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## Psychiatric disorders newly diagnosed among veterans subsequent to hospitalization for COVID-19

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### ABSTRACT

**Objective:** The goal of our study was to evaluate the development of new mental health diagnoses up to 6-months following COVID-19 hospitalization for in a large, national sample.

**Method:** Data were extracted for all Veterans hospitalized at Veterans Health Administration hospitals for COVID-19 from March through August of 2020 utilizing national administrative data. After identifying the cohort, follow-up data were linked through six months post-hospitalization. Data were analyzed using logistic regression.

**Results:** Eight percent of patients developed a new mental health diagnosis following hospitalization. The most common new mental health diagnoses involved depressive, anxiety, and adjustment disorders. Younger and rural patients were more likely to develop new mental health diagnoses. Women and those with more comorbidities were less likely to develop new diagnoses.

**Conclusion:** A subpopulation of patients hospitalized for COVID-19 developed new mental health diagnoses. Unique demographics predictors indicate the potential need for additional outreach and screening to groups at elevated risk of post-hospitalization, mental health sequelae.

### 1. Introduction

Since the COVID-19 pandemic began, over four million patients have been hospitalized for COVID-19 (U.S. Centers for Disease Control and Prevention, 2020). Although some research has evaluated the mental health (MH) impact of contracting COVID-19, there remain limited data available on how hospitalization affects MH distress (Taquet et al., 2021). Much is unknown about whether COVID-19 hospitalization contributes to the development of new MH conditions. The extant

literature finds that hospitalization involving invasive procedures is associated with increased mental health symptoms (Wade et al., 2013). Veterans may be at elevated risk of negative MH outcomes due to their higher prevalence of trauma and other risk factors (Trivedi et al., 2015). However, a recent systematic review shows unclear evidence for the association between COVID-19 hospitalization and MH outcomes (Veazie et al., 2021). The objectives of the current paper are to: (1) Evaluate the development of new MH conditions over time among patients hospitalized for COVID-19 using a large, national dataset; (2)

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Explore demographic (e.g., age) and clinical predictors (e.g., comorbidities) of developing new MH conditions post-COVID-19 hospitalization to inform tailored prevention efforts.

**2. Methods**

We extracted data for all Veteran patients who were hospitalized for COVID-19 between 3/2020–8/2020 using the Veterans Health Administration (VHA) COVID-19: Shared Data Resource, which contains variables on COVID-19 hospitalization and comorbidities derived from multiple data sources. (VA Informatics and Computing Infrastructure, 2020) We chose this time frame to ensure sufficient longitudinal data to evaluate the development of new MH conditions up to six months post-hospitalization through March 2021. We excluded patients who died during hospitalization (n= 1158) or within 6 months of discharge (n= 715), or were missing covariate information (n= 95) for a final sample of 3518 (see Table). We then linked data from the VHA Corporate Data Warehouse, a collection of diagnostic and clinical encounter data capturing information for all VHA patients. We operationalized development of new MH conditions based on whether a Veteran had been diagnosed with the condition within two years prior to hospitalization. We analyzed the odds ratios of developing new MH conditions using a logistic regression model adjusting for age, gender, race, ethnicity, length of hospitalization, ventilator use, body mass index, smoking history, marital status, rurality, Elixhauser score (i.e., comorbidity index), and mental health care utilization (pre- and post-hospitalization) (Moore et al., 2017). We chose the Elixhauser score as our comorbidity index due to past research supporting its utility as a predictor of re-admission and mortality following hospitalization (Moore et al., 2017). Relative model fit was evaluated using standard metrics (e.g., Akaike Information Criterion). All analyses were conducted with R version 4.0.2 (R Development Core Team, 2021).

**3. Results**

Prior to hospitalization, 61% of our sample had a mental health diagnosis. The most common, pre-hospitalization MH conditions were depressive disorders (40%), anxiety disorders (23%), and posttraumatic stress disorder (22%). Eight percent developed a new MH diagnosis with the most common new MH diagnoses being depressive (28%), anxiety (28%), and adjustment disorders (24%). Seventeen percent of patients had a new diagnosis of PTSD. Among patients with a new MH diagnosis, 64% had an existing comorbid MH diagnosis (e.g., prior diagnosis of depression but a new diagnosis of alcohol use disorder; see Supplemental Table 1). We found patients aged <45 years (OR = 1.56, p = .05) or 55–64 years (OR = 1.61, p < .01) were more likely to develop new MH conditions compared to those >=65 as well as those who lived in rural areas (OR = 1.49, p < .05) compared to those in urban areas. Women were less likely than men to develop a new MH condition (OR = 0.56, p < .05). As Elixhauser scores increased, the odds of new MH conditions decreased (OR = 0.99, p < .001; see Table 1). We found no significant interaction effects with race, gender, and MH care engagement in our exploratory analyses. We found no significant associations with other demographics and clinical variables. Mechanical ventilation was associated with increased odds of a new MH diagnosis but was not statistically significant (OR = 1.58, p = .06).

**4. Discussion**

Our findings show that a proportion of patients hospitalized for COVID-19 developed new MH diagnoses (8%) (Trivedi et al., 2015). These results reflect the extant literature showing significant mental health morbidity following medical hospitalization (Xie et al., 2022). Depressive disorders were the most common new MH condition. When considering specific predictors, age and rurality were associated with increased likelihood of developing a new MH condition. It is

**Table 1**  
Sample characteristics by new mental health diagnosis status.

	Overall N= 3518	New Mental Health Diagnosis Status		OR (95% CI)	P value
		No N = 3241	Yes N= 277		
Age (mean (SD))	64.33 (14.78)	64.71 (14.65)	59.78 (15.58)		
Age Category (%)					
65+	1936 (55.0)	1824 (56.3)	112 (40.4)	Ref	Ref
55–64	746 (21.2)	671 (20.7)	75 (27.1)	1.61 (1.13 - 2.29)	0.008
45–54	466 (13.2)	424 (13.1)	42 (15.2)	1.31 (0.85 - 2.03)	0.22
<45	370 (10.5)	322 (9.9)	48 (17.3)	1.56 (1.00 - 2.44)	0.05
Gender, Male/ Female (%)					
Female	263 (7.5)	246 (7.6)	17 (6.1)	0.56 (0.33 - 0.97)	0.04
Race (%)					
White	1649 (46.9)	1520 (46.9)	129 (46.6)	Ref	Ref
Black	1448 (41.2)	1331 (41.1)	117 (42.2)	1.04 (0.77 - 1.41)	0.78
Multiracial	156 (4.4)	146 (4.5)	10 (3.6)	0.90 (0.44 - 1.83)	0.77
Other/Unknown	265 (7.5)	244 (7.5)	21 (7.6)	1.10 (0.63 - 1.90)	0.74
Ethnicity, Non- Hispanic/ Hispanic (%)					
Hispanic/Latino	352 (10.0)	314 (9.7)	38 (13.7)	1.31 (0.86 - 2.00)	0.21
Length of Stay (mean (SD))	9.67 (13.42)	9.67 (13.44)	9.66 (13.22)	1.00 (0.99 - 1.01)	0.74
Ventilator Use, Yes/No (%)					
Yes	256 (7.3)	223 (6.9)	33 (11.9)	1.58 (0.98 - 2.56)	0.06
BMI* (mean (SD))	30.26 (7.34)	30.17 (7.43)	31.39 (6.20)	1.01 (0.99 - 1.03)	0.52
Smoking, Never/ Ever (%)					
Ever	1730 (49.2)	1594 (49.2)	136 (49.1)	0.96 (0.73 - 1.27)	0.77
Marital Status, Married/Single or Other (%)					
Single/Other	2108 (59.9)	1942 (59.9)	166 (59.9)	0.97 (0.74 - 1.28)	0.84
Rurality, Urban/ Rural (%)					
Rural	581 (16.5)	528 (16.3)	53 (19.1)	1.49 (1.05 - 2.13)	0.03
Elixhauser Score (mean (SD))	36.62 (28.19)	36.98 (28.48)	32.40 (24.24)	0.99 (0.98 - 1.00)	<0.001
Any MH† Use, 2-yr Prior/6-mo Post (%)					
No/No	1553 (44.1)	1519 (46.9)	34 (12.3)	Ref	Ref
No/Yes	234 (6.7)	152 (4.7)	82 (29.6)	26.13 (16.74 - 40.81)	<0.001
Yes/No	738 (21.0)	721 (22.2)	17 (6.1)	1.22 (0.67 - 2.21)	0.52
Yes/Yes	993 (28.2)	849 (26.2)	144 (52.0)	9.27 (6.19 - 13.87)	<0.001

\* Body Mass Index.

† Mental Health.

unsurprising that younger age groups showed increased risk, as MH conditions generally onset prior to 50 years of age (Solmi et al., 2021). In terms of rural dwelling patients, there may be more limited access to MH prevention resources increasing likelihood of distress. Clinicians may consider implementing additional MH prevention and intervention measures (e.g., screening, offering outpatient MH care) to mitigate MH morbidity post-COVID-19 hospitalization. Patients who had no history of MH care in the past two years were more likely to have a new MH diagnosis following hospitalization. It is possible that these patients had undetected MH diagnoses due to lack of engagement in MH care. These patients may also have had fewer existing MH coping resources leading to increased likelihood of negative MH sequelae following hospitalization. Unexpectedly, higher Elixhauser scores were associated with decreased likelihood of developing a new MH condition. However, this association appears secondary to inclusion of MH conditions as part of the Elixhauser formula (Moore et al., 2017). This is further supported by an additional sensitivity analysis performed using the Charlson Comorbidity Index which does not contain MH diagnoses (see Supplemental Table 2) and had no association with the development of new MH diagnoses (Charlson et al., 1987).

The current study evaluated the longitudinal association between COVID-19 hospitalization and the development of new MH conditions using a large, national sample. As this was an observational study, it is not possible to infer causation from our findings. In addition, we are unable to determine the degree which the prevalence of new MH conditions in our sample differs from the general population. Due to data limitations, we could not evaluate additional variables of interest such as social support and changes in post-hospitalization care sought outside the VA, which may inform MH trajectories. Although past research finds an increased incidence of PTSD following hospitalization especially within the context of mechanical ventilation, only 17% of our sample had a new diagnosis of PTSD limiting our ability to explore unique associations with specific MH diagnoses (Hatch et al., 2018). Future research should consider exploring social and clinical variables and care sought outside the VA to identify modifiable risk factors as well as those specific to individual MH diagnoses to prevent post-hospitalization MH distress.

#### Author note

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#### Declaration of Competing Interest

The authors report having no conflicts of interest in relation to this manuscript.

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#### Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2022.114570](https://doi.org/10.1016/j.psychres.2022.114570).

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