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Discharge disposition and clinical outcomes of patients hospitalized with COVID-19

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Objectives: By better understanding the long-term effects of COVID-19 and assessing rehabilitation placement among the patients in our study, we hope to determine the predictors of rehabilitation needs in individuals suffering from the long-term sequelae of COVID-19.

Methods: A retrospective chart review was performed of adult patients with a positive COVID-19 polymerase chain reaction test among multiple hospitals in a regional health system. The main outcomes measured were discharge disposition, total length of hospital stay, and overall all-cause mortality and readmission rates within 30 and 90 days of discharge.

Results: Of the 2502 patients included in the study, we found that 65.2% were discharged to home, while the remaining patients were discharged to home healthcare (33.6%), skilled nursing facilities (31.7%), or long-term acute rehabilitation centers (11.6%). The overall all-cause mortality rate at 30 and 90 days were 2.7% and 4.4%, respectively. The overall all-cause 30-day and 90-day readmission rates were 7.0% and 7.6%, respectively.

Conclusion: Younger age and shorter hospitalization stays were the most important predictors of home discharge. Discharge to home was also significantly associated with lower all-cause mortality rates at 30 and 90 days after discharge.

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Introduction

As of July 2022, SARS-CoV-2, the virus responsible for the COVID-19 pandemic, has infected over 560 million people and caused over 6.3 million deaths worldwide [1]. In the United States, the pandemic resulted in over 88 million cases and close to 1 million deaths [1]. Since the start of the pandemic, substantial resources have been poured into understanding the risk factors for mortality in high-risk patients infected by COVID-19. Individual reports from various hospitals worldwide have indicated that many COVID-19 survivors have required rehabilitation to manage long-term symptoms from their infections. One hospital in Paris indicated that up to 51% of their patients hospitalized with COVID-19 experienced long-term sequelae from their infection, including persistent shortness of breath, fatigue, cognitive issues, joint pain, and an overall decline in quality-of-life weeks to months after their initial infection [2–4]. In 2021, the Centers for Disease Control and Prevention (CDC) released guidelines on how to identify and manage long COVID, indicating its prevalence among COVID-19 survivors and the imminent need to address these long-term symptoms [5].

As the long-term sequelae of COVID-19 are becoming better characterized, it is imperative that we turn our attention to rehabilitation after infection resolution to provide these patients with the best likelihood of a complete recovery. This study aims to track the after discharge rehabilitation needs of patients hospitalized with COVID-19 in our hospital system to assess the disability

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Table 1
Discharge disposition.

	Overall (*N* = 2719)	Discharge Location	
		Not Home (*n* = 870)	Home (*n* = 1632)
Died in hospital	217 (8.0)	-	-
Home or self care	1,632 (60.0)	-	100
Home-health care	292 (10.7)	33.6	-
Skilled nursing facility	276 (10.2)	31.7	-
Long-term care	101 (3.7)	11.6	-
Rehab facility	73 (2.7)	8.4	-
Acute care hospital	52 (1.9)	6.0	-
Swing bed	28 (1.0)	3.2	-
Hospice/facility	17 (0.6)	2.0	-
Hospice/home	14 (0.5)	1.6	-
Left against medical Advice	6 (0.2)	0.7	-
Custodial Care Facility	5 (0.2)	0.6	-
Nursing Facility	4 (0.2)	0.5	-
Psychiatric Hospital	2 (0.1)	0.2	-

Note. Data are presented as count (percent) or percent.

burden of long COVID symptoms. We will specifically compare rehabilitation needs and placement of our patients hospitalized with COVID-19 and assess risk factors such as age, ethnicity, length of hospitalization, and intensive care unit placement. By better understanding the disability burden of long COVID and tracking rehabilitation placement among the patients in our hospital system, we hope to eventually determine the predictors of rehabilitation needs in individuals suffering from the long-term sequelae of COVID-19.

Statistical analysis

Descriptive statistics for demographic and clinical variables are presented for the overall patient cohort and stratified by whether the patient was discharged home. Depending on data distribution, continuous variables are presented as mean and SD or median and interquartile range and compared using independent-sample *t*-test or Mann–Whitney test, respectively. Categorical variables are presented as percentages and compared via the chi-square test.

Unadjusted and adjusted logistic regression models were estimated to identify factors associated with being discharged home. Variables in the adjusted model included age, length of stay, biological sex, race/ethnicity, body mass index, smoking status, need for invasive mechanical ventilation, dialysis requirement, and intensive care unit admission. The Kaplan–Meier method and Cox proportional-hazards models were estimated to evaluate differences in time to after discharge death and readmission, for which patients were censored at 30 or 90 days after discharge. For readmission analyses, death served as a competing risk; reported hazard ratios are cause-specific. The proportionality of hazards assumption was assessed for categorical variables using log-negative-log survival curves and using scaled Schoenfeld residuals for continuous variables. For all outcomes, the functional form of continuous variables was evaluated using restricted cubic splines with knot points at the 5^{th}, 35^{th}, 65^{th}, and 95^{th} percentiles; non-linear effects were retained based on model comparison via the likelihood ratio test. All analyses were conducted using SAS v. 9.4 with two-sided *P*-value <0.05 used to indicate statistical significance.

Results

A total of 2719 patients met inclusion criteria, of whom 217 (8.0%) died during their hospital stay and were therefore excluded from subsequent analysis. Of the 2502 patients discharged alive, 1632 (65.2%) were discharged home. Discharge locations of the 870 patients not discharged to home are provided in Table 1, with approximately three-fourths of these patients being discharged to home with healthcare provided (33.6%), a skilled nursing facility (SNF, 31.7%), or a long-term care facility (11.6%).

Demographic and clinical characteristics are presented in Table 2. Unadjusted and adjusted odds of being discharged to home are presented in Table 3. After adjustment, lower odds of being discharged home were observed in older patients, those with longer lengths of hospital stay, females, patients of non-Hispanic ethnicity, and patients requiring invasive mechanical ventilation.

The overall all-cause mortality rate within 30 days of discharge was 2.7% (95% confidence interval [CI]: 2.2% to 3.4%) with a 90-day all-cause mortality rate of 4.4% (95% CI: 3.7% to 5.3%). Both the 30-day and 90-day mortality rates were statistically lower in patients discharged to home (30-day: 1.2% vs 5.5%, $P<.001$; 90-day: 1.9% vs 9.1%, $P<.001$). When considering time-to-death, patients discharged to home died later during the follow-up period (Fig. 1; both log-rank $P<0.001$) and had 61.9% and 60.2% lower risk of death during the 30-day and 90-day follow-up periods, respectively (Table 4).

Finally, the overall all-cause 30-day readmission rate was 7.0% (95% CI: 6.1% to 8.1%) and the all-cause 90-day readmission rate was 7.6% (95% CI: 6.7% to 8.7%). The 30-day and 90-day readmission rates were statistically similar between patients discharged to home or not (30-day: 7.1% vs 6.9%, $P=.889$; 90-day: 7.6% vs 7.7%, $P=.926$). Likewise, both time-to-readmission (Fig. 1) and risk of readmission (Table 4) were statistically similar for patients discharged to home or not during the 30-day and 90-day follow-up periods.

Discussion

Our data demonstrated that 65.2% of hospitalized patients with COVID-19 are discharged to home, with younger age and shorter hospital length of stay being the most important predictors of home discharge. The remaining 40% were primarily discharged to home healthcare, SNFs, or long-term acute care rehabilitation hospitals. Discharge to these outpatient rehabilitation services is associated with patient factors, accessibility, and substandard inpatient quality assessments [6]. Generally, patients with persistent functional deficits, increased frailty, cognitive deficits, and/or lack of in-home support are considered for admission to outpatient rehabilitation centers, all of which are associated with increasing age and a longer, more complicated hospital stay [6–8]. Regarding COVID-19, older adults tend to suffer a more severe course of infection, and survivors are at higher risk of persistent functional deficits after infection resolution [9,10]. It follows that these patients are also likely to require outpatient rehabilitation services and, thus, are less likely to be discharged home.

Table 2
Demographic and clinical characteristics.

	Overall (*N* = 2502)		Not Home (*n* = 870)	Home (*n* = 1632)	*P*
	Missing	Statistic	Statistic	Statistic	
Age	0	64.7 ± 16.5	74.0 ± 13.4	56.8 ± 15.8	<.001
Biological sex					
Female	0	46.8	51.5	44.4	<.001
Male		53.2	48.5	55.6	
Race					
White	186	85.1	87.6	83.8	<.001
African American		9.3	9.8	9.1	
Asian		2.4	1.2	3.0	
Other		3.2	1.4	4.2	
Hispanic or Latino					
No	92	86.5	93.8	82.7	<.001
Yes		13.5	6.2	17.3	
Body mass index	27	32.3 ± 8.8	31.0 ± 8.9	32.9 ± 8.6	<.001
Not obese		46.8	54.6	42.6	<.001
Obese		53.2	45.4	57.4	
Smoking status					
Never	0	66.1	60.8	68.9	<.001
Current/former		33.9	39.2	31.1	
English speaking					
No	2	11.1	6.2	13.7	<.001
Yes		88.9	93.8	86.3	
Insurance status					
Uninsured	8	3.3	1.0	4.5	<.001
Insured		96.7	99.0	95.5	
Academic medical center					
No	0	76.9	78.1	76.2	0.304
Yes		23.1	21.9	23.8	
Intensive care unit					
No	0	80.4	78.6	81.3	0.107
Yes		19.6	21.4	18.7	
Length of stay	0	6 [3-9]	9 [5-18]	5 [3-7]	<.001
Hospital length of stay	0	5 [3-9]	9 [5-18]	5 [3-7]	<.001
Supplemental oxygen	0	35.7	33.5	36.8	0.093
Dialysis	0	2.0	2.8	1.5	0.035
Mechanical ventilation					
Non-invasive	0	11.2	19.8	6.6	<.001
Invasive		5.6	11.3	2.5	<.001

Note. Data are presented as count, mean ± SD, or percent.

Table 3
Unadjusted and adjusted odds ratio for being discharged to home.

	Unadjusted		Adjusted		
	OR (95% CI)	*P*	aOR (95% CI)	F-value	*P*
Age (per 10 years older)	0.51 (0.47-0.54)	<.001	0.47 (0.42-0.51)	232.6	<.001
Hospital length of stay	0.87 (0.85-0.88)	<.001	0.87 (0.85-0.89)	178.8	<.001
Female vs Male	0.75 (0.64-0.89)	<.001	0.65 (0.52-0.81)	14.5	<.001
Hispanic vs Not Hispanic	3.15 (2.31-4.29)	<.001	2.52 (1.50-4.25)	12.1	<.001
Invasive Mechanical Ventilation	0.20 (0.14-0.30)	<.001	0.36 (0.19-0.66)	10.9	0.001
Race					
White	0.31 (0.16-0.59)	<.001	0.69 (0.30-1.59)	3.0	0.386
Black	0.30 (0.15-0.60)	<.001	0.46 (0.18-1.12)		0.088
Asian	0.79 (0.31-2.01)	0.614	1.56 (0.46-5.30)		0.472
Other	Reference		Reference		
New Dialysis	0.55 (0.31-0.97)	0.038	0.55 (0.26-1.14)	2.6	0.106
Body mass index	1.03 (1.02-1.04)	<.001	0.99 (0.98-1.01)	2.2	0.135
Current/former smoker	0.70 (0.59-0.83)	<.001	0.87 (0.70-1.09)	1.5	0.226
ICU vs No ICU	0.85 (0.69-1.04)	0.107	0.93 (0.70-1.23)	0.3	0.609

aOR, adjusted OR; CI, confidence interval; ICU, intensive care unit; OR, odds ratio.

The results of our study are comparable to findings reported in recent literature. A study conducted by the CDC analyzed 126,137 electronic health records of patients with COVID-19 from the Premier Healthcare Database and reported that 60% of the patients were discharged to home or self care [11]. Furthermore, 15% of the patients were discharged to an SNF, and the remaining patients were discharged to either a home with assistance from an organization, hospice or other outpatient location. The study also reported that increased age, defined as 65 years and older, discharge to an SNF or home healthcare, and increased hospital length of stay are associated with increased risk of readmission, although they note that age and discharge to SNF have a more robust association with readmission risk compared to the length of stay. These findings further support our data and suggest that these factors are associated with a more complicated hospitalization course [11]. Additionally, a similar retrospective study reported functional status to be a strong determining factor for discharge disposition for patients with COVID-19 [12]. Key findings include patients with

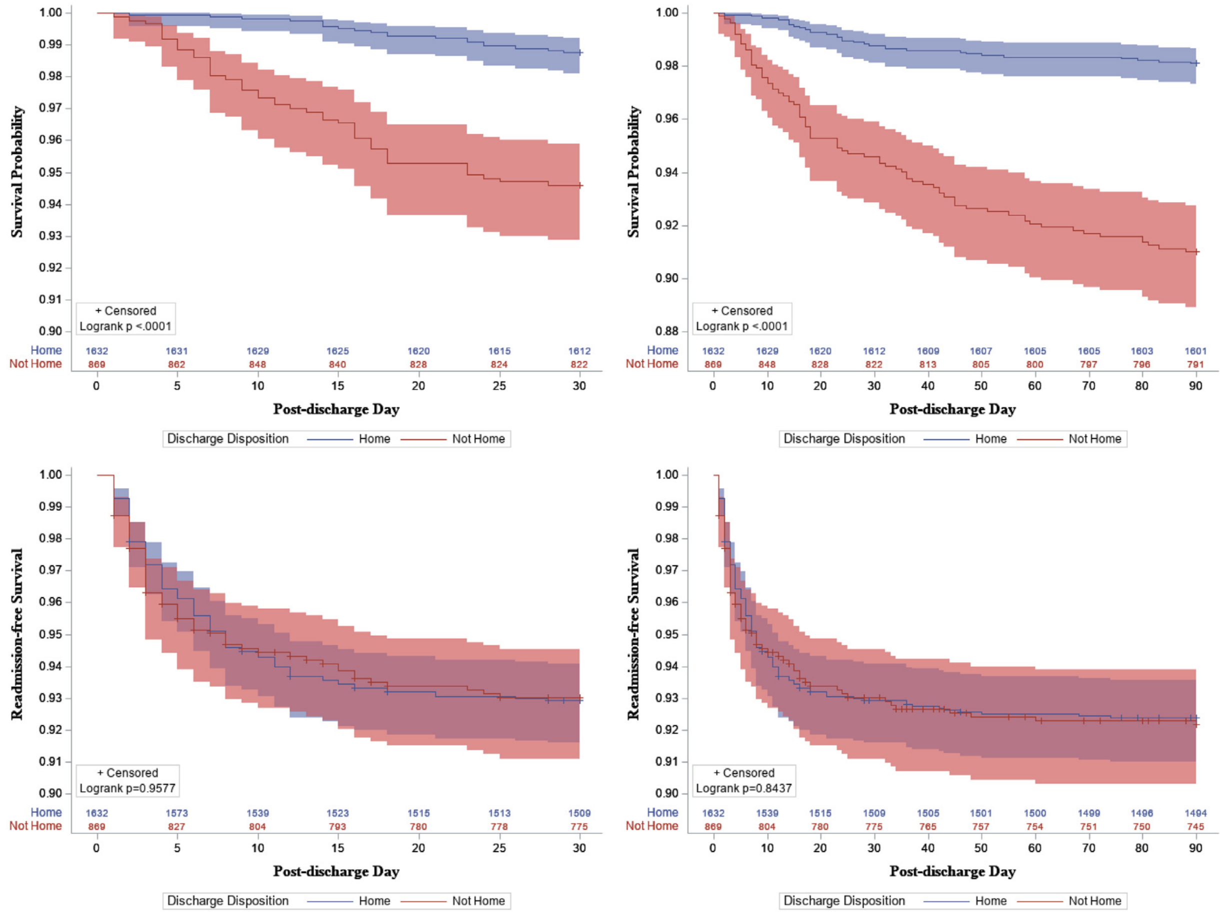

Figure 1. Kaplan–Meier curves for all-cause mortality (top row) and all-cause readmission (bottom row) for 30 days after discharge (left column) and 90 days after discharge (right column). Shaded areas represent 95% confidence intervals.

Table 4
Risk of death during the 30-day and 90-day follow-up period.

	Unadjusted		Adjusted	
	HR (95% CI)	*p*	aHR (95% CI)	*p*
All-cause Mortality				
30-day	0.22 (0.13-0.37)	<0.001	0.38 (0.20-0.72)	0.003
90-day	0.20 (0.13-0.31)	<0.001	0.40 (0.24-0.65)	<0.001
All-cause Readmission				
30-day	1.01 (0.74-1.38)	0.959	1.11 (0.76-1.63)	0.596
90-day	0.97 (0.72-1.31)	0.843	1.20 (0.84-1.74)	0.322

Note. HR below 1 indicate a lower risk of the outcome in patients discharged to home relative to patients not discharged to home. aHR were adjusted for age, biological sex, race, ethnicity, tobacco use, body mass index, whether the patient was in the intensive care unit, hospital length of stay, need for invasive mechanical ventilation, and new dialysis.
aHR, adjusted HR; CI, confidence interval; HR, hazard ratios.

longer hospitalization, increased age, and comorbidities who were more likely to be discharged to an institution away from home.

Contrarily, a study involving 310 patients hospitalized with COVID-19 reported a high home discharge rate of 90.6% and, consequently, a lower SNF placement rate. However, the study's relatively younger population and patients' preference to avoid SNF placement due to pandemic regulations were key contributors to a lowered SNF placement rate [13].

Our results further add to the existing literature regarding the long-term burden of COVID-19 infections. We found that patients discharged away from home were significantly associated with a higher mortality rate at both 30-day and 90-day intervals. As previously discussed, the patients expected to be discharged to rehabilitation centers have likely suffered a more severe course of the disease and thus are at an increased risk for mortality. Our data support recent analyses that showed increased age and SNF placement to be associated with increased mortality rates [14]. By understanding the predisposing risk factors for increased mortality following COVID-19 infection, discharge disposition decisions can be properly adjusted to plan for adequate resources necessary to care for those patients needing this type of specialized care with the goal of improving patient outcomes.

However, our study does have some limitations. Given the retrospective study design, there is a possibility of selection bias. Although this bias is common among retrospective cohort studies, understanding all limitations is helpful in determining the validity and clinical importance of our study. Furthermore, there also may be other variables necessary to be included in the adjusted analyses for which we did not account. However, determining every possible potential variable as they relate to outcome variables prior to data analysis is improbable; therefore, we selected the variables that we believed to be the most important based on prior literature and similar studies. Lastly, our mortality rates include only patients that expired in our health system and do not capture patient deaths that had occurred outside of the hospital setting. These deaths were not reported in the records and were not included in our results. This might have resulted in an underestimation of the mortality. Although mortality may be underreported, we believe this discrepancy to be minor and unlikely to change the analysis results, given the strength of the correlation both before and after adjustment.

Author contributions

SP, GTT, AR, ZC, MV, MT, RV, CD participated in the study design. RW, IN performed data collection and statistical analyses. SP, GTT, AR, ZC, RW helped draft the manuscript. RV, MT, MV, CD overviewed and supervised the project. All authors read and approved the final manuscript.

Declaration of competing interest

The authors have no conflicts of interest to declare

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Ethical approval

This study was approved by the Institutional Review Board at Creighton University (#2002233-01).

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