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Early versus late COVID-19 Home Health Care patient population: Shifting sociodemographics and comparable outcomes

Tami M. Videon | Robert J. Rosati | Steven H. Landers

The Visiting Nurse Association Health Group Inc., Holmdel, New Jersey, USA

Correspondence
Robert J. Rosati, The Visiting Nurse Association Health Group Inc., 23 Main St, Suite D1, Holmdel, NJ 07733, USA.
Email: Robert.Rosati@vnahg.org

Abstract

Early in the pandemic when hospitals reached capacity, Home Health Care (HHC) became a critical source of care for COVID-19 patients and continues to be an important source of care for recovering COVID-19 patients. Little is known about the COVID-19 patient population treated in HHC. This retrospective observational cohort follows 1614 HHC patients with a COVID-19 diagnosis and compares an "Early Cohort" between March 31 and May 31, 2020 to a "Late Cohort" between June 1 and December 31, 2020 for differences in: (1) sociodemographic and clinical characteristics (2) health care utilization, and (3) outcomes. Early patients were younger, more likely to be a minority, referred from hospitals or directly from emergency departments, started their care with greater independence in functional abilities, and had fewer comorbidities. Early patients were more likely to have COVID-19 as their primary diagnosis (88.5% vs. 79.4%, $p < 0.001$), and were assessed as having more severe COVID-19 symptoms. Early and Late Cohorts were assessed similarly for dyspnea at the start of care. COVID-19 patients in the Early Cohort were more likely to have their vital signs monitored remotely (7.3% vs. 1.4%; $p < 0.001$), have received oxygen in their home (27.8% vs. 15.3%; $p < 0.001$), and received more virtual care than patients in the Late Cohort (2.04 visits vs. 0.86 visits; $p < 0.001$), although they had approximately two fewer total visits (12.48 vs. 14.45; $p < 0.001$). Patients in both cohorts had substantial improvement in dyspnea and functional ability during the course of HHC.

KEYWORDS
COVID-19, activities of daily living, homecare, nursing care, interventions diseases

1 | INTRODUCTION

The COVID-19 pandemic was a massive juggernaut racing through health care systems worldwide. Anticipating a surge in demand for care at the start of the pandemic, hospital systems explored innovative ways of expanding capacity. Identifying previously unused spaces, modifying existing building space, and erecting field stations were quickly embraced as widespread solutions. Acute care systems' ability to accommodate COVID-19 patients' critical care needs became a primary focus. Measures of hospital-based healthcare utilization among COVID-19 patients were routinely reported in the news, and hospital bed capacity and ventilator availability became lingua franca of the pandemic.

The establishment of data tracking and real-time dashboards provided rapid dissemination of metrics on spread, severity of illness, and survival (Centers for Disease Control and Prevention, n.d.-a, n.d.;

State of New Jersey Department of Health, n.d.). Hospitalization, intensive care unit admission, and mortality within acute care settings became established benchmarks. Interactive websites and open data sources allowed researchers and laymen alike to explore patient populations in hospital settings. The Centers for Disease Control and Prevention provided access to six hospital-centered data sets (Centers for Disease Control and Prevention, n.d.-b).

A panicked population, differential infection rates, lack of knowledge about the course of illness, rapidly changing best practices for treatment, restrictions prohibiting hospital discharges from being denied admission to nursing homes, and vast numbers of primary care physicians opting not to treat COVID-19 patients or having insufficient PPE supplies all influenced substantial selection effects on how patients flowed through various health systems (Boehmer et al., 2020; Centers for Disease Control and Prevention n.d.-c, n.d.-d; Johns Hopkins Coronavirus Resource Center, n.d.). Two years into the pandemic, there is a solid understanding of patient populations flowing through hospital systems seeking health care for COVID-19. With hospitals giving priority to the most critical patients, the hospital census early in the pandemic overrepresented the elderly and patients with multiple comorbidities (Centers for Disease Control and Prevention, n.d.-d). However, as the pandemic evolved, hospital admissions transitioned to a younger population with fewer comorbidities (Horwitz et al., 2021).

In the initial surge, as hospitals approached maximum capacity, they needed contingency plans for patients in excess of their facility capabilities. Home Health Care (HHC) became an important source of care for COVID-19 patients as hospital beds were restricted to the most severely ill patients, and less severely ill, stable patients were referred to HHC. Yet, there are no published studies on patient overflow from hospitals into other care settings. One noteworthy exception is the documented excessive mortality among residents discharged from hospitals to nursing homes and longer-term care facilities, as well as infection rates among staff in these facilities (Kosar et al., 2021). Unlike the wildfire contagion witnessed in congregate care facilities, home health patients are safe from contagion from other patients, and research indicates home health clinicians experienced low rates of work-related infections while delivering care to COVID-19 patients (Videon et al., 2022).

While there are several nationally representative databases centering on COVID-19 and hospital care, there are no representative data sets on HHC. Despite the essential role of role of HHC in treating COVID-19 patients, there is little understanding of which patients were directed to HHC when acute care settings were unable to meet the demand for care. Documented improvements in acute care treatment of COVID-19 (Horwitz et al., 2021) necessarily led to a greater number of survivors requiring postacute care as the pandemic progressed. Therefore, we would expect changes in the COVID-19 HHC patient population as the pandemic progressed.

Only a handful of studies examined outcomes for HHC COVID-19 patients. These studies suggest HHC was adept at reducing symptom burden and increasing functional independence among early HHC COVID-19 patients (Bowles et al., 2021; Videon et al., 2021). However, to date, little is known about outcome trends among postacute patients. Evaluating outcomes for COVID-19 HHC patients is vital for future waves of COVID-19, and potential future pandemics. To what extent did HHC function as overflow for hospitals at maximum capacity? To what extent was HHC able to manage more critically ill patients for which hospitals did not have capacity? To what extent was HHC adept in treating convalescing patients discharged from hospitals? Did the impact of HHC on COVID-19 patients' outcomes change as best practices evolved? In this study, patients admitted to HHC early in the pandemic are compared to those admitted later. These populations are described and compared on sociodemographic and clinical characteristics, health care utilization, and outcomes.

2 | DESIGN AND SAMPLE

This retrospective, observational, cohort study used data from one of New Jersey's largest providers of HHC, The Visiting Nurse Association Health Group (VNAHG), to examine admissions of patients diagnosed with COVID-19 in 2020. New Jersey is a suitable geographic region to explore early cases in the pandemic, as its proximity to New York City made it an epicenter of early COVID-19 cases. By June 1, 2020, New Jersey was surpassed only by New York State in the incidence of COVID-19 cases (Statista, n.d.). At the start of the pandemic, anticipating surge capacity, the VNAHG made arrangements with local hospitals to take COVID-19 positive patients onto HHC service when there were not enough hospital beds for admission. The sample was limited to patients with a COVID-19 diagnosis who began their HHC between March 31 and December 31, 2020 ($n = 1614$). This study received approval from the VNAHG Institutional Review Board.

Figure 1 plots HHC admissions for patients with a COVID-19 diagnosis. After an initial surge peaking in late April, the number of COVID-19 patients receiving HHC dropped precipitously, and remained low until cases began increasing again in early November 2020. This curve mirrors figures reported by the New Jersey department of health for COVID-19 infections as well as hospitalizations (State of New Jersey Department of Health, n.d.). Using the natural curve of the graph, COVID-19 patients who came onto service between March 31 and May 31, 2020 were designated as the "Early Cohort," and those admitted between June 1 and December 31, 2020 as the "Late Cohort."

3 | MEASURES

3.1 | Physical assessments

The Outcome and Assessment Information Set (OASIS) is a comprehensive assessment tool mandated for HHC patients by the Centers for Medicare & Medicaid Services (CMS) (2019). The OASIS is a rich data source that includes information on clinical characteristics, functional abilities (instrumental activities of daily livings), and

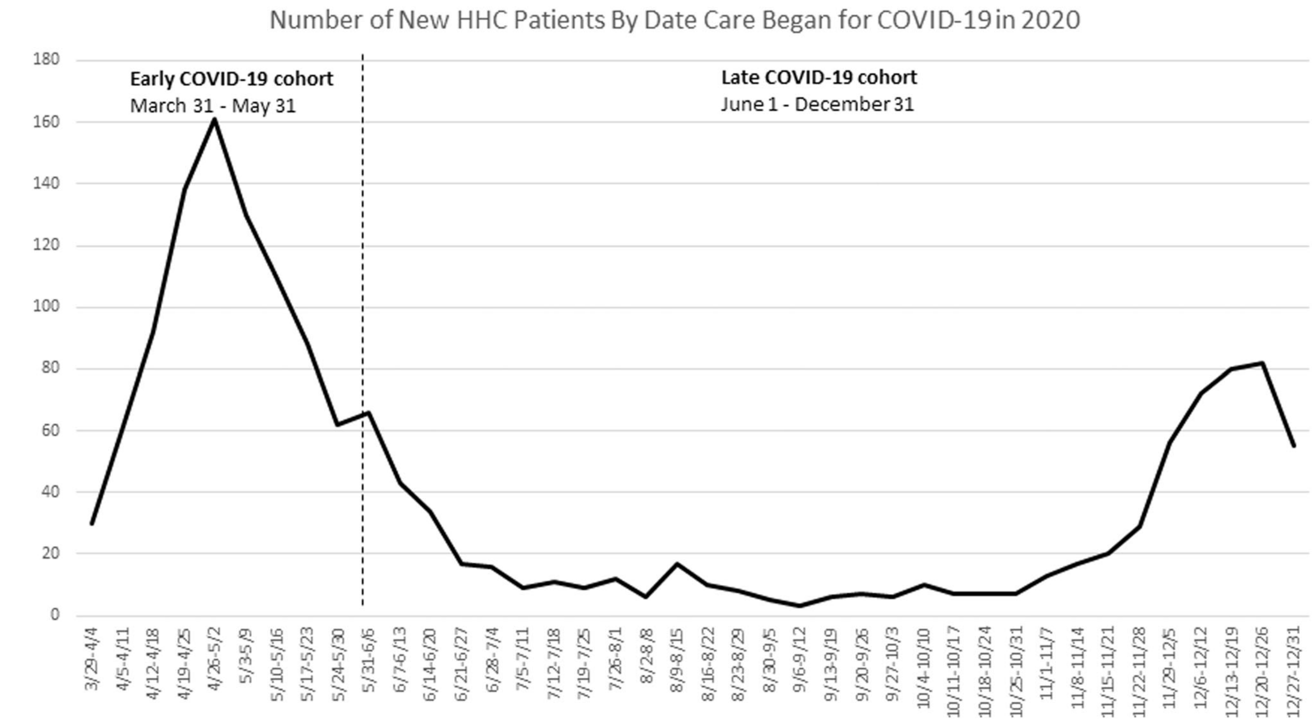

FIGURE 1 Admission of patients with COVID-19 into Home Health Care (HHC).

health status in addition to sociodemographic characteristics. Assessments are required at the start of care (SOC), transfer to inpatient facility, resumption of care, and discharge.

The OASIS contains 10 items assessing patient functional abilities (eating, oral hygiene, toilet hygiene, shower/bathing, upper body dressing, lower body dressing, putting on/taking off footwear, roll left to right, sit to lying, and lying to sitting on side of bed). At SOC, and discharge, patients are asked to perform these activities, while clinicians rate their performance. Response categories range from 1 (helper does all the effort to complete the activity) to 6 (patient completes the activity by themselves with no assistance from a helper). A small number of assessments ($n = 7$) indicated the activity was not attempted because the patient did not perform this activity before the current illness. These responses were recoded as dependent (=1) for that activity. An aggregate measure was created summing these 10 items with scores that ranged from 10 (total dependence) to 60 (total independence).

In addition to assessments of functional abilities, the OASIS contains four questions on patients' usual ability with everyday activities before the current illness (selfcare, ambulation, stairs, and functional cognition). Responses ranged from 1 (a helper completed the activities for the patient) to 3 (independent, no assistance needed). We summed responses to these four questions to form a single measure of pre-COVID-19 functional abilities, ranging from 4 (dependent on a helper for all activities) to 12 (complete independence). While not directly comparable to the measure of functional ability, it provides a gauge of independence in functional abilities before COVID-19 infection.

3.2 | Sociodemographics

Measured characteristics at admission included: sex, age, and race and ethnicity, living situation, and referral source.

3.3 | Clinical diagnoses and symptoms

Clinicians determined a primary diagnosis, and up to five other diagnoses for which the patient was receiving HHC. The degree of symptom control for each of the patient's diagnoses at SOC was assessed on a scale that ranges from 0 (asymptomatic, no treatment needed at this time) to 4 (symptoms poorly controlled). COVID-19 designation was determined by an ICD-10 code of U07.1 at the SOC OASIS assessment.

3.4 | Dyspnea

Severe acute respiratory syndrome coronavirus 2 is the virus that can lead to COVID-19. Dyspnea, or shortness of breath, is a common clinical symptom of COVID-19, and is frequently used as an indicator of respiratory symptoms (Simonelli et al., 2021). Dyspnea was measured using the OASIS measure of dyspnea with response categories that range from 0 (patient not short of breath) to 4 (short of breath at rest). Clinicians rated patients' dyspnea at SOC and again at discharge.

3.5 | Health care utilization

Data on visits made to the patient during the episode of care were obtained from the agency's Electronic Medical Records. Visits were categorized as in-person visits and visits done remotely (telehealth via phone call, video conference through tablets provided by the organization for telehealth, or an app on the patient's phone). Both the in-person and remote utilization measures included visits from all disciplines, including skilled nursing (SN), speech language pathologist (SLP), physical therapy (PT), occupational therapy (OT), Master of social work (MSW), home health aide (HHA).

3.6 | Data analysis

Change in patients' outcomes (dyspnea and functional ability) through the course of the HHC episode was calculated by subtracting SOC scores from discharge scores; positive scores indicated improvement, and negative scores indicated patient decline from SOC to discharge. Patients who were transferred to an inpatient facility or expired during the course of their care did not have outcome measures at the termination of HHC; therefore, only discharged patients were included in the analyses of change. Categorical variables were reported as frequencies and percentages, and continuous variables as means and standard deviations. Fisher's Exact test were provided for frequency comparisons and *F*-statistics for comparisons of means. All analyses were performed in SPSS, version 25.

4 | RESULTS

A total of 1614 patients diagnosed with COVID-19 received HHC services between March 31 and December 31, 2020. The Early Cohort consisted of 880 patients and the Late Cohort consisted of 734 patients. Patients were primarily non-Hispanic White and between 65 and 84 years old (see Table 1). A total of 218 (13.5%) patients were transferred to an inpatient facility and 11 (<1%) expired during the course of their care and were not included in analysis because of lack of outcome measures. Patients discharged from HHC included in the analyses numbered 1385 (85.8% of the original sample). There were no significant cohort differences in the percentage of patients whose care ended in discharge (86.5% Early, 85.0% Late; $p = 0.43$).

4.1 | Patient characteristics: Comparing Early and Late COVID-19 cohorts

4.1.1 | Sociodemographic and clinical characteristics

Table 1 indicates a shifting patient demographic between the Early and Late COVID-19 Cohorts. Average patient age increased from 67 to 72 years old, with a doubling of the percentage of patients 85 years and older (9.0%–18.1%; $p < 0.001$). Whites comprised 41.0% of patients in the early COVID-19 patient cohort, but grew to 55.7% in the Late Cohort ($p < 0.000$). Changes in the percentage of Hispanic patients decreased significantly from the Early (22.6%) to Late (13.5%) Cohort ($p < 0.001$); although changes in the Black and other racial and ethnic categories were not significant.

Before their current illness, COVID-19 patients in the Early Cohort rated their performance of everyday activities as more independent compared with the Late Cohort (10.87 vs. 10.22; $p < 0.001$); 68.4% of the Early Cohort could complete all four activities independently, compared to only 50.5% of the Late Cohort ($p < 0.001$).

The majority of patients in the Early Cohort (68.3%) were referred from hospitals. While hospitals remained the largest referral category in the Late Cohort (59.1%), the proportion was smaller ($p < 0.001$), and there were greater proportions of referrals from SN facilities (10%–15%; $p < 0.01$) and other facilities (6.8%–9.8%; $p > 0.05$).

Patients in the Early Cohort were also significantly more likely to come directly to HHC from hospital emergency departments (ED) and were not admitted to an inpatient bed at the hospital (2.8% vs. 0.1%; $p < 0.001$). Analyses examining patients coming directly from the ED indicated they were, on average, 10 years younger (57 vs. 67 years old; $p < 0.001$) and had substantially fewer comorbidities (3.5 vs. 4.6; $p < 0.001$) compared to other Early Cohort patients; only 44.0% of patients admitted to HHC directly from the ED had five comorbidities compared to 77.4% referred to HHC in other ways. Comparisons of symptom severity indicated no significant differences between patients admitted to HHC from the ED and those admitted after hospital discharge. A greater proportion of the Early Cohort had COVID-19 listed as the primary diagnosis for seeking HHC (88.5% vs. 79.4%; $p < 0.001$), and Early Cohort patients were assessed to have significantly more severe symptoms for COVID-19 (2.61 vs. 2.43; $p < 0.001$). Patients in the Early Cohort were also significantly more likely to receive remote monitoring (7.3% vs. 1.4%; $p < 0.001$) and home oxygen (27.8% vs. 15.3%; $p < 0.001$) than patients in the Late Cohort. Both groups had considerable comorbidities, although the Late Cohort had significantly more comorbidities than the Early Cohort (4.56 vs. 4.76; $p < 0.001$); 76.5% of the Early Cohort had five or more comorbidities compared to 87.5% of the Late Cohort ($p < 0.001$).

4.1.2 | Health care utilization

Health care utilization was also significantly different between the cohorts. The Early Cohort had fewer in-person visits (10.4 vs. 13.6; $p < 0.001$), but received significantly more remote visits (2.0 vs. 0.9; $p < 0.000$). Overall, the Early Cohort received two fewer visits (12.5 vs. 14.5; $p < 0.01$). Compared to Early Cohort patients, Late Cohort patients received significantly more in person visits for every discipline (SLP, PT, OT, MSW, and HHA) except nursing (Early = 5.3, Late = 5.7; $p = 0.133$). The Early Cohort had significantly greater

TABLE 1 Sociodemographic characteristics of HHC COVID-19 patients by Early versus Late Cohort ($n = 1614$)

	Early Cohort ($n = 880$) Mean ± SD or N (%)	Late Cohort ($n = 734$) Mean ± SD or N (%)	Fischer's exact test or t-statistic	p value
Demographics				
Male	439 (49.9%)	350 (47.7%)	0.78	0.395
Age	67.14 ± 14.50	71.55 ± 14.03	38.09	<0.001
Under 65 years old	349 (39.7%)	216 (29.4%)	18.41	<0.001
65–84 years old	452 (51.4%)	386 (52.6%)	0.24	0.653
85 years of age and older	79 (9.0%)	132 (18.0%)	28.57	<0.001
Race and ethnicity				
Black	241 (27.4%)	177 (24.1%)	2.23	0.138
Hispanic	199 (22.6%)	99 (13.5%)	22.14	<0.001
White	361 (41.0%)	409 (55.7%)	34.12	<0.001
Other	79 (9.0%)	49 (6.7%)	2.90	0.096
Live alone	131 (14.9%)	133 (18.1%)	3.06	0.091
Patient functioning in everyday activities before COVID-19 infection				
Summary score (range 0–12)	10.87 ± 1.95	10.22 ± 2.24	38.45	<0.001
% of patients who were totally independent (score of 12) before COVID-19	602 (68.4%)	371 (50.5%)	53.34	<0.001
Referral source				
Hospital	601 (68.3%)	434 (59.1%)	14.62	<0.001
Rehab facility	128 (14.5%)	116 (15.8%)	0.49	0.486
Skilled nursing facility	91 (10.3%)	112 (15.3%)	8.80	0.003
Other	60 (6.8%)	72 (9.8%)	4.77	0.036
ED to home	25 (2.8%)	1 (0.1%)	18.47	<0.001
COVID-19 measures				
COVID-19 is primary diagnosis	779 (88.5%)	583 (79.4%)	25.13	<0.001
Severity of COVID-19 symptoms	2.61 ± 0.56	2.43 ± 0.61	35.94	<0.001
Comorbidities				
Average	4.56 ± 0.90	4.76 ± 0.72	23.62	<0.001
Five or more comorbidities	673 (76.5%)	642 (87.5%)	32.02	<0.001
Health care utilization				
Overall visits	12.48 ± 12.05	14.45 ± 16.86	7.45	0.006
In-person visits	10.44 ± 11.92	13.59 ± 16.87	19.19	<0.001
Remote visits	2.04 ± 1.89	0.86 ± 1.28	187.80	<0.001
Remote monitoring	64 (7.3%)	10 (1.4%)	31.96	<0.001
Home oxygen	245 (27.8%)	112 (15.3%)	36.78	<0.001

Abbreviations: HHC, Home Health Care; *M*, mean; SD, standard deviation.

TABLE 2 Patient outcomes at start of care, discharge, and change by cohort ($N = 1385$)

	Early Cohort ($n = 761$) $M \pm SD$	Late Cohort ($n = 624$) $M \pm SD$	Fstatistic	*p* value
Dyspnea at discharge				
Start of care	1.99 ± 0.89	2.01 ± 0.88	0.29	0.591
Discharge	0.37 ± 0.59	0.44 ± 0.60	4.62	0.032
Change	1.61 ± 0.90	1.57 ± 0.89	0.82	0.365
Functional abilities				
Start of care	38.75 ± 10.01	34.90 ± 10.15	49.57	>0.001
Discharge	56.26 ± 7.92	53.64 ± 10.08	29.21	>0.001
Change	17.51 ± 9.37	18.78 ± 9.45	5.91	0.011

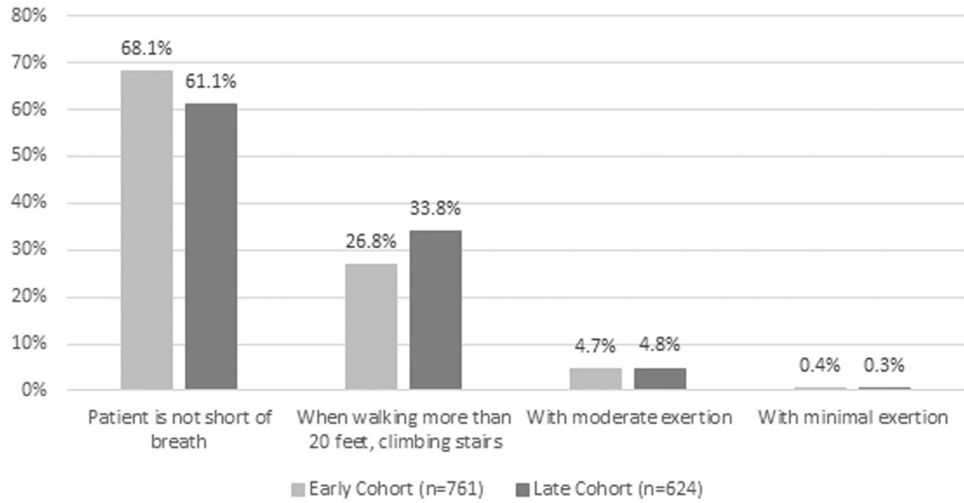

FIGURE 2 Shortness of breath (dyspnea) at discharge by cohort.

remote visits for nurses and physical therapists, but not social workers.

4.1.3 | Patient outcomes: Comparing Early and Late COVID-19 Cohorts

4.1.3.1 | *Dyspnea*

Table 2 reports on patient outcomes at SOC and discharge as well as change scores for COVID-19 patients discharged from HHC ($n = 1385$). At SOC, dyspnea levels were similar for the Early and Late Cohorts when comparing means (1.99 vs. 2.01; $p = 0.591$). By discharge, there were significant differences between the groups; the Early Cohort had a significantly lower mean score (0.37 vs. 0.44; $p = 0.032$), indicating less dyspnea. Figure 2 shows the distribution of categorical responses for dyspnea at discharge. The Early Cohort were more likely to have no shortness of breath (68% vs. 61%; $p = 0.007$) when discharged from HHC. The Late Cohort were significantly more likely to be short of breath when walking more 20 ft or climbing stairs (34% vs. 27%; $p = 0.006$). Directly examining change scores in dyspnea from SOC to discharge revealed nonsignificant differences between the groups (1.61 vs. 1.57; $p = 0.365$).

4.1.3.2 | *Functional abilities*

At SOC, patients in the Early Cohort had significantly higher functional scores (38.8 vs. 34.9; $p < 0.001$). Similarly, at discharge, patients in the Early Cohort had significantly greater functional abilities (56.3 vs. 53.6; $p < 0.001$). Examining change in functional abilities indicated patients in the Late Cohort experienced significantly greater gains than the Early Cohort (17.5 vs. 18.8; $p = 0.011$).

5 | DISCUSSION

This study provides a first glimpse into trends for the HHC COVID-19 patient profile, the substantial shift in the way COVID-19 patients were referred to HHC, and their health care utilization. Patients in the Early Cohort were more frequently referred from a hospital, including those directly from the ED, while the Late Cohort had greater proportions of patients referred from SN and other facilities. These findings suggest that in the early phase of the pandemic, HHC functioned as a source of overflow care in a healthcare system of overburdened acute care facilities. Prioritization of more vulnerable patients within hospitals in the Early Cohort is evidenced by the younger age and fewer comorbidities among patients referred to HHC directly from the ED. Among patients in the Early Cohort, similar symptom severity ratings for patients referred directly from the ED and those referred after hospital discharge likely reflect that hospitals moved less acute patients directly to HHC and admitted more severely ill patients until they were well enough to transition to HHC. Comparisons of illness severity between the Early and Late Cohorts indicate HHC admitted a more acutely sick patient population early in the pandemic. This difference is not solely a function of a greater percentage of hospital referrals in the Early Cohort. Hospital referrals in the Early Cohort had more severe symptoms than hospital referrals in the Late Cohort (2.63 vs. 2.52; $p < 0.001$). Again, these findings suggest that during surge capacity, hospitals were triaging patients, and shifting them to HHC with greater symptom severity (compared with later in the pandemic) to free beds for more critically ill patients. Other indicators of more severe illness in the Early Cohort were the greater likelihood of receiving oxygen in the home as well as remote monitoring.

At the start of the pandemic, age was strongly associated with mortality, with increases in age associated with exponentially higher mortality (Biswas et al., 2021; Caramelo et al., 2020; Center for Disease Control & Prevention, n.d.-d; Hussain et al., 2020). High mortality among the elderly during the initial phase of the pandemic not only changed the demography of the US population, but also the potential pool of HHC patients. Shifts to a more aged HHC patient population in the Late Cohort, as well as greater referrals from SN and other facilities, likely signal improvements in acute treatment and stabilization of COVID-19 patients as the pandemic progressed (Horwitz et al., 2021; Kosar et al., 2021; Seligman et al., 2021).

The COVID-19 pandemic radically transformed health care delivery, with massive increases in telehealth and remote services (Jonnagaddala et al., 2021; Raffan et al., 2021; Slomski, 2020). Early reports suggested that blood-oxygen saturation was an important, but silent, clinical warning sign of deterioration among COVID-19 patients (Shah et al., 2020). The organization was able to seamlessly enroll COVID-19 patients into their existing remote monitoring program, allowing clinical surveillance of this at-risk population and early intervention if necessary. Rapid uptake of remote monitoring early in the pandemic may have allowed clinicians to avert unnecessary hospitalization among a more acutely ill patient population in the Early Cohort. Patients in the Early Cohort were also significantly more likely to receive oxygen in the home. There were no differences in the rate of hospitalization between the Early and Late Cohort (Early 12.7%, Late 14.4%; $p = 0.342$). These findings suggest that increased interventions (oxygen in the home and monitoring) may have kept Early Cohort patients from deteriorating and cycling back to the hospital.

During the pandemic there was a greater demand for virtual care. In HHC, payment parity between telemedicine and in-person services was low before the pandemic. At the start of the pandemic some commercial payers, and the Centers for Medicare and Medicaid Services modified their payment policy to provide reimbursement for all telemedicine care, across video or voice platforms. At the outset of the pandemic, organizational protocols called for an in-person SOC visit, followed by remote visits until a standard period of contagiousness had passed, or in-home visits were requested by the patient, or warranted medically. Patients in the Early Cohort had significantly more telehealth visits compared to the Late Cohort. Roughly half of the remote care provided was by phone, while the other half employed newer technology (i.e., video platforms). Overall, patients in the Early Cohort received more telehealth visits than those in the Late Cohort. Despite a greater volume of nursing telehealth visits in the Early Cohort, there were no significant differences in the number of in-person nursing visits. These findings suggest telehealth was not a replacement for in-person nursing care, but reflected increased remote monitoring of vital signs as well as check-ins to make sure the patient did not require increased care. Patients in the Early Cohort utilized more telehealth PT visits, but received fewer in-person PT visits. These findings could indicate a transition to remote PT care early in the pandemic, to prevent virus transmission among patients and staff, with transitioning back to in-person care. These findings also suggest a greater need for PT among the Late Cohort group. The overall greater utilization of healthcare services among the Late Cohort was due to increases in in-person therapy visits (PT, OT, MSW, and HHA), consistent with an older patient population with greater comorbidities. Delivery of health care services via telehealth not only addressed patient preferences to avoid in-home contact, but also served to protect clinicians from potential infection. Some of the remote visits were driven by patients requesting phone check-ins rather than in-person visits. Additionally, early in the pandemic, the organization placed a greater emphasis on remote care in efforts to adjust for staffing shortages. As the pandemic progressed, modes of transmission were better understood and workforce availability stabilized, leading to less remote care for COVID-19 patients.

The cohorts had significantly different racial/ethnic profiles. Patients in the Early Cohort were significantly more likely to be a minority and reported greater independence in daily activities before COVID-19 infection. This profile suggests that "essential workers" may have comprised a substantial number of early HHC COVID-19 patients (Selden & Berdahl, 2020; US Bureau of Labor Statistics, 2021). As the pandemic progressed, the patient profile of COVID-19 HHC patients more closely resembled a typical HHC patient population; they were older, had more comorbidities, and had greater functional dependencies at SOC (Avalere Health & Alliance for Home Health Quality and Innovation, 2021; Videon et al., 2021).

Despite different starting and ending points, patients in both cohorts exhibited large gains in independence in functional abilities between SOC and discharge. While less than 1% of patients, in both the Early and Late Cohorts, had complete independence in functional activities at SOC, by discharge 64% of Early, and 47% of Late Cohort patients, were completely independent. On average, the Early Cohort gained 17.5 points in a 60-point scale of functional abilities. The Late Cohort gained nearly 19 points. This increase in approximately 30% of the range in functional abilities is substantial, and noteworthy. Differences in improvement in functional abilities between the Early and Late Cohort were not large, and were approximately equivalent to a change in one response category (with six levels of responses) to one question (out of 10). These findings suggest that even though the cohorts had different starting points, the different patient groups received relatively similar benefit from the receipt of HHC.

Research suggests that recovering COVID-19 patients may take some time to fully regain their functional abilities (Blair et al., 2021), and that some individuals continue to have on-going deficits in their ability to perform everyday activities weeks after infection (Bowles et al., 2021; Vaes et al., 2020; Videon et al., 2021). We did not have OASIS measures of functional ability before COVID-19 infection, therefore it is unknown whether patients returned to their usual state of health by discharge, or whether recuperation from COVID-19 was incomplete when HHC ended, with lingering sequela. Patients in the Early Cohort indicated they had greater independence in everyday activities before COVID-19 infection, so it could be expected they would be discharged with more functional independence. However, since the measure of functioning before illness is different from the measure of functional abilities at SOC and discharge, analyses cannot determine if patients returned to their pre-COVID-19 level of functional independence.

Nearly all patients, 95% of both the early and Late Cohorts, had some level of difficulty breathing (dyspnea) when they began HHC. Both cohorts demonstrated substantial improvement in dyspnea by discharge (1.6 on a five-point scale). By discharge, patients in the Early Cohort were significantly more likely to have no shortness of breath (68% vs. 61%; $p < 0.05$). It is unclear whether differences in dyspnea at discharge reflects lingering dyspnea in a subset of patients that is attributable to their COVID-19 infection, or a return to preinfection "usual" breathing. Several studies suggest that patients recovering from COVID-19 have lingering dyspnea, with patients reporting shortness of breath weeks after infection (Cellai & O'Keefe, 2020; Halpin et al., 2020; O'Keefe et al., 2020; Weerahandi et al., 2021; Wu et al., 2021). The Late Cohort had more comorbidities in general, and greater comorbidities have been shown to be associated with delayed return to usual health (Tenforde et al., 2020). Moreover, older age is associated with prolonged symptoms (Carvalho-Schneider et al., 2021), and the Late Cohort was significantly older. An alternative explanation is that differences in dyspnea at discharge represent differences between the cohorts that predate COVID-19 infection.

6 | CONCLUSION

The vital role of role of HHC in treating COVID-19 patients, has been absent from public discourse and minimally included in the published literature. Early in the pandemic, HHC readily took overflow patients from hospitals, often directly from the ED, and provided care to a new patient population in a heavily strained health care system. As the pandemic progressed, acute care settings underwent a transition from older patients with greater comorbidities, to a younger patient population with fewer comorbidities. In contrast, HHC served a substantially younger population with fewer comorbidities at the start of the pandemic and trended to older patients with more comorbidities later in the pandemic. Care of COVID-19 HHC patients also shifted significantly as the pandemic progressed; Early Cohort HHC patients were significantly more likely to receive remote monitoring, oxygen in the home, and have remote check-ins compared to the Late Cohort. These findings highlight the changing function of HHC in the pandemic; from accepting overflow from acute care (e.g., directly from EDs), to a growing subpopulation from long term care facilities.

Despite a change in the patient population seeking HHC for COVID-19, sociodemographically as well as clinically, patients in both the Early and Late Cohort demonstrated substantial and significant improvements in dyspnea and functional abilities during the course of HHC. HHC proved adept at treating exceptionally different patient populations, altering treatment depending on the needs of patients, and demonstrating extensive improvements in outcomes. HHC holds the potential, in future waves of COVID-19, or a new pandemic, of both serving as a source of overflow care when acute care settings are overburdened, as well as serving patients discharged from acute and long-term care settings.

AUTHOR CONTRIBUTIONS

Tami M. Videon: Conception and Design, Analysis and interpretation of data, Drafting of article, Critical revision for important intellectual content, Final approval of the article, Statistical expertise. **Robert J. Rosati:** Conception and Design, Analysis and interpretation of data, Drafting of article, Critical revision for important intellectual content, Final approval of the article. **Steven H. Landers:** Drafting of article, Critical revision for important intellectual content, Final approval of the article.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Authors elect to not share data.

ORCID

Robert J. Rosati http://orcid.org/0000-0002-2425-8570

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