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# Surviving COVID-19 After Hospital Discharge: Symptom, Functional, and Adverse Outcomes of Home Health Recipients

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**Background:** Little is known about recovery from coronavirus disease 2019 (COVID-19) after hospital discharge.

**Objective:** To describe the home health recovery of patients with COVID-19 and risk factors associated with rehospitalization or death.

**Design:** Retrospective observational cohort.

**Setting:** New York City.

**Participants:** 1409 patients with COVID-19 admitted to home health care (HHC) between 1 April and 15 June 2020 after hospitalization.

**Measurements:** Covariates and outcomes were obtained from the mandated OASIS (Outcome and Assessment Information Set). Cox proportional hazard models were used to estimate the hazard ratio (HR) of risk factors associated with rehospitalization or death.

**Results:** After an average of 32 days in HHC, 94% of patients were discharged and most achieved statistically significant improvements in symptoms and function. Activity-of-daily-living dependencies decreased from an average of 6 (95% CI, 5.9 to 6.1) to 1.2 (CI, 1.1 to 1.3). Risk for rehospitalization or death was higher for male patients (HR, 1.45 [CI, 1.04 to 2.03]); White patients (HR, 1.74 [CI, 1.22 to 2.47]); and patients with heart failure (HR, 2.12 [CI, 1.41 to 3.19]), diabetes with complications (HR, 1.71 [CI, 1.17 to 2.52]), 2 or more emergency department visits in the past 6 months (HR, 1.78 [CI, 1.21 to 2.62]), pain daily or all the time (HR, 1.46 [CI, 1.05 to 2.05]), cognitive impairment (HR, 1.49 [CI, 1.04 to 2.13]), or functional dependencies (HR, 1.09 [CI, 1.00 to 1.20]). Eleven patients (1%) died, 137 (10%) were rehospitalized, and 23 (2%) remain on service.

**Limitations:** Care was provided by 1 home health agency. Information on rehospitalization and death after HHC discharge is not available.

**Conclusion:** Symptom burden and functional dependence were common at the time of HHC admission but improved for most patients. Comorbid conditions of heart failure and diabetes, as well as characteristics present at admission, identified patients at greatest risk for an adverse event.

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New York State reported its first official case of coronavirus disease 2019 (COVID-19) on 1 March 2020 (1), approximately 1 month after the first U.S. case was reported on 31 January in Washington State (2). According to the World Health Organization (3), the United States surpassed both China and Italy in total number of cases on 29 March 2020 and maintains the highest number of cases worldwide (4). After a major outbreak in Westchester County, New York City and the surrounding area became an epicenter of the COVID-19 pandemic (5). As of 15 September 2020, New York City contained 54% of New York State's cases and 3.6% of total U.S. cases (6). Now, at nearly 200 days since the first reported case in New York, we can begin to explore what recovery looks like.

Survivors of COVID-19 are a vulnerable population who often have sequelae from their illness and hospital stay, which may impair their overall health status and create greater health needs after hospitalization (7). However, a recent large case series demonstrated that 94.1% of patients with COVID-19 were discharged home (8). How their recovery needs, which are probably similar to those of sepsis survivors (9), are being met is unclear.

No information exists yet to describe the characteristics and outcomes of COVID-19 survivors discharged to the home setting. With rich data from home health care (HHC), we describe characteristics of patients with COVID-19 upon admission to HHC, the home visits received, and the extent of recovery among COVID-19 survivors discharged from HHC. Finally, we profile the risk factors associated with rehospitalization or death.

## Methods

This retrospective observational cohort study was conducted at the largest free-standing not-for-profit home health agency in the United States, which is located in the New York City area, the epicenter of the COVID-19 pandemic. The Institutional Review Board of the Visiting Nurse Service of New York exempted this study because it used existing data collected for routine HHC and was deidentified for analysis.

### Sample

All patients with confirmed COVID-19 who were referred from a hospital and admitted to HHC services through the Visiting Nurse Service of New York between 1 April and 15 June 2020 were included ($n$ = 1409). Referrals came from 64 hospitals in the 5 surrounding boroughs of New York City. Patients were followed until 15 September 2020.

### Measurements

Each COVID-19 diagnosis was confirmed by laboratory results from the referring hospital. Sociodemographic

variables, including age, race, ethnicity, sex, referring hospital, and insurance type, were obtained from the referral, intake, and OASIS (Outcome and Assessment Information Set) version D-1 datasets. The OASIS D-1 is a comprehensive Centers for Medicare & Medicaid Services–mandated assessment tool completed by the HHC nurse or physical therapist. It includes nearly 100 structured data items related to an HHC recipient's functional status, clinical status, and service needs (10). Item reliability ranges from fair to excellent (11–13). Functional, clinical, and service characteristics include medical diagnoses, rehospitalization risk factors, pain, dyspnea, cognitive function, anxiety, activities of daily living (ADLs), and medication management. Assessments are collected by clinicians at admission, transfer, resumption, recertification, and discharge from HHC. The OASIS assessment is mandatory, so no data are missing.

Number of functional dependencies at both HHC admission and discharge was determined by counting how many of 9 ADLs (grooming, dressing upper body, dressing lower body, bathing, toilet transferring, toilet hygiene, transferring, ambulation, and feeding) required human help for the patient to perform.

Information on the number of HHC visits, the type of visit (in-person, phone, or tele-video), and the discipline of the clinician delivering care (registered nurse, physical therapist, occupational therapist, speech therapist, home health aide, or social worker) was obtained from the agency's administrative data.

Adverse events (transfer to an inpatient facility or death before discharge from HHC) were coded by the HHC clinician on the transfer or discharge OASIS. Other disposition codes include resumption of care after a rehospitalization, discharge to the community with or without assistive services, transfer to another facility (rehabilitation or skilled nursing facility, nursing home, or hospice), or recertification for more HHC. Once discharged from HHC, subsequent rehospitalization events were not identifiable unless patients returned to HHC.

Participants were followed from HHC admission to discharge to the community, until an adverse event (death or rehospitalization), or until 15 September 2020, whichever occurred first.

### Statistical Analysis

Categorical variables are reported as frequencies and proportions and continuous variables as means and SDs. $\chi^2$ and *t* tests (2-group comparisons) or 1-way analysis of variance (3-group comparisons) were used where appropriate. McNemar tests were used to estimate the differences and CIs in the frequency of symptoms and functional status from HHC admission to discharge to the community. Negative binomial regression models were used to obtain marginal means and 95% CIs, comparing the average number of visits by visit type and clinician discipline across age groups.

Cox proportional hazard models were used to identify factors measured at the time of admission to HHC that were associated with an adverse event. For the purpose of this analysis, follow-up was defined as the time until the first adverse event or 15 September 2020. Factors associated with the event in unadjusted models were included in a multivariate model. The final adjusted model was obtained by using stepwise regression until a parsimonious model was found. The indicator variable for age 65 or greater was forced into the model. The proportionality assumption was tested for all variables and the full adjusted model. Statistical tests were performed with R, version 4.0.0 (The R Foundation), and negative binomial regression models with Stata 16.1 (StataCorp).

### Role of the Funding Source

This study was not directly funded. Several investigators received salary support from other sources, and that funding did not influence the study design, analysis, or decision to publish this analysis.

## RESULTS

The sample consists of 1409 COVID-19 survivors discharged from a short-stay acute care hospital and admitted to HHC between 1 April and 15 June 2020. Table 1 presents the sociodemographic and clinical characteristics of the overall sample upon admission to the agency and by age category. Referrals were received from 64 hospitals in the New York City area. The first home health visit occurred within 3 days of hospital discharge for 80% of the sample (average, 2.4 days [SD, 2.19]).

The average age of the cohort was 67 years (SD, 15); 43% of the patients were younger than 65 years, 36% were between the ages of 65 and 80 years, and 21% were aged 80 years or older. The cohort was 51% male, 27% non-Hispanic White, 28% non-Hispanic Black, and 35% Hispanic. Medicare was the payer for 46% of patients; 15% were insured by Medicaid only; 12% were dually eligible for Medicaid-funded services and Medicare; and 27.5% were categorized as having "other" coverage, which largely included private insurance.

### Clinical Profiles of COVID-19 Survivors Upon HHC Admission

The HHC admission profile of COVID-19 survivors illustrates comorbid conditions, substantial risk factors for rehospitalization, symptom burden, and functional dependence (Table 1). The most common comorbid conditions were hypertension (69%), diabetes (41%), and chronic pulmonary disease (16%). Regarding rehospitalization risk, 94% had at least 1 risk factor from the OASIS assessment: 74% received 5 or more medications; 50% reported exhaustion on admission; 22% had difficulty adhering to medical instructions; and 15% had a recent decline in mental, emotional, or behavioral status. Pain was present daily or all the time for 42% of patients, 84% reported dyspnea with any exertion, 50% reported symptoms of anxiety, and 47% reported confusion. Functional dependence, defined as needing human help with ADLs, was very common, with an average of 6 (SD, 2) dependencies in 9 activities; 85% of patients depended on help with 4 or more ADLs, whereas 65% were unable to self-manage their oral medications.

***Table 1.*** Profile, Overall and by Age, of Patients With COVID-19 Discharged From a Short-Stay Hospital and Admitted to HHC*

| Characteristics at Start of HHC | All Patients (*n* = 1409) | Age Group | | |
|---|---|---|---|---|
| | | <65 y (*n* = 599) | 65–79 y (*n* = 506) | ≥80 y (*n* = 304) |
| Male | 724 (51) | 338 (56) | 250 (49) | 136 (45) |
| Race | | | | |
| Non-Hispanic White | 387 (27) | 118 (20) | 153 (30) | 116 (38) |
| Non-Hispanic Black | 400 (28) | 179 (30) | 150 (30) | 71 (23) |
| Hispanic | 489 (35) | 237 (40) | 157 (31) | 95 (31) |
| Other | 133 (9) | 65 (11) | 46 (9) | 22 (7) |
| Payer | | | | |
| Medicare only | 644 (46) | 57 (10) | 351 (69) | 236 (78) |
| Medicaid only | 212 (15) | 190 (32) | 14 (3) | 8 (3) |
| Dual | 166 (12) | 24 (4) | 85 (17) | 57 (19) |
| Other | 387 (27) | 328 (55) | 56 (11) | 3 (1) |
| Lives alone | 274 (19) | 79 (13) | 115 (23) | 80 (26) |
| Mean days from hospital discharge to SOC (SD) | 2.4 (2.2) | 2.4 (2.2) | 2.4 (2.2) | 2.4 (2.2) |
| Elixhauser comorbid conditions | | | | |
| Congestive heart failure | 139 (10) | 40 (7) | 52 (10) | 47 (15) |
| Cardiac arrhythmias | 161 (11) | 25 (4) | 69 (14) | 67 (22) |
| Valvular disease | 19 (1) | 3 (1) | 7 (1) | 9 (3) |
| Hypertension | | | | |
| Uncomplicated | 699 (50) | 256 (43) | 283 (56) | 160 (53) |
| Complicated | 270 (19) | 70 (12) | 114 (23) | 86 (28) |
| Other neurologic disorders | 90 (6) | 33 (6) | 29 (6) | 28 (9) |
| Chronic pulmonary disease | 230 (16) | 98 (16) | 77 (15) | 55 (18) |
| Diabetes | | | | |
| Uncomplicated | 365 (26) | 160 (27) | 140 (28) | 65 (21) |
| Complicated | 216 (15) | 79 (13) | 85 (17) | 52 (17) |
| Hypothyroidism | 100 (7) | 30 (5) | 44 (9) | 26 (9) |
| Kidney failure | 221 (16) | 63 (11) | 90 (18) | 68 (22) |
| HIV/AIDS | 36 (3) | 22 (4) | 12 (2) | 2 (1) |
| Metastatic cancer | 18 (1) | 7 (1) | 10 (2) | 1 (0) |
| Solid tumor without metastasis | 127 (9) | 41 (7) | 54 (11) | 32 (11) |
| Obesity | 122 (9) | 81 (14) | 32 (6) | 9 (3) |
| Depression | 96 (7) | 30 (5) | 35 (7) | 31 (10) |
| Hospitalization risk factors | | | | |
| Receiving ≥5 medications | 1045 (74) | 382 (64) | 411 (81) | 252 (83) |
| Difficulty adhering to medical instructions | 314 (22) | 106 (18) | 121 (24) | 87 (29) |
| Currently reports exhaustion | 709 (50) | 290 (48) | 274 (54) | 145 (48) |
| History of falls (≥2, or fall with injury in past 12 mo) | 110 (8) | 26 (4) | 43 (8) | 41 (13) |
| Multiple ED visits (≥2 in past 6 mo) | 186 (13) | 58 (10) | 72 (14) | 56 (18) |
| Multiple hospitalizations (≥2 in past 6 mo) | 211 (15) | 63 (11) | 85 (17) | 63 (21) |
| Decline in mental, emotional, or behavioral status in past 3 mo | 211 (15) | 61 (10) | 88 (17) | 62 (20) |
| Other risk | 320 (23) | 136 (23) | 131 (26) | 53 (17) |
| Unintentional weight loss (≥10 lb in past 12 mo) | 148 (11) | 57 (10) | 57 (11) | 34 (11) |
| No risk reported | 84 (6) | 51 (9) | 22 (4) | 11 (4) |

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*Table 1*–Continued

| Characteristics at Start of HHC | All Patients (*n* = 1409) | Age Group | | |
|---|---|---|---|---|
| | | <65 y (*n* = 599) | 65–79 y (*n* = 506) | ≥80 y (*n* = 304) |
| Symptoms | | | | |
| Frequency of pain interfering with activity/movement | | | | |
| No pain | 379 (27) | 176 (29) | 130 (26) | 73 (24) |
| Pain that does not interfere | 133 (9) | 62 (10) | 47 (9) | 24 (8) |
| Less than daily | 305 (22) | 124 (21) | 114 (23) | 67 (22) |
| Daily, not constantly | 555 (39) | 213 (36) | 206 (41) | 136 (45) |
| All the time | 37 (3) | 24 (4) | 9 (2) | 4 (1) |
| When is patient short of breath? | | | | |
| Not short of breath | 228 (16) | 120 (20) | 63 (12) | 45 (15) |
| Walking 20 ft, climbing stairs | 518 (37) | 222 (37) | 194 (38) | 102 (34) |
| Moderate exertion | 518 (37) | 206 (34) | 192 (38) | 120 (39) |
| Minimal exertion or at rest | 145 (10) | 51 (9) | 57 (11) | 37 (12) |
| Urinary incontinence or urinary catheter | | | | |
| Neither | 1046 (74) | 524 (87) | 368 (73) | 154 (51) |
| Incontinence | 328 (23) | 66 (11) | 122 (24) | 140 (46) |
| Catheter | 35 (2) | 9 (2) | 16 (3) | 10 (3) |
| Cognitive function | | | | |
| Alert/oriented | 984 (70) | 503 (84) | 333 (66) | 148 (49) |
| Requires prompting | 327 (23) | 76 (13) | 144 (29) | 107 (35) |
| Requires assistance and direction, or considerable assistance | 92 (7) | 18 (3) | 27 (5) | 47 (16) |
| When is the patient confused? | | | | |
| Never | 744 (53) | 383 (64) | 242 (48) | 119 (39) |
| In new and complex situations only | 575 (41) | 198 (33) | 240 (48) | 137 (45) |
| On awakening or at night, during the day/evening, or constantly | 85 (6) | 14 (2) | 23 (5) | 48 (16) |
| When is the patient anxious? | | | | |
| None of the time | 702 (50) | 322 (54) | 245 (49) | 135 (45) |
| Less often than daily | 351 (25) | 150 (25) | 133 (26) | 68 (23) |
| Daily or all the time | 350 (25) | 125 (21) | 127 (25) | 98 (33) |
| Functional dependencies | | | | |
| Grooming | 881 (63) | 306 (51) | 331 (65) | 244 (80) |
| Dressing upper body | 875 (62) | 308 (51) | 325 (64) | 242 (80) |
| Dressing lower body | 1130 (80) | 431 (72) | 421 (83) | 278 (91) |
| Bathing | 1357 (96) | 563 (94) | 497 (98) | 297 (98) |
| Toilet transferring | 1267 (90) | 505 (84) | 469 (93) | 293 (96) |
| Toilet hygiene | 625 (44) | 203 (34) | 240 (47) | 182 (60) |
| Transferring | 1042 (74) | 366 (61) | 405 (80) | 271 (89) |
| Ambulation | 1248 (89) | 487 (81) | 470 (93) | 291 (96) |
| Feeding | 144 (10) | 40 (7) | 44 (9) | 60 (20) |
| Mean ADL/IADL dependencies (SD), *n* | 6 (2) | 5.4 (2) | 6.3 (2) | 7 .1 (2) |
| Number of ADL/IADL dependencies | | | | |
| 0 | 26 (2) | 20 (3) | 4 (1) | 2 (1) |

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*Table 1*–Continued

| Characteristics at Start of HHC | All Patients (*n* = 1409) | Age Group <65 y (*n* = 599) | 65-79 y (*n* = 506) | ≥80 y (*n* = 304) |
|---|---|---|---|---|
| 1–3 | 195 (14) | 134 (22) | 49 (10) | 12 (4) |
| 4–6 | 416 (30) | 194 (32) | 162 (32) | 60 (20) |
| ≥7 | 772 (55) | 251 (42) | 291 (58) | 230 (76) |
| Oral medication management dependency | 895 (65) | 315 (54) | 350 (70) | 230 (76) |

ADL = activity of daily living; COVID-19 = coronavirus disease 2019; ED = emergency department; HHC = home health care; IADL = instrumental activity of daily living; SOC = start of care.
* Values are numbers (percentages) of patients unless otherwise indicated.

## Baseline Differences by Age

As shown in Table 1, race and ethnicity differed by age category, as did comorbid conditions, symptom severity, and function. For example, of the patients aged 65 and younger, 40% were Hispanic and 14% (CI, 11% to 17%) had obesity as a diagnosis, whereas obesity was present in only 6% (CI, 4% to 9%) of those aged 65 to 79 and 3% (CI, 1% to 6%) of those aged 80 years and older. Dyspnea was present on admission in 84% of the patients, but it was more severe among those in the older age groups: Among those aged 80 years and older, 51% reported dyspnea with moderate, minimal exertion or at rest, compared with 43% of those younger than 65 years. The average number of functional dependencies was higher in the group aged 80 years and older, with an average of 7.1 deficits (CI, 6.9 to 7.3 deficits) compared with 5.5 (CI, 5.2 to 5.6) in the group younger than 65.

## Service Use and Disposition

The 1409 patients with COVID-19 on HHC service between 1 April and 15 September 2020 received 13 926 home health visits. Most visits (76%) were in person, 16% by telephone, and 8% by tele-video. Registered nurses provided 52% of the visits, physical therapists provided 37%, and the remainder were provided by social workers and occupational and speech therapists. Overall, the patients received 11.1 visits on average (marginal means 95% CI, 10.8 to 11.4 visits). Compared with the under-65 age group, the 80-and-older group received more visits overall (11.9 [CI, 11.1 to 12.6] vs. 10.9 [CI, 10.4 to 11.4]), more in-person visits (9.1 [CI, 8.5 to 9.7] vs. 8.1 [CI, 7.7 to 8.5]), and more physical therapy visits (4.6 [CI, 4.0 to 5.1] vs. 3.8 [CI, 3.5 to 4.1]). Eleven patients 1%) died, and 137 (10% [CI, 8.1% to 11.2%]) were rehospitalized. Only 23 patients remain on service (Table 2).

After an average of 32 days of care (SD, 25.7), 94% of patients with COVID-19 in HHC were discharged (*n* = 1319); 1241 (87%) were discharged without any adverse events (rehospitalization or death). More than half (57%) of those rehospitalized returned to HHC and were subsequently discharged (n = 78). Although discharge was

*Table 2.* Service Use and Disposition of All COVID-19 HHC Patients, by Age*

| Service Use and Disposition | All Patients (*n* = 1409) | Age Group <65 y (*n* = 599) | 65-79 y (*n* = 506) | ≥80 y (*n* = 304) |
|---|---|---|---|---|
| Mean days in HHC (SD) | 32 (27) | 31 (27) | 32 (26) | 34 (29) |
| Discharge disposition | | | | |
| Rehospitalization | 137 (10)† | 45 (8) | 52 (10) | 40 (13) |
| Death with no hospitalization | 8 (1) | 3 (1) | 3 (1) | 2 (1) |
| Total deaths‡ | 11 (1) | 4 (1) | 4 (1) | 3 (1) |
| Adverse event | | | | |
| None, discharged to the community or other service with end-of-HHC assessment data | 1224 (87) | 529 (88) | 444 (88) | 251 (83) |
| None, discharged to the community or other service without end-of-HHC assessment data; no discharge assessment in record | 17 (1) | 9 (2) | 4 (1) | 4 (1) |
| Still in HHC service | 23 (2) | 13 (2) | 3 (1) | 7 (2) |

COVID-19 = coronavirus disease 2019; HHC = home health care.
* Values are numbers (percentages) of patients unless otherwise indicated.
† Includes 78 patients who returned to HHC after rehospitalization, with subsequent discharge.
‡ Includes 3 patients who died during or after a hospital stay.

***Table 3.*** Comparison of Symptoms and Functional Dependencies in COVID-19 HHC Patients From HHC Admission to Discharge ($n$ = 1302)*

| Symptoms and Dependencies | Admission | Discharge |
|---|---|---|
| Symptoms | | |
| Frequency of pain interfering with activity/movement | | |
| No pain | 365 (28 [26–31]) | 914 (70 [68–73]) |
| Pain that does not interfere | 121 (9 [8–11]) | 182 (14 [12–16]) |
| Less than daily | 286 (22 [20–24]) | 135 (10 [9–12]) |
| Daily, not constantly, or all of the time | 530 (41 [38–43]) | 71 (6 [4–7]) |
| When is patient short of breath? | | |
| Not short of breath | 204 (16 [14–18]) | 954 (73 [71–76]) |
| Walking 20 ft, climbing stairs | 488 (37 [35–40]) | 287 (22 [20–24]) |
| Moderate exertion | 484 (37 [35–40]) | 55 (4 [3–5]) |
| Minimal exertion or at rest | 126 (10 [8–11]) | 6 (0.5 [0–1]) |
| Cognitive function | | |
| Alert/oriented | 923 (71 [69–74]) | 1125 (87 [85–89]) |
| Requires prompting | 297 (23 [21–25]) | 130 (10 [8–12]) |
| Requires assistance and direction, or considerable assistance | 76 (6 [5–7]) | 42 (3 [2–4]) |
| When is the patient confused? | | |
| Never | 692 (53 [51–56]) | 1012 (78 [75–80]) |
| In new and complex situations only | 536 (41 [39–44]) | 251 (19 [17–22]) |
| On awakening or at night, during the day/evening, or constantly | 70 (5 [4–7]) | 38 (3 [2–4]) |
| When is the patient anxious? | | |
| None of the time | 651 (50 [47–53]) | 1063 (82 [79–84]) |
| Less often than daily | 325 (25 [23–28]) | 191 (15 [13–17]) |
| Daily or all the time | 321 (25 [22–27]) | 48 (4 [3–5]) |
| Functional dependencies | | |
| Grooming | 801 (62 [59–64]) | 98 (8 [6–9]) |
| Dressing upper body | 792 (61 [58–63]) | 111 (9 [7–10]) |
| Dressing lower body | 1036 (80 [77–82]) | 185 (14 [12–16]) |
| Bathing | 1253 (96 [95–97]) | 369 (28 [26–31]) |
| Toilet transferring | 1169 (90 [88–91]) | 334 (26 [23–28]) |
| Toilet hygiene | 556 (43 [40–45]) | 103 (8 [7–10]) |
| Transferring | 950 (73 [70–75]) | 76 (6 [5–7]) |
| Ambulation | 1150 (88 [86–90]) | 286 (22 [20–24]) |
| Feeding | 122 (9 [8–11]) | 34 (3 [2–4]) |
| Mean [95% CI] ADL/IADL dependencies (SD), $n$ | 6.0 [5.9–6.1] (2.3) | 1.2 [1.1–1.3] (2.2) |
| Number of ADL/IADL dependencies | | |
| 0 | 24 (2 [1–3]) | 782 (60 [57–63]) |
| 1–3 | 187 (14 [13–16]) | 359 (28 [25–30]) |
| 4–6 | 397 (30 [28–33]) | 87 (7 [5–8]) |
| ≥7 | 694 (53 [51–56]) | 74 (6 [4–7]) |
| Oral medication management dependency | 812 (64 [61–66]) | 152 (12 [10–14]) |

ADL = activity of daily living; COVID-19 = coronavirus disease 2019; HHC = home health care; IADL = instrumental activity of daily living.
* Values are numbers (percentages [95% CI]) of patients unless otherwise indicated.

documented without an event, 17 patients had an OASIS assessment at admission but not at discharge. These missing data were not expected because the OASIS is required, but these patients were more likely than the rest of the sample to have had cognitive impairment at admission. The absence of a caregiver as an informant due to COVID-19 restrictions may explain why the discharge data are missing (Table 2).

### Profile of COVID-19 Patients Discharged From HHC

Table 3 shows data for 1302 discharged patients who had admission and discharge assessments. We found statistically significant improvements in both symptoms and function from admission to discharge for all variables. Improvements include a reduction of 35 percentage points (CI, 32 to 38 percentage points) in the frequency of patients reporting pain daily or all the time (from 41% to 6%), an increase of 57 percentage points (CI, 54 to 61 percentage points) in the frequency of reports of no dyspnea (from 16% to 73%), an increase of 16 percentage points (CI, 12 to 18 percentage points) in cognitive alertness (from 71% to 87%), and an increase of 32 percentage points (CI, 28 to 35 percentage points) in no anxiety (from 50% to 82%). Substantial improvements were seen in functional status (such as a reduction of 68 percentage points [CI, 65 to 71 percentage points] in the frequency of dependencies for bathing [from 96% on admission to only 28% at discharge] and 66 percentage points [CI, 63 to 69 percentage points] for ambulation [from 88% to 22%]). The average total number of functional dependencies decreased from 6 (CI, 5.9 to 6.1) to 1.2 (CI, 1.1 to 1.3) between admission and discharge.

Table 3 excludes 107 patients because they died, are still on service, or are still in the hospital and therefore do not have discharge data. Their admission characteristics are statistically significantly different from patients with discharge data on many of the risk factors associated with adverse events described in the next section (data not shown).

### Risk Factors Associated With Adverse Events of Rehospitalization and Death

Table 4 shows the survival analysis risk factors associated with rehospitalization or death (145 events). Risk for rehospitalization or death was higher among male patients (HR, 1.45 [CI, 1.04 to 2.03]); White patients (HR, 1.74 [CI, 1.22 to 2.47]); and patients who had heart failure (HR, 2.12 [CI, 1.41 to 3.19]), diabetes with complications (HR, 1.71 [CI, 1.17 to 2.52]), 2 or more emergency department visits in the past 6 months (HR, 1.78 [CI, 1.21 to 2.62]), pain daily or all the time (HR, 1.46 [CI, 1.05 to 2.05]), cognitive impairment (HR, 1.49 [CI, 1.04 to 2.13]), or functional dependencies (HR, 1.09 [CI, 1.00 to 1.20]). The hazard increased by 9% for each ADL dependency (HR, 1.09 [CI, 1.00 to 1.20]).

## Discussion

In contrast to the poor symptom and functional profile of patients at HHC admission, by the time of HHC discharge approximately 1 month later, most patients had statistically significant improvements in pain, dyspnea, cognition, and anxiety. In addition, functional gains were common: COVID-19 survivors were admitted to HHC with an average of 6 functional deficits and discharged with an average of 1. More than a third of the study sample received physical therapy. These gains were achieved after an average of 11 visits per episode that began within 2 days of hospital discharge for 80% of the sample.

***Table 4.*** Factors Associated With Adverse Events in Patients With COVID-19 Discharged From a Short-Stay Hospital and Admitted to HHC*

| Factors | Events, *n* | HR (95% CI) | |
|---|---|---|---|
| | | Unadjusted | Adjusted |
| Overall adverse events | 145 | – | – |
| Rehospitalization | 137 | – | – |
| Death | 8 | – | – |
| Age ≥65 y | 97 | 1.53 (1.08–2.16) | 1.01 (0.69–1.47) |
| Male sex | 95 | 1.37 (0.98–1.90) | 1.45 (1.04–2.03) |
| Non-Hispanic White race | 55 | 1.66 (1.19–2.32) | 1.74 (1.22–2.47) |
| Congestive heart failure | 32 | 2.69 (1.82–3.98) | 2.12 (1.41–3.19) |
| Diabetes, complicated | 38 | 2.05 (1.41–2.96) | 1.71 (1.17–2.52) |
| Multiple ED visits (≥2 in past 6 mo) | 37 | 2.38 (1.64–3.46) | 1.78 (1.21–2.62) |
| Pain daily or all the time | 77 | 1.62 (1.17–2.24) | 1.46 (1.05–2.05) |
| Cognitive impairment | 64 | 1.96 (1.41–2.72) | 1.49 (1.04–2.13) |
| ADL/IADL dependencies (per each additional dependency), *n* | – | 1.18 (1.09–1.29) | 1.09 (1.00–1.20) |

ADL = activity of daily living; COVID-19 = coronavirus disease 2019; ED = emergency department; HHC = home health care; HR = hazard ratio; IADL = instrumental activity of daily living.
* Other factors considered: patient living alone, hypertension, metastatic cancer, receiving >5 medications, multiple hospitalizations (≥2 in past 6 mo), urinary incontinence/catheter, confusion, and anxiety.

Admission characteristics of COVID-19 survivors are very similar to those of sepsis survivors admitted to HHC nationally (14). Recent evidence suggests that early home health visits, coupled with outpatient follow-up in week 1, decreased rehospitalizations among sepsis survivors (15). Further study is needed to determine whether that intervention made a difference for patients recovering from COVID-19.

The age distribution among this cohort of COVID-19 survivors was younger than typical for a Medicare HHC population (16) (mean age, 67 vs. 78.7), possibly because patients who died during acute care were older. A recent study of patients with COVID-19 in New York City reported that 53.7% of those aged 80 or older died during hospitalization (8).

The proportions by race and ethnicity in our COVID-19 sample were similar to those of overall New York City COVID-19 cases: White, 27% versus 21%; Black, 29% versus 34%; and Hispanic, 35% versus 32%, respectively (17). However, they were different from those of typical Medicare HHC recipients and the agency's usual population. Nationally, 85% of Medicare-certified HHC recipients are White and only 1.9% are Hispanic (16). The proportion of Hispanic patients cared for by the study home care agency before the pandemic was 24% on average (18). The COVID-19 cohort raised that proportion to 35%, with most patients younger than 65 years. This increase may reflect a nationwide COVID-19 infection rate that is 5 times higher among Hispanic persons aged 40 to 50 years than among White persons (19). Also, Latino and Black patients are nearly twice as likely to die of COVID-19 (19). However, the incidences of rehospitalization and death were too low in our study to show any association between race or ethnicity and adverse events, and the White patients in our sample were mostly aged 80 or older and had the highest proportion of rehospitalizations. Male patients made up more than half (51%) of our HHC sample, compared with 39% of the patients usually visited by this agency (18) and 38% in HHC nationally before the COVID-19 pandemic (20).

The death rate observed during HHC for our sample of patients with COVID-19 was low at 1% and was lower than the 3% seen in typical national Medicare HHC samples (20). Although further study is necessary to determine the impact of COVID-19 on long-term mortality, the low death rate observed in this study may be a result of the average age of the sample being lower than that of most typical HHC recipients.

The overall rehospitalization rate of 10% among the COVID-19 survivors in this study was much lower than the 15.6% 30-day readmission rate for the general Medicare-certified home health population (21); it is even lower than that of similar groups, such as survivors of sepsis (20%) and patients with heart failure (24%) or kidney and urinary tract diagnoses (26%), all of whom had major complications (20). Our results do show a higher risk for patients with comorbid heart failure, complicated diabetes, or emergency department use, all of which indicate complex health needs. The limited amount of information transferred from acute care to HHC (22) prohibits knowledge of COVID-19 severity, such as length of stay, days in intensive care, or time on a ventilator. To fully understand risk, these are important data elements to collect for research and quality clinical care.

The survival analysis for patients with COVID-19 revealed several characteristics associated with increased risk for rehospitalization or death. These factors might be used to identify COVID-19 survivors who warrant extra attention. Male sex increased the risk by 45% and is consistent with other COVID-19 studies (23,24). Surprisingly, White race increased the risk by 74% compared with all other races combined, which is in contrast to other studies reporting that Latino and Black patients are nearly twice as likely to die of COVID-19 (19). However, the largest proportion of patients aged 80 and older were White, and this age group had higher rates of all the other risk factors we report, such as heart failure, complicated diabetes, rates of previous emergency department use, pain, cognitive impairment, and functional deficits. Our findings are consistent with those of other studies of general home health Medicare recipients, in which most of these factors were highly associated with rehospitalization (25). Specifically, diabetes is well known as a risk factor for both contracting COVID-19 (26) and having poor outcomes (27,28). Historically, previous hospital admission has been a known risk factor for rehospitalization among the Medicare-certified HHC population, but it was not for the COVID-19 cohort (13). Although confirmatory studies are warranted, these findings may be used to risk stratify COVID-19 survivors admitted to HHC who are at increased risk for adverse events.

A key recommendation to prepare for postacute care surges due to COVID-19 was to expand HHC use to provide skilled nursing and rehabilitative services in the home, thereby preventing transmission to other patients, as may occur in inpatient facilities (29). This advice was prescient, because our study shows that COVID-19 survivors discharged from HHC had excellent symptom improvement and functional outcomes, highlighting that postacute support through HHC affords an opportunity to aid the recovery of future patients with COVID-19. Thus far, skilled HHC has been largely overlooked during the COVID-19 pandemic (30). Nationally, only 11% of patients hospitalized with COVID-19 were discharged home with home health services (21). The positive outcomes profiled in this study suggest the value and importance of discharging vulnerable COVID-19 survivors to skilled HHC to support their recovery. However, a direct comparison of outcomes to confirm the benefit for patients discharged to home with versus without HHC has not been done. A recent analysis of New York City COVID-19 hospitalizations found that 94% of patients were discharged to home, but whether they were discharged with or without HHC was not specified and only 6% were discharged to a facility (8).

Our findings suggest that acute care providers might carefully consider which COVID-19 survivors would benefit from HHC after hospitalization. A decision support tool to identify general hospitalized patients for HHC referral may be helpful (31,32). Increasing referrals to HHC has the potential to provide support and achieve improved recovery for perhaps many more patients.

This study has some limitations. Although the sample of COVID-19 survivors from 64 hospitals was large and diverse, all the patients were discharged from hospitals in the New York City area and received HHC from 1 agency. Their

profiles may not be generalizable to the population of COVID-19 survivors elsewhere, domestically or internationally. The rehospitalization rate was obtained from the OASIS and agency administrative data and may have missed events occurring between visits if patients or caregivers were unable to report them. Rehospitalizations and other outcomes occurring after home care discharge were not available unless patients returned to HHC.

In conclusion, upon returning home from acute care, large proportions of COVID-19 survivors had many functional dependencies, as well as pain and dyspnea, and more than half reported exhaustion at HHC admission. After HHC, which included skilled nursing and physical therapy, the large majority of survivors were discharged alive, having achieved statistically significant improvements in symptom burden and functional outcomes. However, our follow-up was limited, and approximately 1 in 4 patients still had dyspnea and depended on help to bathe and ambulate at discharge. In addition, we do not have discharge outcomes for 107 patients who died, had cognitive impairment, or are still on service or in the hospital.

These findings and recent reports about "long haulers"—COVID-19 survivors still reporting symptoms 30 to 40 days from onset (33)—call for further study to determine longer-term outcomes and to target extra attention to patients with risk factors associated with continued symptoms, rehospitalization, or death.

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