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Assessment of 90-day Return to Hospital among COVID-19 Patients: A Single Centre Study.

Yusran Yusoff[1*], Nabil Abdullah[1], Mahiran Mustafa[2], Fauzi C. Hussin[3], Ghazali A. Rashid[3].

[1]CRC Kelantan, Institute for Clinical Research, National Institute of Health (NIH), Ministry of Health Malaysia
[2]Medical Department, Hospital Raja Perempuan Zainab II, Ministry of Health Malaysia
[3]Emergency Department, Hospital Raja Perempuan Zainab II, Ministry of Health Malaysia

Corresponding Author
Mohd Yusran Yusoff
Clinical Research Centre (CRC) Kelantan, Blok A Tingkat 1 (A-2-1) Kuarters Kakitangan HRPZII, 15586 Kota Bharu, Kelantan, Malaysia.
Email: use_ran86@yahoo.com

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Abstract

Introduction: Readmissions among COVID-19 patients increase healthcare burdens and resource utilization. Identifying risk factors can help mitigate this issue**.** This study aimed to determine the proportion and predictors of hospital returns among COVID-19 patients.

Materials and methods: A single-centre retrospective cohort study was conducted involving adult COVID-19 patients admitted between December 2020 and May 2021. Patients who died during hospitalization or were transferred to another hospital were excluded. Demographic and clinical characteristics from index hospitalisation were collected. Subsequent emergency department visits or readmission for acute illness within 90 days post-discharge were recorded, including dates and reasons for return, and readmission outcome. Multivariable logistic regression was used to identify the independent predictors for return to hospital.

Results: A total of 1000 COVID-19 patients were included, and 86 patients [8.6% (95% CI: 7.0–10.5] returned to the hospital within 90 days post-discharge. Most returns (n = 52, (60.5%), occurred within two weeks of discharge. Multivariable analysis identified chronic kidney disease (AOR=3.11, 95% CI: 1.40-4.90) and complication with organizing pneumonia (AOR=3.17, 95% CI: 1.36-7.40) as independent predictors for return to hospital. Additionally, the combination of underlying cardiac disease and concomitant bacterial infection significantly increased the risk (AOR=5.47, 95% CI: 2.57-11.24).

Conclusions: Several factors, including underlying medical conditions and complications during admission, were independent predictors of hospital returns. These factors should be carefully addressed prior to discharge to reduce readmission risk.

Keywords: *Coronavirus, COVID-19, readmission, SARS-CoV-2.*

Introduction

Coronavirus disease (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has led to significant global morbidity and mortality since its emergence[1]. The dramatic widespread progression of COVID-19 into a pandemic has placed a substantial burden on healthcare systems worldwide, with its broad clinical presentations ranging from mild respiratory symptoms to severe multi-organ dysfunction [2].

The management of COVID-19 remains a challenge for healthcare providers and public health authorities due to the evolving nature of the virus, the emergence of new variants, and the long-term consequences of infection. While acute care has been the primary focus, post-discharge outcomes, including hospital readmission, have gained increasing attention. Returns to hospital, whether through emergency department (ED) visits or readmissions, contribute to healthcare strain by increasing patient load, resource utilization, and overall economic costs [3]. Several international studies have reported the proportion of readmission or return to hospital among COVID-19 patients and their associated factors; however, data within Malaysia remain scarce. This study aims to address this knowledge gap. Understanding the local burden and determinants of hospital returns is crucial for optimizing post-discharge care strategies, improving patient outcomes, and reducing unnecessary healthcare utilization.

Therefore, we aimed to determine the proportion of hospital returns among hospitalised COVID-19 patients and identify independent predictors for such returns. These findings have important implications for discharge management, potentially reducing readmission-associated morbidity and mortality. By identifying the risk factors for hospital returns this study will guide healthcare providers in optimizing care for high-risk patients and preventing readmissions.

Materials and methods

Study design and participants

This retrospective cohort study involved COVID-19 patients admitted to the adult medical ward of Hospital Raja Perempuan Zainab (HRPZII) between December 2020 to May 2021. HRPZll served as the primary referral centre for COVID-19 in Kelantan, Malaysia during the study period.

Inclusion criteria comprised of adult patients (≥ 18 years), with laboratory-confirmed diagnosis of COVID-19 by reverse transcriptase–polymerase chain reaction (RT-PCR) assay, Antigen Rapid Test kit (RTK-Ag), or GeneXpert performed on nasopharyngeal swab specimens. We excluded those who were transferred to other facilities for step-down care or expired during the index hospitalisation.

Index hospitalisation is defined as the patient's first COVID-19-related admission during the study period. Return to hospital is defined as the first subsequent visit to the emergency department or readmission for acute problems within 90 days post-discharge (excluding elective procedures, deliveries, and trauma cases).

Sample size was calculated using an online calculator based on the single proportion formula [4]. Using an expected proportion of 9% derived from previous study [5], with 2% precision at a 95% confidence level, the minimum required sample size was 962 after accounting for a 10% dropout rate. No sampling method was applied in this study because all available samples within the sampling period were screened for eligibility. This approach was adopted to maximise the number of samples and minimise the risk of bias.

Ethical approval

This study adhered to the Declaration of Helsinki and Malaysian Good Clinical Practice Guideline. It was registered in the National Medical Research Registry (NMRR-21-1410-60651), and approved by the Medical Research & Ethics

Committee (MREC), Ministry of Health Malaysia (KKM/NIH/ P21-1365 (4)).

Data collection

Facility approval was obtained from the head of medical department and the hospital director prior to data collection. Patients' data was extracted from the electronic medical system using keyword search technique based on the discharge diagnosis of COVID-19. Collected data included demographics, comorbidities, highest C-reactive protein (CRP) value, chest X-ray results, steroid duration, ICU admission, complications, and length of stay during their index hospitalisation. Hospital returns within 90 days post-discharge were traced using electronic medical records, with patients who were lost to follow-up categorized as 'no return'. The primary reason for return to hospital was also identified based on the documented diagnosis at the emergency department. Readmitted patients, ICU admissions and outcome upon discharge were collected. All data were extracted from both electronic and physical clinical records using a standardised data collection form.

Statistical analysis

Demographic and clinical characteristic variables were analysed using descriptive statistics. Categorical variables were presented as frequencies and percentages, while continuous variables were presented as mean ± standard deviation (SD) or median and interquartile range (IQR) depending on the normality of distribution. The proportion of return to hospital was reported as a percentage with 95% confidence interval (CI).

Univariable analyses were performed using chi-square or Fisher's Exact test for categorical variables and independent t-test or Mann-Whitney for continuous variables. Multiple logistic regression analysis was used to identify the significant predictors for return to the hospital. Variables with $p < 0.25$ from univariable analyses were included for the multivariable model. Both forward and backward LR method were applied for variable selection. Multicollinearity was assessed with the variance inflation factor (VIF), and the model assumptions were examined using classification table and the Hosmer-Lemeshow test. Two-way interaction terms were further stratified for interpretation. Adjusted odds ratios (AORs) with 95% CIs were reported for the final model.

The statistical analyses were performed using IBM's SPSS software version 23 and RStudio version 1.4.1103. A *p* value of less than 0.05 was considered statistically significant.

Results

Study population and baseline characteristics

A total of 1,000 patients who fulfilled the study criteria were included in the analysis. The mean age was 52.76 ± 17.18 years old, with a male predominance (54.5%, n = 545) and a predominantly Malay race (98.3%). The most common comorbidities were hypertension (48.1%), diabetic mellitus (40%), cardiac disease (10.8%), chronic kidney disease (CKD) (8.4%), and chronic lung disease (6.8%). Demographic and clinical characteristics for index hospitalisation are presented in Table 1.

Hospital Return Outcomes

The proportion of patients returning to hospital within 90 days post-discharge was 8.6% (95% CI: 7.0 – 10.5). Among those who returned, 64 patients (74.4%) required readmission. The interval [median (IQR)] from discharge to return was 12 (29) days, and most of the returns (60.5%) were within two weeks post-discharge. The most common reasons for return were sepsis (31.3%, n = 27) followed by pneumonia (22.1%, n = 19) and long COVID syndrome (20.9%, n = 18). On readmission, 6 (7%) patients required ICU care, and 4 patients (4.7%) had inpatient mortality (Table 2).

Predictors of Hospital Return

The final multiple logistic regression model consisted of four independent predictors. This model significantly improved the prediction of return to hospital among hospitalised COVID-19 patients compared to a null model, $\chi^2(5)=35.603$, $p<0.001$. The model also explained 7.9% (Nagelkerke R^2) of the variance for the study outcome, and the correct prediction rate was 91.4% of cases. The Hosmer-Lemeshow test showed that the overall model fit well ($p = 0.934$). The model indicated that underlying CKD (AOR = 3.11, 95% CI: 1.40-4.90, $p = 0.004$) and complications with organising pneumonia (AOR = 3.17, 95% CI: 1.36-7.40, $p = 0.009$) were significant predictors for return to the hospital. There was significant interaction between underlying cardiac disease and complications with bacterial infection. Further subgroup analysis revealed that among those without underlying cardiac disease, concomitant bacterial infection had 1.68 higher odds of return ($p = 0.043$). Meanwhile, the presence of both cardiac disease and bacterial infection resulted in 5.47 times higher odds of return ($p < 0.001$). The result of multiple logistic regression is summarised in Table 3.

Discussion

This study describes the demographic and clinical characteristics of COVID-19 patients admitted to a tertiary hospital on the east coast of Malaysia and identifies risk factors for hospital return. The cohort primarily comprised middle-aged and elderly patients with pre-existing comorbidities, including hypertension, type 2 diabetes mellitus, cardiac disease, and chronic kidney disease (CKD). These results are related to the reported incidence of COVID-19 in Malaysia, which was highest among the 55-to-64-year age group, and most cases involved chronic comorbidities such as diabetes, hypertension, and heart disease [6]. This pattern is consistent with data reported from China and New York [7, 8].

In this study, 8.6% of patients returned to the hospital, and 6.4% required readmission within 90 days post-discharge from index hospitalisation. A direct comparison with previous studies is difficult due to variations in follow-up duration, as most studies focus solely on readmission. A study in New York reported a lower proportion of return at 3.6% albeit a shorter follow-up period of 14 days [3]. The overall 30-day readmission rate ranges between 4.3% to 7.6% [9-11]. Another study in Spain, with a longer six-month follow-up, reported a much lower readmission rate at 4.3% [12]. Meanwhile, a large-scale cohort study in the United States found a 9% readmission rate within two months of discharge [5]. Most returns were due to infection which is related to the predictors identified in our analysis.

Examining factors associated with return to hospital, our study found that underlying CKD is a significant predictor in multivariable analysis. CKD has also been shown to predict readmission in a few published studies [5, 9, 11]. This is expected because patients with CKD or kidney failure are already at high risk of recurrent hospitalisations even without a COVID-19 infection [13]. Those with CKD are generally older and often have some degree of functional impairment, along with renal and cardiovascular complications that may contribute to readmission [14]. Kidney disease is also associated with secondary immunodeficiency, which increases susceptibility to infection [15]. Thus, special care must be taken for this group of patients before discharge.

In terms of acute complications, patients with organising pneumonia (OP) had a higher risk of returning to the hospital. This can be explained by the fact that the primary site of COVID-19 infection is the lungs, and OP may occur as a pulmonary reaction to the infection. Acute inflammatory process triggered by viral-induced damage to the alveoli is the key mechanism for the development of OP [16]. Patients may experience ongoing respiratory symptoms such as exertional dyspnoea and fatigue post-discharge. Worsening symptoms and recurrent infection are common and often lead to return to the hospital. While most patients recover from OP within a

year, some may require specific treatment [16]. Outpatient follow-up is therefore essential to monitor patients'
progress.

Our results showed that cardiac disease alone does not predict a return to the hospital, contrary to several previous studies [5, 10, 11]. However, the co-occurrence of cardiac disease and bacterial infection significantly increases risk of return. Bacterial infection was defined as the initiation of antibiotics based on clinical diagnosis by the treating clinicians regardless of culture results. This approach may overestimate true bacterial infections, given the the excessive use of antibiotics in COVID-19 patients [17]. According to a cohort study in Italy, bacterial infection may reflect disease severity in COVID-19 patients but is not associated with increased mortality [18]. More severe disease inevitably contributes to a longer recovery period and consequently increases the risk of return. COVID-19 is also known to exacerbate pre-existing cardiac disease, leading to a severe clinical course and adverse outcomes [19]. The interplay between bacterial infection and underlying cardiac disease during COVID-19 infection further aggravates the outcome. To our knowledge, none of the previous studies reported a synergistic interaction between cardiac disease and bacterial infection leading to return or readmission to the hospital. This result merits further investigation. Nevertheless, it should be interpreted with caution given the non-standard definition of bacterial infection used in this study.

This study has several limitations. First, its retrospective design means that data quality relies on documentation in clinical records and cannot capture real-time disease progression. Second, the return rate may have been underestimated because visits to other healthcare facilities were not captured during the follow-up. Other potential factors that may influence hospital readmission that include COVID-19 variants, patients' adherence to outpatient follow-up, and medications compliance, were not considered. Additionally, the generalisability of the results may be limited due to the relatively small sample size. Another limitation is the 90-day follow-up period, which does not allow assessment of longer-term outcomes. Lastly, this study was conducted prior to the completion of the mass vaccination program in Malaysia. Follow-up studies might be required to compare these findings with current patient profiles.

Conclusions

Our study found that the proportion of return to hospital was 8.6%, and the predictors of return were chronic kidney disease, organising pneumonia, cardiac disease, and concomitant bacterial infection. Return to hospital and readmission among COVID-19 patients will continue to impose additional burdens on the healthcare system. Although COVID-19 has now entered the endemic phase, continuous monitoring and evaluation of best practices crucial for managing future outbreaks. Vulnerable patient groups with these risk factors require comprehensive assessment and proper predischarge plan to reduce the risk of return or readmission. The use of stratification with a validated scoring method is warranted to facilitate healthcare providers in strategizing discharge plans for COVID-19 patients.

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Conflict of interest

The authors declare they have no conflict of interest.

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Authors' Contributions

YY & NA - concept, design, literature search, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing. MM, FCH & GAR – concept, data acquisition, manuscript review.

Table 1**.** Demographic and clinical characteristics for index hospitalisation

Characteristics	Total n (%)	No return n (%)	Return n (%)	*P* value
		914 (91.4)	86 (8.6)	
Age group, year				
<40	267 (26.7)	250 (27.3)	17 (19.8)	0.307
40-60	349 (34.9)	317 (34.7)	32 (37.2)	
>60	384 (38.4)	347 (38.0)	37 (43.0)	
Gender				
Male	455 (45.5)	410 (44.9)	45 (52.3)	0.184
Female	545 (54.5)	504 (55.1)	41 (47.7)	
Race				
Malay	983 (98.3)	899 (98.4)	84 (97.7)	0.652*
Non-Malay	17 (1.7)	15 (1.6)	2 (2.3)	
Comorbidities				
Hypertension	481 (48.1)	434 (47.5)	47 (54.7)	0.203
Diabetes Mellitus	400 (40.0)	352 (38.5)	48 (55.8)	0.002
Cardiac disease	108 (10.8)	91 (10.0)	17 (19.8)	0.005
CKD/ESRF	84 (8.4)	68 (7.4)	16 (18.6)	0.001
Chronic lung disease	68 (6.8)	59 (6.5)	9 (10.5)	0.158
Length of stay, median (IQR), days	7 (5)	7 (5)	9 (10)	0.007†
ICU admission, yes	148 (14.8)	131 (14.3)	17 (19.8)	0.175
CRP, median (IQR), mg/L	25.3 (72.8)	23.5 (68.7)	48 (100.8)	0.004†
Steroid use	619 (61.9)	553 (60.5)	66 (76.7)	0.003
Complications	555 (55.5)	493 (53.9)	62 (72.1)	0.001
Sepsis	404 (40.4)	353 (38.6)	51 (59.3)	<0.001
Acute kidney injury	74 (7.4)	66 (7.2)	8 (9.3)	0.481
Organising pneumonia	34 (3.4)	25 (2.7)	8 (9.3)	0.005*
Transaminitis	99 (9.9)	93 (10.2)	6 (7.0)	0.342
Pulmonary embolism	21 (2.1)	19 (2.1)	2 (2.3)	0.7*
ACS	10 (1.0)	7 (0.8)	3 (3.5)	0.047*

* Fisher's exact, † Mann-Whitney

Notes: CKD = chronic kidney disease; ESRF = end stage renal disease; ICU = intensive care unit; CRP = C-reactive protein; ACS = acute coronary syndrome

Table 2. Characteristics and outcomes of COVID-19 patients who returned to hospital.

Characteristics	n (%)
Interval, weeks (from discharge to return)	
<2w	52 (60.5)
2-4w	11 (12.8)
4-8w	16 (18.6)
>8w	7 (8.1)
Required admission	
Yes	64 (74.4)
No	22 (25.6)
Reason for return	
Sepsis	27 (31.3)
Pneumonia	19 (22.1)
Long covid syndrome	18 (20.9)
Acute kidney injury	5 (5.8)
Acute coronary syndrome	4 (4.7)
Gastrointestinal bleed	2 (2.3)
Stroke	1 (1.2)
Heart failure	1 (1.2)
Acute respiratory distress syndrome	1 (1.2)
Others	22 (25.6)
ICU admission	
Yes	6 (7.0)
No	86 (93.0)
Outcome	
Discharge home	81 (94.2)
In-patient mortality	4 (4.7)
Step down care	1 (1.2)

Table 3. Multiple logistic regression analysis to determine predictors for return to hospital among COVID-19 patients

Predictors	X^2 stat (df)*	Adjusted OR (95% CI)	*P*
Chronic kidney disease	5.06 (1)	3.11 (1.40, 4.90)	0.004
Organising pneumonia	6.84 (1)	3.17 (1.36, 7.40)	0.009
Cardiac disease and bacterial infection	20.45 (1)		
Yes, Yes	4.55†	5.47 (2.57, 11.24)	<0.001
No, Yes	2.03†	1.68 (1.02, 2.77)	0.043
Yes, No	-0.55†	0.71 (0.17, 2.10)	0.582
No, No (reference)		1	

* Likelihood Ratio (LR) test, † Z test.

Notes: OR = odd ratio; CKD = chronic kidney disease.

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