# Factors Associated with Mortality in Hospitalized Older Adults with COVID-19: A Large Retrospective Cohort Study

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# Factors Associated with Mortality in Hospitalized Older Adults with COVID-19: A Large Retrospective Cohort Study

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## ABSTRACT

**Background:** Age has been implicated as the main risk factor for COVID-19-related mortality. Our objective was to determine patient factors associated with mortality in hospitalized older adults with COVID-19.

**Methods:** Retrospective cohort study of adults age 65+ (N=4,949) hospitalized with COVID-19 in the greater New York metropolitan area between 3/1/20-4/20/20. Data included patient demographics and clinical presentation. Multivariate logistic regression was used to evaluate associations.

**Results:** Average age 77.3 (SD=8.4), 56.0% male, 20.8% African American, 15.1% Hispanic. In a multivariate analysis, male gender (OR=1.47), higher comorbidity index (OR=1.10), admission from a facility (lower baseline function; OR=1.71), early DNR (declining life-sustaining treatments, OR=2.45), and higher illness severity (higher MEWS, OR=6.26, and higher oxygen requirements, OR=15.00) were associated with mortality, while age was not ($p = 0.22$).

**Conclusion:** Our findings highlight the need to look beyond age in hospitalized older adults with COVID-19 when considering prognosis and treatment decisions.

## INTRODUCTION

Coronavirus disease 2019 (COVID-19) has infected all adults indiscriminately, it has taken the greatest toll on older adults[1-4]. Of the more than 87,000,000 cases globally, 31% have been over 65 years old; accounting for 45% of hospitalizations, 53% of ICU admissions, and 80% of deaths[1]. Age has consistently been implicated as one of the main risk factors for poor outcomes in COVID-19, including severe disease, hospitalization, and mortality[2-4]. While previous studies evaluating COVID-19 related mortality accounted for demographic and clinical characteristics, few have considered factors that are highly relevant to the older adult population, namely functional and cognitive status as well as baseline advance directives regarding life-sustaining treatment preferences.

Although age contributes to models predicting mortality, there is robust literature demonstrating that function is a strong predictor of poor outcomes among the geriatric population[5,6]. Unfortunately, functional status is infrequently incorporated into models due to insufficient assessment and documentation by medical professionals[7]. Another critical, yet frequently unaddressed and undocumented factor in older adults is advance directives, including goals of care and life-sustaining treatment preferences[8]. Early Do-Not-Resuscitate (DNR), documented within 24 hours of admission, has been associated with baseline care preferences and prognosis that may not be related to the patient's acute illness, and has been shown to be an independent risk factor for mortality[9-11]. Therefore, an early DNR can be used as a proxy for mortality risk. However, COVID-19 studies evaluating mortality have either excluded or failed to account for patients with DNR documentation on admission[2-4].

As COVID-19 continues to spread globally, concerns about present and future shortages in hospital and critical care beds, staffing, and treatments (e.g. ventilators and vaccines), have focused attention on resource allocation. Decisions about resource allocation during COVID-19 first started in Northern Italy, where the number of sick patients grossly outnumbered available health care resources[12]. Since then, many countries and states have prepared to invoke or have activated pre-existing crisis standards of care to address this concern. Some of these strategies highlight older age as the main criteria, placing older adults at a disadvantage regardless of their baseline characteristics[13-20]. In a recent position statement, the American Geriatrics Society (AGS) indicated that age should never be used as the sole or main indicator to exclude older adults from receiving care[21].

The objective of this study was to determine which patient factors are associated with mortality in hospitalized older adults with COVID-19, accounting for critical factors relevant to the older population.

**METHODS**

The study was conducted at a large academic health system, serving approximately 11 million people in the greater New York metropolitan area. The COVID-19 Research Consortium and institutional review board approved the study. Data was abstracted from inpatient medical records with the following inclusion criteria: age greater than or equal to 65; admitted to one of eleven health system hospitals between March 1$^{st}$, 2020 and April 20$^{th}$, 2020; and confirmed diagnosis of COVID-19 infection by positive result on polymerase chain reaction of a nasopharyngeal sample. Clinical course and outcomes were monitored until June 10th, 2020.

Transfers from one in-system hospital to another were merged and considered as a single visit. For patients with multiple admissions during the study period, only the first admission was included. Data were collected from enterprise electronic health record (EHR) (Sunrise Clinical Manager; Allscripts).

**Data Elements**

Patient demographics included age, gender, race, ethnicity, insurance, primary language, smoking history, and body mass index (BMI); all elements were captured from pre-specified categories in the EHR. Comorbid conditions were collected using ICD-10 codes based on past medical history documented prior to or at index admission, including: diabetes mellitus (DM), hypertension, chronic obstructive pulmonary disease (COPD), dementia, asthma, cancer, coronary artery disease (CAD), atrial fibrillation, chronic kidney disease (CKD), autoimmune disorder, and immunodeficiency. Comorbidity index was calculated based on the Charlson Comorbidity Index (CCI), excluding the age component[22]. Arrival from a facility was used as a surrogate indicator for functional status or the need for assistance in activities of daily living. Baseline functional status was coded as “arrived from” home versus any facility (skilled nursing facility,SNF, assisted living, and group home). Further details on type of facility and level of assistance provided (e.g. long-term care vs. sub-acute rehabilitation) was not available.

Patient preferences for declining life-sustaining treatments on admission were based on the presence of an “early” (within 24 hours of admission) DNR order. Early DNR has been described in the literature as a surrogate for worse baseline prognosis as well as preferences for life-sustaining treatment and has been shown to be an independent predictor of mortality[9-11].

Illness acuity on presentation consisted of the first documented Modified Early Warning Score (MEWS) and first documented method of oxygen delivery (no oxygen, nasal cannula, venturi mask, nonrebreather mask, high flow, noninvasive ventilation, and mechanical ventilation). MEWS is pre-calculated in the EHR and includes respiratory rate (breaths/min), oxygen saturation, temperature, systolic blood pressure (SBP), heart rate (HR), and level of consciousness[23]. Oxygen methods consisting of venturi masks, high flow oxygen, and noninvasive mechanical ventilation were discouraged within the health system to minimize risk of aerosolized spread. Given the small number of cases,  they were categorized as follows: venturi mask (n=30, 0.6%) was grouped with nasal cannula, and high flow oxygen (n=16, 0.3%) and non-invasive ventilation (n=26, 0.5%) with non-rebreather masks. Fever on arrival was defined as temperature of >37.8 degrees Celsius.

Data elements for hospital course and outcomes included: 1) length of stay (LOS); 2) discharge disposition (home, skilled nursing facility/assisted living, psychiatric facility, hospice home/facility, left against medical advice, still admitted at time of analysis); and 3) 30-day hospital readmission.

The primary outcome of interest was hospital mortality.

**Analysis**

Data was summarized using descriptive statistics: means and standard deviation (SD) were computed for continuous variables, frequencies and percentages for categorical variables.

Patients who were still hospitalized at time of data extraction or transferred to a facility in which data for their complete hospital course could not be obtained, were excluded from the univariate and multivariate analysis (Figure 1). A series of univariate and multivariate logistic regressions analyses were performed to evaluate the association between in-hospital mortality (binary outcome) and factors that have been related to in-hospital mortality in prior studies. These factors included: age, gender, race, ethnicity, insurance, BMI, comorbidity index (total comorbidity index (minus age), rather than individual comorbidities), individual comorbid conditions (hypertension, DM, asthma, CKD, and COPD), arrived from – home vs. facility (as a surrogate for baseline functional status), history of dementia, DNR order within 24 hours of admission (as a surrogate for preferences for declining life-sustaining treatment), and severity of acute illness (first documented MEWS and oxygen delivery method on hospital arrival).

First, univariate analyses were performed. Variables that were significantly associated with hospital mortality ($p < 0.05$) in the univariate analysis were considered as candidate variables for final model in the multivariate analysis.

The final models for multivariate analysis were chosen using a backward selection method. Two final models were constructed: one without age forced into the final model while performing the backward selection (Model 1); and one with age forced into the final model while performing the backward selection (Model 2).

Multicollinearity was measured using variance inflation factor (VIF), which assessed how much the variance of an estimated regression coefficient increased if the variables in the model were correlated (e.g. age with comorbidity). A VIF between 5 and 10 indicates high variable correlation. All analyses were performed using SPSS v26, IBM Corp, Armonk, NY, and SAS 9.4, SAS Institute Inc., Cary, NC.

## RESULTS

### Demographics

A total of 4,969 patients 65 years and older were included, with mean age of 77.3 years (SD=8.4), 56.0% male; 46.8% were Caucasian, 20.8% African American, and 15.1% Hispanic. The most common comorbidities were hypertension (61.1%), diabetes (36.8%), atrial fibrillation (14.6%), and chronic kidney disease (13.3%). Average comorbidity index (Charlson comorbidity index minus age component) was 3.4 ($\pm$ 2.84). In addition, 13.0% had dementia, 20.8% came to the hospital from a facility, and 5.7% had a DNR order within 24 hours of admission. See Table 1 for full details of patient characteristics.

### Hospital Presentation, Course and Outcomes

On arrival, 26.7% were febrile (mean temperature was 37.4 degrees Celsius, SD=1), 79.6% required oxygen therapy, and average MEWS was 4.2 (SD=1.7). The median length of stay was seven days (mean 9.9), 35.3% expired, 39.6% were discharged home, and 19.5% were discharged to a facility. See Table 2 for details on hospital presentation and course.

### Univariate Analysis

Each of the following factors were related to mortality in the univariate analysis: older age, male gender and non-minority race were significantly associated with outcome of death, as was admission from any type of facility (as opposed to living at home). In terms of medical variables, higher comorbidity index and dementia were all significantly associated with mortality. Markers of severity of acute illness - MEWS, first documented oxygen delivery, and life-sustaining preferences (having an early DNR) were all significantly related to mortality. In contrast to previously published series, insurance status and BMI were not significantly related to mortality (Table 2)[2,3].

**Multivariate Analyses**

In the multivariate analysis for Model 1 (age was not forced into the equation), we found that male gender (OR=1.47, 95% confidence interval =1.27-1.70), higher comorbidity index (1.10, 1.08-1.13), admission from a facility (lower functional status) (1.71, 1.43-2.04), early DNR (declining life-sustaining treatment preferences) (2.45, 1.80-3.34), and higher illness severity (higher MEWS and higher oxygen requirements) (6.26, 5.40-7.27; 15.00, 8.81-22.95, respectively) were associated with mortality. After backward variable selection, age, race, and dementia were not included in the final model. (Table 3)

In the multivariate analysis for Model 2 (age was forced into the equation), age was not associated with hospital mortality after controlling for the other variables in the model ($p = 0.22$); that is, in older adults (65+), age was not independently associated with hospital mortality. (Table 4) No significant multicollinearity was found among the variables, including age, in the model.

## DISCUSSION

Our study found that in hospitalized older adults with COVID-19 admission from a facility, early DNR, multimorbidity, and illness severity, but not age, were associated with mortality. This is in stark contrast to most studies to-date that have implicated age as the main risk factor for mortality in COVID-19[2-4]. These studies, however, did not account for factors that are important in hospitalized older adults, such as function and life-sustaining treatment preferences.

There is robust literature demonstrating that baseline functional status is strongly associated with poor outcomes among the older adults[5,6]. However, baseline functional status is infrequently assessed at hospital admission. Therefore, medical professionals often rely on subjective assessments, which have been shown to be inaccurate[7]. Furthermore, even when assessed, functional status is rarely documented in a meaningful way[7]. Given the difficulty of obtaining objective measures, most COVID-19 studies have not considered functional status. Our study utilized the ‘arrived from’ variable as a surrogate marker for baseline functional status and the need for skilled care (arrived from a facility). Although we were unable to distinguish between those who were “life-stay” residents in long-term care versus limited-stay for sub-acute rehabilitation, all locations house populations who generally have functional impairments. While it is important for future studies to evaluate baseline functional status using more precise, objective measures, this is often difficult in the real-world setting. Therefore with further validation, ‘arrived from’ may be a good surrogate measure that is easily obtained. Regardless, assessing and incorporating functional status is essential when evaluating clinical outcomes in older adults.

There is also increasing evidence demonstrating an association between frailty and poor outcomes in those with COVID-19[24]. However, frailty measures are also not readily available on hospital presentation nor captured in a systematic fashion in most EHR. During the COVID-19 crisis our health system utilized emergency documentation which did not include activities of daily living. Given the association between frailty and poor outcomes, using a short reliable tool would be useful for assessing such relationships [25]. However many existing frailty tools are long and impractical for the hospital setting, requiring self-report for multiple activities (e.g. Frailty Index), include physical performance components (e.g. Edmonton Frail Scale, gait speed) or subjective judgement by the clinician (e.g. Clinical Frailty Scale) all of which pose difficulty for administration in the hospital setting [26].

Multimorbidity, as measured with cumulative indeces such as the CCI, has been associated with hospital mortality in older adults; and also in hospitalized patients with COVID-19 [27,28]. Such composite index measures generally do not account for heterogeneity and severity of the individual conditions (e.g. uncontrolled diabetes vs. controlled diabetes or mild vs. advanced dementia). Future studies should consider comorbidity severity and impact on function and quality of life when considering comorbidities in COVID-19.

Another critical factor in older adults (and patients of all ages) is advance directives, including discussion and documentation for life-sustaining treatment preferences and DNR. Provider predictions about life expectancy often do not match the patient’s treatment preferences[8,29]. Although age has traditionally been used as a “proxy” for life expectancy, older adults of the same age can have different trajectories. While advance directives should be discussed openly, this discussion and decision should not be imposed or pressured. As such, timely, patient-centered goals of care discussions that focus on what matters most to the patient are essential[30].

The need for maximizing utilization of limited health care resources has been a reality since the start of COVID-19. Throughout the pandemic, physicians have been forced to make extraordinary decisions regarding allocation of hospital and intensive care beds, as well as mechanical ventilation, being forced to choose who to treat among the overwhelming number of severely-ill individuals[13,15,18]. In response to treatment decisions and resource allocation during COVID-19, several strategies, guidelines, and frameworks have been proposed, most of which highlight age as the main factor in making resource allocation determinations[13-20,31].

While a few of these guidelines recommend advanced age as a sole exclusion, the majority include age along with other criteria such as comorbid conditions, functional status, advance directives (specifically preferences for life-sustaining interventions), and severity of acute illness[16-19,31]. However, due to the limited ability to account for functional status and advance directives, age often becomes the de facto characteristic used for resource allocation[32]. Our findings highlight the need to look beyond age when making treatment decisions. We would argue that age should not be used as a sole indicator to determine resource allocation. Given the disproportionate effect of COVID-19 on older adults, it is critical that future studies incorporate baseline functional status and preferences for life-sustaining interventions on admission[15].

When thinking about prognosis during any public health crisis, a multi-principle, clinical and ethical framework is likely the best approach to achieve equity[17,21]. California and Pennsylvania have successfully implemented such guidelines that incorporate the Sequential Organ Failure Assessment (SOFA) as a predictor of hospital survival and the presence of underlying medical conditions that limit prognosis[33,34]. Using a severity of illness score that does not include age, predicts mortality in patients admitted to the hospital with COVID-19 and may further limit bias[4]. As demonstrated, the MEWS used by our study, also does not include age and has been shown to be an independent predictor of mortality, although not in those with COVID-19[23]. Oxygen requirement on hospital presentation may provide an additional non-biased indicator of illness severity.

Front-line health care professionals should not be expected to make decisions regarding prognosis and resource allocation on their own. There is an urgent need for clear, consistent, evidence-based, and transparent national processes that are predicated upon clinical evidence and ethical considerations. Based on our findings, clinical decision-making related to COVID-19 should consider a more comprehensive approach. Our findings support the AGS position statement indicating age alone should never be used to make decisions regarding resource allocation under conditions of resource scarcity[21]. Although a healthy older adult may have fewer “life-years” to be saved, there is significant heterogeneity among individuals of different age groups and a healthy older adult’s prognosis may be more favorable than predicted based on age alone.

This study has several limitations. First, in this initial analysis of mortality outcomes for older adults hospitalized with COVID-19, we did not compare outcomes across the full age range of adult patients. However, our study included a large population of older adults with an age range spanning more than 40 years. This span is broad enough to capture the increased physiological heterogeneity seen with age, and across which decisions about resource utilization arise more frequently. A second limitation was that due to the overwhelming number of cases admitted at the peak of COVID-19, our large integrated health system functioned as "one hospital." Patients were transferred within the health system as well as to nationally-operated army facilities. While transferred patients were included in the descriptive data, they were excluded from the univariate and multivariate analyses if their discharge disposition was unknown. However, this number (N=162) was small and unlikely to make a difference statistically in this large cohort). A third limitation is that given the retrospective nature of the study and large numbers of patients we were limited to elements in the EHR and thus used surrogate markers for functional status and life-sustaining treatment preferences. We have previously published the validity of these data elements as surrogate markers[10]. Lastly, we did not account for the effect of in-hospital treatments for COVID-19. Our focus was on patient characteristics and initial presentation and is not meant to assess treatments best described by clinical trials. Future studies are needed to evaluate the effect of different treatment modalities on mortality in older adults hospitalized with COVID-19.

## CONCLUSION

COVID-19 has disproportionally affected older adults. Our study found that male gender, higher comorbidity index, lower functional status, early DNR (declining life-sustaining treatment preferences), higher illness severity- but not age- were associated with mortality in hospitalized older adults with COVID-19. Future studies need to validate our results by including baseline functional status, multimorbidity, and life-sustaining treatment preferences, when evaluating prognosis and making treatment decisions for hospitalized older patients with COVID-19, thus going beyond age as a predictor of mortality.

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**Author Contributions:**

Liron Sinvani, study design, assisted with data management, statistical analysis and interpretation, and led the manuscript writing. She had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Allison Marziliano, study design, led data cleaning and management, and assisted with statistical analysis, interpretation, and manuscript writing.

Alex Makhnevich, study design, assisted with data management, statistical analysis, interpretation, and manuscript writing.

Yan Liu, co-led data acquisition, assisted with data cleaning and management, and contributed to manuscript writing.

Michael Qiu, co-led data acquisition, assisted with data cleaning and management, and contributed to manuscript writing.

Meng Zhang, led the statistical analysis and interpretation and contributed to manuscript writing.

Suzanne Ardito, contributed to study design, assisted with data management, and contributed to manuscript writing.

Maria Carney, study design, assisted with data interpretation, and contributed to manuscript writing.

Michael Diefenbach, study design, assisted with data interpretation, and contributed to manuscript writing.

Karina Davidson, study design, assisted with data interpretation, and contributed to manuscript writing.

Edith Burns, study design, guided data management, assisted with data interpretation, and contributed to manuscript writing.

**Competing Interests Statement**

The authors declare no competing interests.

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**LEGENDS**

**Figure 1:** Flow Diagram of Patient Population

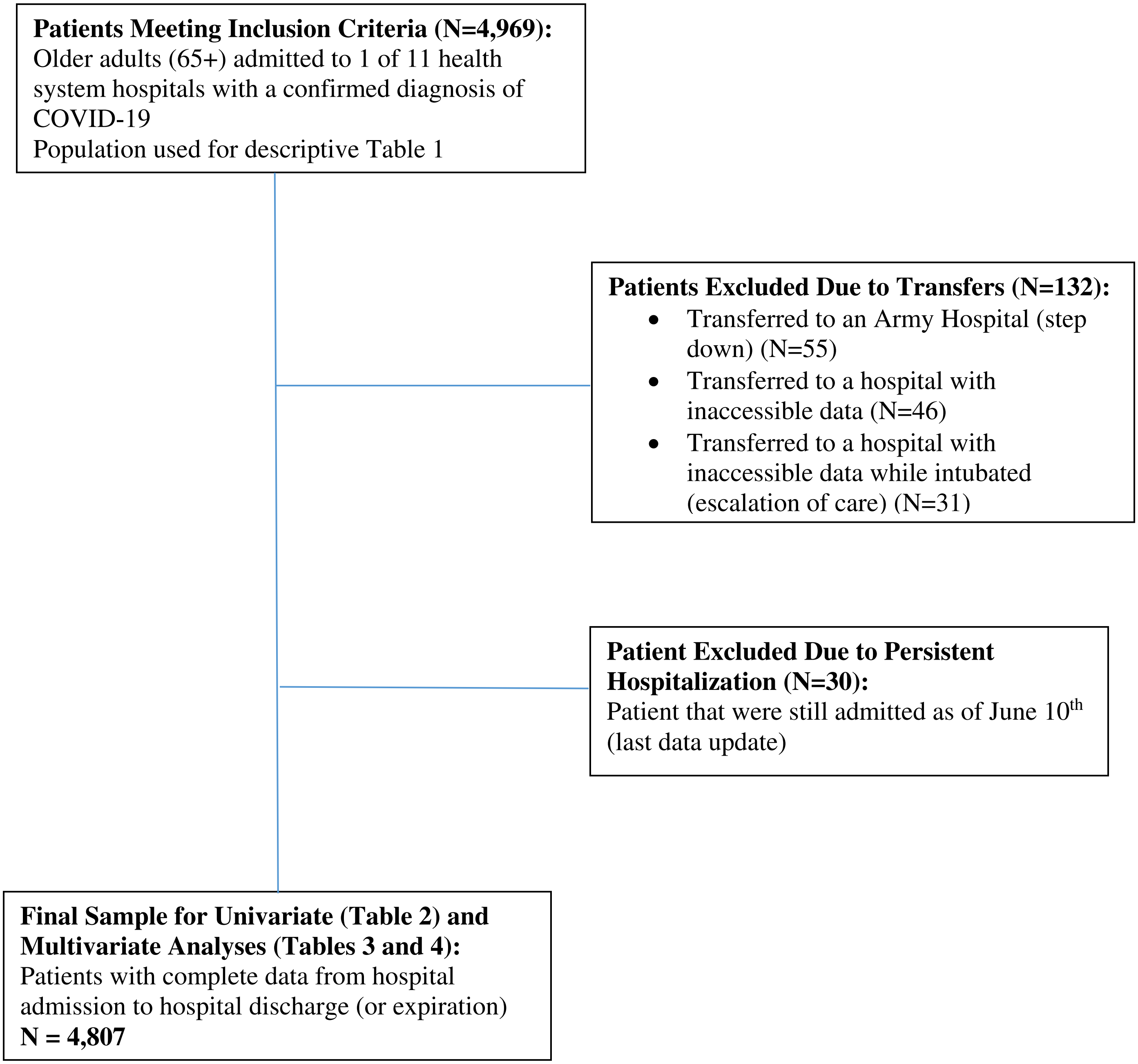


**Table 1:** Patient Characteristics and Hospital Outcomes (N = 4,969)

| **Demographics** | **M (SD) or n (%)** |
|---|---|
| Age | 77.3 (8.4) (range 65-107) |
| Gender | |
| Male | 2783 (56.0) |
| Female | 2186 (44.0) |
| Race | |
| Black | 1033 (20.8) |
| Asian | 399 (8.0) |
| White | 2325 (46.8) |
| Other | 1020 (20.5) |
| Not available | 192 (3.9) |
| Ethnicity | |
| Hispanic/Latino | 751 (15.1) |
| Not Hispanic/Not Latino | 3940 (79.3) |
| Not available | 278 (5.6) |
| Insurance | |
| Medicaid | 271 (5.5) |
| Medicare/Medicaid | 26 (0.5) |
| Medicare | 4083 (82.2) |
| No insurance | 25 (0.5) |
| Private | 554 (11.1) |
| Missing | 8 (0.2) |
| Other | 2 (0.0) |
| Primary Language | |
| English | 4053 (81.6) |
| Not English | 916 (18.4) |
| Diabetes Mellitus | 1829 (36.8) |
| Hypertension | 3034 (61.1) |
| Atrial Fibrillation | 723 (14.6) |
| Chronic Obstructive Pulmonary Disease | 422 (8.5) |
| Asthma | 248 (5.0) |
| Cancer | 428 (8.6) |
| Coronary Artery Disease | 267 (5.4) |
| Atrial Fibrillation | 723 (14.6) |
| Chronic Kidney Disease | 660 (13.3) |
| Body Mass Index | |
| Underweight (below 18.5) | 108 (2.2) |
| Normal (18.5 to 24.9) | 1056 (21.3) |
| Overweight (25 to 29.9) | 1293 (26.0) |
| Obese (30 or above) | 1038 (20.9) |
| Missing | 1474 (29.7) |

| | |
|---|---|
| **Comorbidity Index*[a]** | |
| Charlson Comorbidity Index (CCI) | 6.64 (3.10) |
| **Baseline Functional/Cognitive Status** | |
| Dementia | 648 (13.0) |
| Arrived From | |
| Home | 3923 (78.9) |
| Facility | 1033 (20.8) |
| Missing | 13 (0.3) |
| **Advance Directives** | |
| Early DNR[b] (within 24 hours of admission) | 283 (5.7) |
| **Severity of Acute Illness** | |
| Modified Early Warning Score (MEWS) | 4.2 (1.7) |
| Oxygen Therapy on Arrival | |
| None | 1013 (20.4) |
| Nasal Cannula | 3219 (64.8) |
| Venturi Mask | 30 (0.6) |
| Nonrebreather | 439 (8.8) |
| High Flow | 16 (0.3) |
| Noninvasive Ventilation | 26 (0.5) |
| Mechanical Ventilation | 226 (4.5) |
| **Hospital Outcomes** | |
| Length of Stay (days) | 10.00 (10.2) |
| Median (days) | 7 |
| Hospital Mortality | 1753 (35.3) |
| Discharge Disposition | |
| Home | 1966 (39.6) |
| Facility | 970 (19.5) |
| Psychiatric Facility | 15 (0.3) |
| Hospice Home; Hospice Facility | 28 (0.6); 57 (1.1) |
| Left Against Medical Advice | 18 (0.4) |
| Still admitted | 30 (0.6) |
| 30-Day readmission | 331 (6.7) |

[a] * = minus age

[b] DNR = Do Not Resuscitate

**Table 2:** Univariate Logistic Regressions of the Association between Patient Factors and Hospital Mortality (N = 4,807) (Expired versus Discharged Alive)

| **Predictor** | **OR (95% CI)** | **Interpretation** |
|---|---|---|
| **Demographics** | | |
| Age (continuous) | 1.041 (1.034, 1.049) | Older age associated with mortality |
| Gender (male vs. female) | 1.317 (1.169, 1.484) | Male gender associated with mortality |
| Race | 1.282 (1.139, 1.444) | Non-minority race associated with mortality |
| Ethnicity | 0.880 (0.744, 1.040) | |
| Insurance | 0.956 (0.751, 1.215) | |
| **Comorbidity Index** | | |
| Comorbidity Index (CCI-age)[b] | 1.084 (1.062, 1.106) | Higher CCI associated with mortality |
| **Functional/Cognitive Status** | | |
| Dementia | 1.598 (1.350, 1.891) | Dementia associated with mortality |
| Arrived from (facility vs. home) | 1.940 (1.686, 2.232) | Arrival from a facility associated with mortality |
| **Severity of Illness on Presentation** | | |
| MEWS (severely-ill vs. not severely-ill)[c] | 6.756 (5.878, 7.765) | Higher MEWS associated with mortality |
| First documented oxygen | | Higher oxygen needs on admission associated with mortality |
| First documented oxygen (nasal cannula, vs. room air) | 2.582 (2.162, 3.084) | |
| First documented oxygen (nonrebreather vs. room air) | 5.685 (4.448, 7.267) | |
| First documented oxygen (mechanical ventilation vs. room air) | 14.777 (10.385, 21.028) | |
| **Advanced Directives** | | |
| Early DNR[d] (vs. late or no DNR) | 3.456 (2.686, 4.448) | Early DNR associated with mortality |

[a] *denotes $p < .05$
[b] CCI = Charlson Comorbidity Index
[c] MEWS = Modified Early Warning Score
[d] DNR = Do Not Resuscitate

**Table 3:** Multivariate Logistic Regression (Model 1). Patient Factors Significantly Associated with Hospital Mortality (Expired versus Discharged Alive)

| **Patient Characteristics** | **OR (95% CI)** |
|---|---|
| Gender (male vs. female) | 1.472 (1.272, 1.703) |
| CCI[b] | 1.104 (1.076, 1.132) |
| Arrived from (facility vs. home) | 1.708 (1.434, 2.035) |
| MEWS[c] (severely-ill vs. not severely-ill) | 6.263 (5.397, 7.267) |
| First documented oxygen (nasal cannula, vs. room air) | 2.742 (2.230, 3.371) |
| First documented oxygen (nonrebreather, vs. room air) | 5.306 (3.981, 7.074) |
| First documented oxygen (mechanical ventilation vs. room air) | 15.001 (9.806, 22.949) |
| Early DNR[d] (vs. late or no DNR) | 2.451 (1.799, 3.340) |

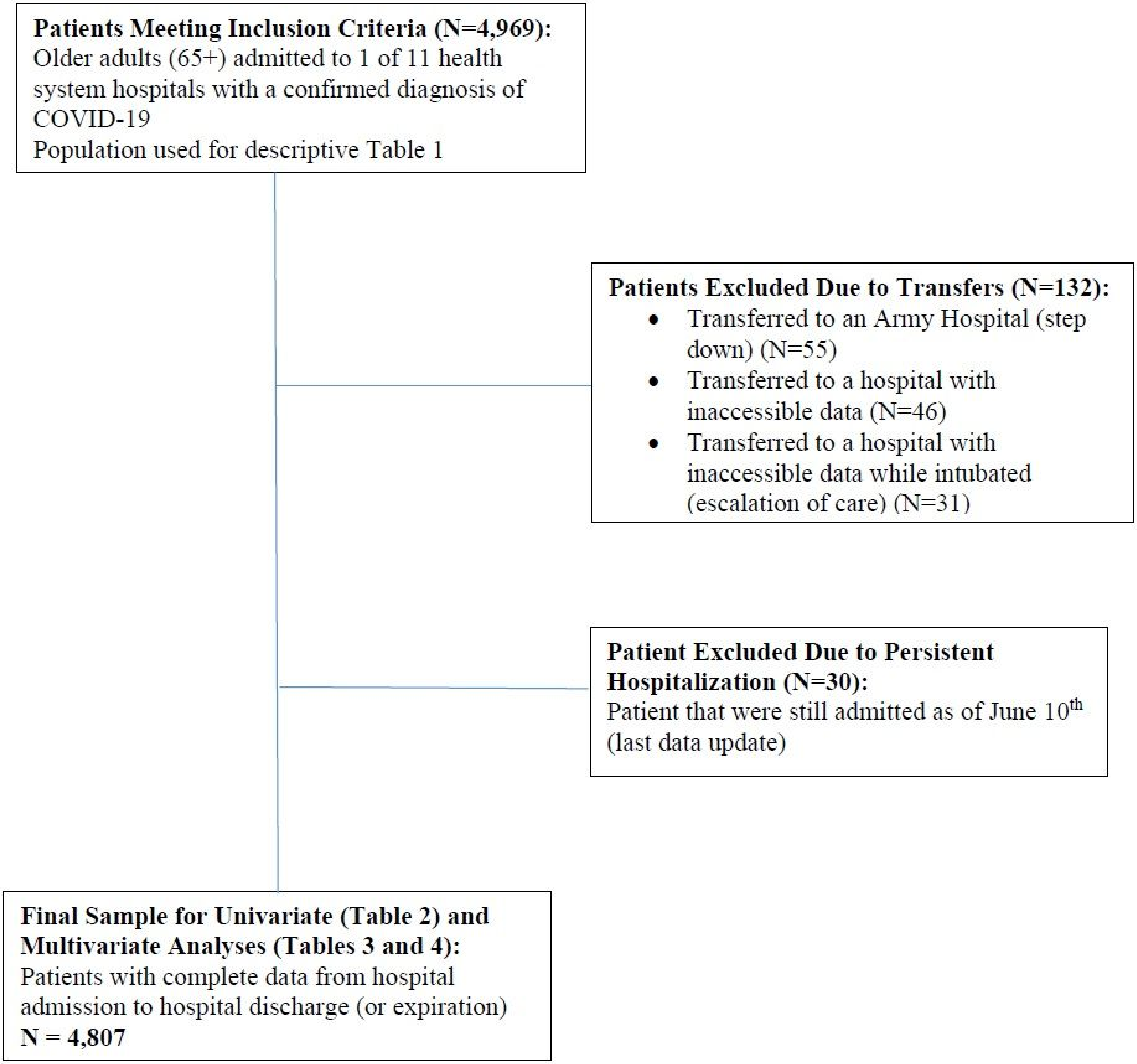
[a] *denotes $p < .05$
[b] CCI = Charlson Comorbidity Index (without age component)
[c] MEWS = Modified Early Warning Score
[d] DNR = Do-Not-Resuscitate

**Table 4:** Multivariate Logistic Regression (Model 2). Association between Age and Hospital Mortality (Expired versus Discharged Alive) After Controlling for Patient Factors Relevant to the Older Adult Population (Age was Forced into the Model)

| **Patient Characteristics** | **OR (95% CI)** |
|---|---|
| Age (continuous) | 1.006 (0.996, 1.015) |
| Gender (male vs. female) | 1.490 (1.286, 1.726) |
| CCI[b] | 1.102 (1.074, 1.131) |
| Arrived from (facility vs. home) | 1.677 (1.404, 2.003) |
| MEWS[c] (severely ill vs. not severely ill) | 6.078 (5.198, 7.105) |
| First documented oxygen (nasal cannula, vs. room air) | 2.755 (2.241, 3.389) |
| First documented oxygen (nonrebreather, vs. room air) | 5.340 (4.005, 7.121) |
| First documented oxygen (mechanical ventilation vs. room air) | 15.237 (9.954, 23.325) |
| Early DNR[d] (vs. late or no DNR) | 2.370 (1.732, 3.243) |

[a] *denotes $p < .05$
[b] CCI = Charlson Comorbidity Index (without age component)
[c] MEWS = Modified Early Warning Score
[d] DNR = Do-Not-Resuscitate

# Figures




### Figure 1

Flow Diagram of Patient Population