)

Table 3: Presenting symptoms to the geriatric COVID-19 ward.

Presenting symptoms	Frequency (%)
Cough	493 (52.3)
Fever	365 (36.7)
Runny nose	169 (17.9)
Sore throat	98 (10.4)
Lethargy	89 (9.4)
Anosmia	67 (7.1)
Diarrhoea	67 (7.1)
Anorexia	55 (5.8)
Dyspnoea	42 (4.5)
Vomiting	27 (2.9)

Table 4: COVID-19 clinical stage recorded during hospital stay.

Clinical Stage of COVID-19	Frequency (%)
1	96 (10.2)
2	265 (28.1)
3	432 (45.8%)
4	144 (15.3%)
5	6 (0.6%)

hospital, and the remaining 1.1% went for rehabilitation (Figure 1 and Table 5).

Age ≥ 80 years (OR 1.96, p-value < 0.001), severe functional impairment (Katz Index ≤ 2) (OR 1.83, p-value 0.0016), frailty with dependence (CFS ≥ 5) (OR 1.71 p-value 0.003) and high COVID-19 Decision Support Tool Score (OR 1.96, p-value 0.012) were associated with severe COVID-19 clinical stage in the univariate analysis. Multivariate analysis performed with logistic regression confirmed only age ≥ 80 years (OR 1.60, p-value 0.019) as the factor for vulnerability associated with severe COVID-19 clinical stage (Table 6).

39 (4.1%) patients died within 30 days of admission whereas 884 (93.7%) were still alive within 6 months of admission (Figure 2). 6.1% of male patients, 11.0% of patients with severe functional impairment (Katz Index ≤ 2), and 12.7% of patients with severe COVID-19 pneumonia (Stage 4 or 5) died within 30 days of admission (Table 7).

There was a strong association of the male gender (OR 2.20, p-value 0.015), age ≥ 80 years (OR 2.78, p-value 0.001), severe functional impairment (OR 3.66, p-value <

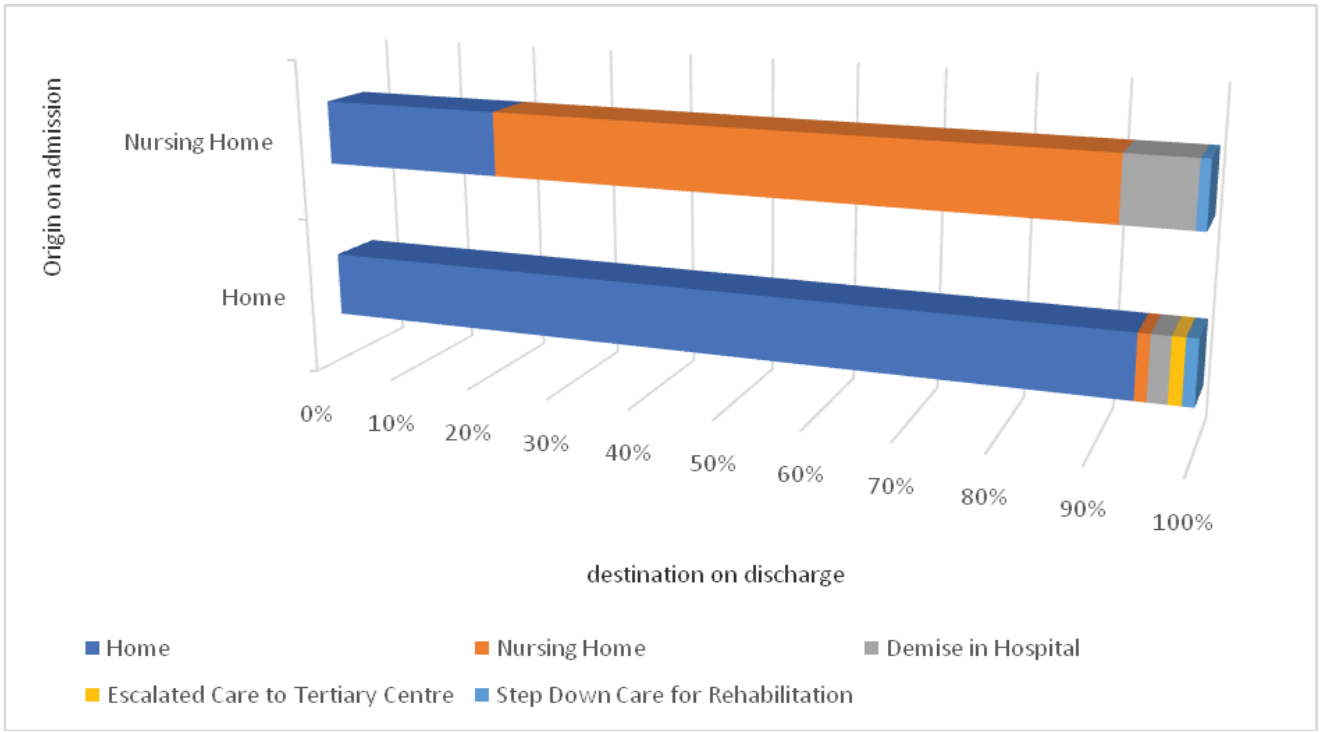

Figure 1: Patients' origin on admission and destination on discharge.

Table 5: Patient's origin on admission and destination on discharge.

		Destination on Discharge					
		Home	**Nursing Home**	**Demise in Hospital**	**Escalated Care to Tertiary Centre**	**Step Down Care for Rehabilitation**	**Total**
Origin on Admission	Home	798 (93.9%)	11 (1.3%)	18 (2.1%)	12 (1.4%)	11 (1.3%)	850
	Nursing Home	20 (21.5%)	65 (69.9%)	7 (7.5%)	0 (0%)	1 (1.1%)	93
Total		818 (86.7%)	76 (8.0%)	25 (2.7%)	12 (1.3%)	12 (1.3%)	943

Table 6: Univariate and multivariate analysis of factors for vulnerability associated with severe COVID-19 (Stage 4 or 5).

		Univariate Analysis	**Multivariate Analysis**
Variable	Severe COVID-19(%)	OR (95% CI) p-value	OR (95% CI) p-value
Male	16.6	1.09 (0.76-1.55) 0.643	-
Age ≥ 80 years	22.6	1.96 (1.37-2.80) < 0.001	1.60 (1.08-2.37) 0.019
Severe functional impairment (Katz Index ≤ 2)	24.0	1.83 (1.11-3.00) 0.016	1.30 (0.75-2.25) 0.346
Frailty with dependence (CFS ≥ 5)	20.2	1.71 (1.20-2.42) 0.003	1.30 (0.86-1.97) 0.208
COVID-19 Decision Support Tool (Points ≥ 9)	17.3	1.96 (1.15-3.35) 0.012	1.32 (0.73-2.39) 0.350
Multiple Co-morbidities (CCI ≥ 3)	16.2	1.84 (0.65-5.23) 0.247	-
Presence of delirium/cognitive impairment (4AT ≥ 4)	18.6	1.39 (0.78-2.47) 0.268	-
Polypharmacy (≥ 5 medications)	14.4	0.84 (0.58-1.21) 0.348	-

OR: Odds Ratio; CI: Confidence Interval

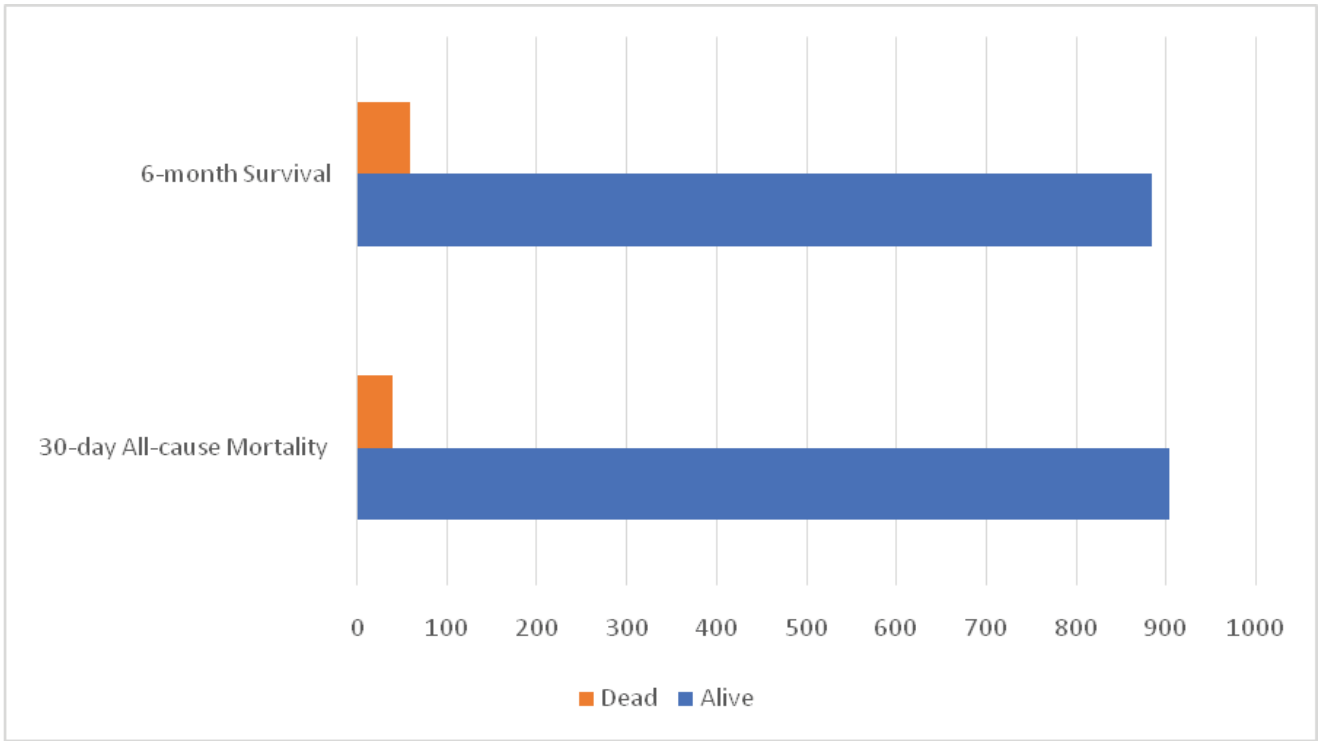

Figure 2: 30-day all-cause mortality and 6-month survival.

Table 7: Univariate and multivariate analysis of factors for vulnerability associated with 30-day all-cause mortality.

		Univariate Analysis	Multivariate Analysis
Variable	30-Day All-Cause Mortality (%)	OR (95% CI) p-value	OR (95% CI) p-value
Male	6.1	2.20 (1.15-4.23) 0.015	2.50 (1.17-5.35) 0.019
Age ≥ 80 years	7.3	2.78 (1.46-5.31) 0.001	1.71 (0.80-3.65) 0.167
Severe functional impairment (Katz Index ≤ 2)	11.0	3.66 (1.73-7.63) < 0.001	3.43 (1.27-9.21) 0.015
Frailty with dependence (CFS ≥ 5)	6.2	2.40 (1.24-4.63) 0.008	1.53 (0.65-3.60) 0.328
Presence of delirium/cognitive impairment (4AT ≥ 4)	9.3	3.09 (1.35-7.07) 0.005	1.40 (0.51-3.85) 0.516
Severe COVID-19 Pneumonia (Stage 4 or 5)	12.7	5.61 (2.91-10.79) < 0.001	3.74 (1.77-7.92) < 0.001
COVID-19 Decision Support Tool	4.6	2.06 (0.72-5.86) 0.169	-
Multiple Co-morbidities (CCI ≥ 3)	4.2	1.81 (0.24-13.48) 0.559	-
Polypharmacy (≥ 5 medications)	14.4	1.23 (0.64-2.35) 0.534	-

OR: Odds Ratio; CI: Confidence Interval

0.001), frailty with dependence (OR 2.40, p-value 0.008), presence of cognitive impairment/delirium (OR 3.09, p-value 0.005) and severe COVID-19 (OR 5.61, p-value < 0.001) with 30-day all-cause mortality on univariate analysis. The male gender (OR 2.50, p-value 0.019), severe functional impairment (OR 3.43, p-value 0.015), and severe COVID-19 clinical stage (OR 3.74, p-value < 0.001) were the factors for vulnerability associated with 30-day all-cause mortality from multivariate analysis with logistic regression (Table 7).

The effect of destination on discharge on 6-month survival was evaluated with Kaplan Meier which showed significant differences (p < 0.001 by Log Rank Mantel-Cox Test).

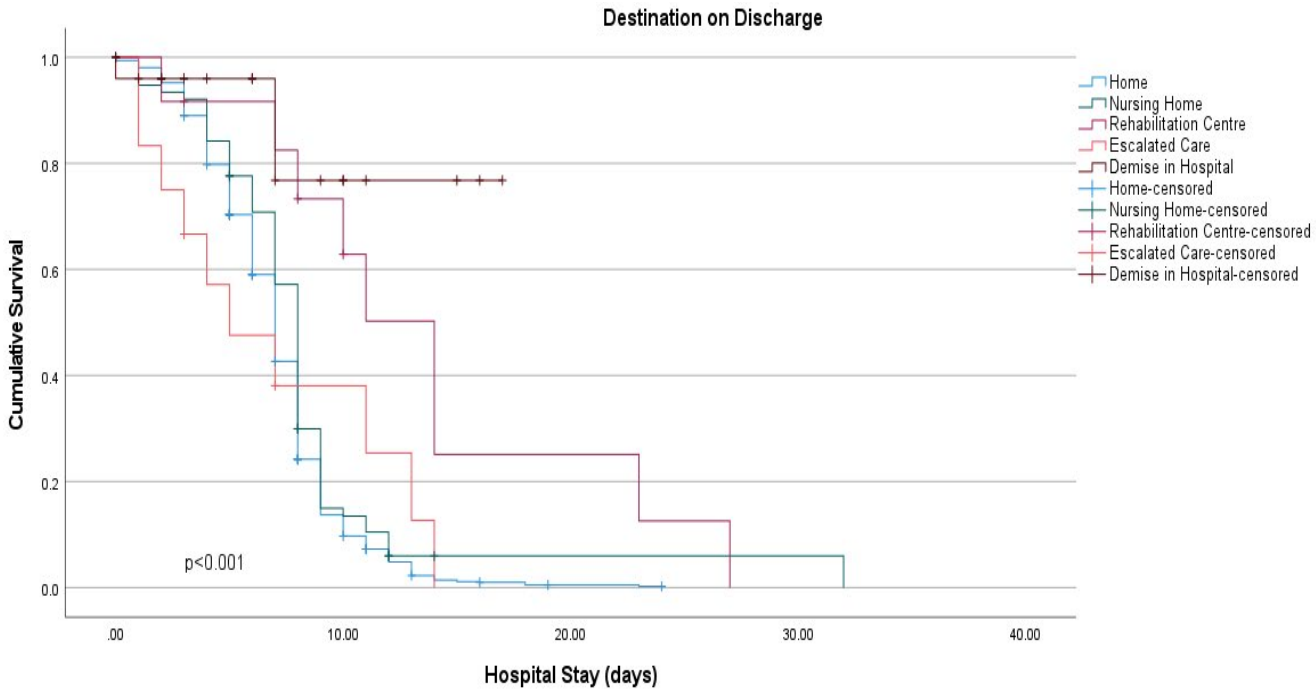

Figure 3: Survival curves by Kaplan Meier for destination on discharge.

Discharge to a rehabilitation centre showed the best median survival time of 14 days of hospital stay (Standard Error [SE] 0.11, 95% Confidence Interval [CI] 10.88-17.12) followed by discharge to a nursing home with a median of 8 days of hospital stay (SE 0.20, 95% CI 7.62-8.38). Discharge to home had a median survival time of 7 days of hospital stay (SE 1.59, 95% CI 6.79-7.21). Escalated care had a lower median survival time of 5 days of hospital stay (SE 2.36, 95% CI 0.38-9.62) and the median time for demise in hospital could not be computed as the survival curve did not drop to ≤ 0.5 (Figure 3).

Discussion

The mean age of patients admitted to the geriatric acute medical take for COVID-19 was 76.41 years with most being community-dwelling and relatively independent in their activities of daily living as reflected in their Katz. Most did not have any cognitive impairment. However, most of them were vulnerable as reflected in the CFS and had moderate co-morbidities as seen in the CCI. Older age and the presence of co-morbidities had been implicated with severe COVID-19 and mortality [15,16]. At the time of the establishment of this geriatric-specific quarantine facility, the Ministry of Health Malaysia was still implementing its COVID-19 immunisation programme. The nation's 97% adult population completed their vaccination of at least 2 doses of any given type approved by the local health authorities only in December 2021 [17,18]. As a result, this quarantine facility was imperative in the isolation, management, and monitoring of older adults with COVID-19 to ensure prompt delivery of healthcare holistically to this vulnerable group of people.

A substantial amount (9.9%) of patients were admitted from the nursing home. Being in a confined area with a communal style of living; adhering to physical distancing could be difficult with the risk of the rapid spread of the disease among residents and caregivers. Before the massive roll-out of immunisation, frequent surveillance of residents with respiratory symptoms for COVID-19 was required for the detection and eventual isolation and holistic management of older patients. Due to limited health resources during the height of the pandemic, residents with multiple co-morbidities with poor functional status with severe COVID-19 could be managed or palliated by the healthcare team at the residential facility itself [19].

The mean COVID-19 Decision Support Tool score was 11.1. Based on this triaging system, in a limited healthcare resources setting, most of the patients would be of lower priority for escalated intensive care due to the supposedly poorer outcome [13]. In a study conducted in the United Kingdom, a score of ≥ 9 was more specific and sensitive for predicting treatment limitations rather than predicting mortality [20]. This risk stratification tool was eventually rejected by the health authorities in the United Kingdom [21]. Although the COVID-19 Decision Support Tool was utilized to assist in the risk stratification of our patients, the decision for the direction of care of patients was based on the judgment of the clinician and not entirely on this support tool alone. This cohort of community-dwelling older adults had hypertension, diabetes mellitus, and ischemic heart disease as the more common co-morbidities, consistent with the prevalence of non-communicable diseases in Malaysia with cardiovascular diseases as the leading causes of death [22].

Most patients presented with upper respiratory symptoms. A substantial amount of them also presented with non-specific and non-respiratory symptoms of diarrhoea, vomiting, lethargy, and anorexia which contributed to diagnosis and management challenges.

The mean length of stay was 6.99 days. This was consistent with the quarantine period as recommended by the local health authorities at the time of the study (before mass immunisation) based on the COVID-19 clinical staging. Most patients were in stage 3 or below (84.1%). Those in stages 1 or 2 required 7 days and stage 3 required 10 days of quarantine. Patients with severe COVID-19; stages 4 or 5 (13.9%) required at least 14 days of quarantine and monitoring in a health facility [1,7].

The institutionalization of patients especially those with severe diseases would ensure early detection of complications and appropriate prompt management with the option for escalation of care as required. 1.3% of them received escalated care in an intensive care setting. These patients were chosen for escalation based on the clinical judgment of the attending medical team and may have better baseline function and no major co-morbidities. Patients with severe disease with poorer baseline function and co-morbidities with expected poor outcomes were provided with the best medical therapy at the existing medical vicinity. These patients were managed with ceiling of care clearly dictated and informed to the next of kin. 2.7% of them died during the hospital stay. Zerah, et al. [23] reported a 31% inpatient mortality in their multi-centre study in similar acute care geriatric wards. Our cohort of patients had an overall mortality of 0.56 per 100,000 population as compared to the national average of 110 per 100,00 population [5,6]. The relatively lower inpatient and overall mortality in our cohort of patients could be because most were community-dwelling independent individuals and diagnosed at a milder stage during admission while the severely ill patients from the community were sent directly to tertiary centres for intensive care.

In our cohort of patients, the advanced age of ≥ 80 years (OR 1.60, p-value 0.019) was an independent risk factor associated with severe COVID-19. Severe COVID-19 itself (OR 3.74, p-value < 0.001), the male gender (OR 2.50, p-value 0.019), and severe functional impairment (Katz Index ≤ 2) (OR 3.43, p-value 0.015) were independent factors associated with 30-day all-cause mortality.

Advanced age has long been associated with adverse outcomes in respiratory infections. In the validation study for the CURB-65 score for community-acquired pneumonia, age ≥ 65 years was independently associated with 30-day mortality (OR 3.5, 95% CI 1.6-8.0) [24]. Covino, et al. reported higher mortality for patients aged ≥ 85 years (Hazard Ratio [HR] 2.40 95% CI 1.32-4.35, p-value 0.004) in a group of older patients aged 80 years and above hospitalized for COVID-19 in Italy. They also reported dependency in ADL (HR 2.57, 95% CI 1.14-5.82, p-value 0.023) as associated with inpatient mortality [25]. In a study among community-dwelling nursing home residents with COVID-19, the odds of death within 30 days were higher for residents aged 80 years and above (OR 1.46, 95% CI 1.14-1.86). Women had a lower risk of 30-day mortality than men (OR 0.69, 95% CI 0.60-0.80) and the odds of dying were higher when there were moderate (OR 1.49, 95% CI 1.18-1.88) or severe (OR 1.64, 95% CI 1.30-2.08) physical impairments [26].

There are various anatomical, physiological, and immunological changes in the respiratory system with age. The respiratory muscle strength decreases and can impair effective cough. There is progressive impairment in lung function from 25 years onwards with increased alveolar dead space and less effective gas exchanges [27]. Impairment of daily function is an important indicator of the overall well-being of the older person as the ability to conduct daily tasks is very much dependent on the interplay of cognitive, physical, social, and environmental factors [9]. Males are more susceptible to COVID-19 infection probably due to the higher expression of Angiotensin-converting enzyme-2 (ACE 2) for which the SARS-CoV-2 binds to infiltrate the respiratory system [28]. All these factors individually increase the older person's vulnerability to poor outcomes and mortality.

Because of the unique setup of this geriatric isolation health facility, targeted comprehensive geriatric assessments were conducted with subsequent interventions by the interdisciplinary team. Some of the interventions conducted were "Triflo breathing exercise" for COVID-19 clinical stages 1 to 3 [29] and "pursed-lip" for clinical stages 4 to 5 [30]. Patients who were able, were encouraged to mobilise to prevent deconditioning. Those with limited mobility were provided with constant limb stretching exercises and positional changes to prevent contractures and pressure injuries. Patients who were at risk of malnutrition or had ageusia with poor oral intake were provided with individualized nutritional management by the dietitian. Patients were able to access the designated stations for oral nutritional supplements within the quarantine facility. The pharmacists ensured an adequate supply of patients' existing medications during the quarantine period and upon discharge. Medication reconciliation was essential to patients who were vulnerable to the risk of hypotension, hypoglycemia, or a tendency to bleed.

Most of patients were discharged home (86.7%) and nursing home (8.0%) respectively. Those who were discharged but detected to have "geriatric giants" such as falls, cognitive impairment, incontinence, or medical issues which required further management were given

outpatient geriatric or medical clinic reviews to ensure the continuation of care. 1.3% of them required inpatient rehabilitation and were transferred to the rehabilitation ward after the quarantine period. There was a limitation on manpower and inpatient rehabilitation facilities at the height of the pandemic during the period of study.

There is good evidence that older adults with multiple co-morbidities and frailty who survive severe illnesses are more likely to experience complications of cognitive decline, physical deconditioning, and multi-organ failure [31,32]. Geriatric rehabilitation by the interdisciplinary team of doctors, pharmacists, nurses, therapists, and nutritionists are essential for the long-term recovery and survival of ill older adults with COVID-19 [33]. To concur with this fact, our study showed that patients who had inpatient rehabilitation had the best median survival time of 14 days (SE 1.59, 95%CI 10.88-17.12, p-value < 0.001).

Strengths and Limitations

The strength of this study is that based on our knowledge, this is the first study in the nation and the South East Asian region to represent the real-life description of patients admitted to a COVID-19 isolation health facility exclusively for older persons. The limitations of the study are that of single-centre review and retrospective analysis.

Conclusion

This study has shown that advanced age ≥ 80 years, male gender, severe functional impairment, and severe COVID-19 clinical stage were associated with adverse outcomes and 30-day all-cause mortality. Geriatric rehabilitation has proven to improve survival.

The focused CGA and geriatric management principles which were incorporated in the review and management of patients have successfully identified vulnerable patients for rehabilitation and improved their outcomes and survival. Further analysis is required to compare the outcomes of this study with a centre without focused geriatric care.

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Authors' Contribution

All authors listed were directly and equally involved in the planning, data collection, analysis, write-up, and editing of this study manuscript.

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