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MAJOR ARTICLE

Clinical Management of Hospitalized Coronavirus Disease 2019 Patients in the United States

Essy Mozaffari,[1] Aastha Chandak,[2] Zhiji Zhang,[2] Shuting Liang,[1] Julie Gayle,[3] Mark Thrun,[1] Robert L. Gottlieb,[4,5,6,7] Daniel R. Kuritzkes,[8] Paul E. Sax,[8] David A. Wohl,[9] Roman Casciano,[2] Paul Hodgkins,[1] and Richard Haubrich[1]

[1]Gilead Sciences, Foster City, California, USA, [2]Certara, New York, New York, USA, [3]Premier Inc., Charlotte, North Carolina, USA, [4]Baylor University Medical Center, Dallas, Texas, USA, [5]Baylor Scott and White Heart and Vascular Hospital, , Dallas, Texas, USA, [6]Baylor Scott and White The Heart Hospital, Plano, Texas, USA, and [7]Baylor Scott and White Research Institute, Dallas, Texas, USA, [8]Division of Infectious Diseases, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA, [9]University of North Carolina, Chapel Hill, North Carolina, USA

Background. The objective of this study was to characterize hospitalized coronavirus disease 2019 (COVID-19) patients and describe their real-world treatment patterns and outcomes over time.

Methods. Adult patients hospitalized on May 1, 2020–December 31, 2020 with a discharge diagnosis of COVID-19 were identified from the Premier Healthcare Database. Patient and hospital characteristics, treatments, baseline severity based on oxygen support, length of stay (LOS), intensive care unit (ICU) utilization, and mortality were examined.

Results. The study included 295 657 patients (847 hospitals), with median age of 66 (interquartile range, 54–77) years. Among each set of demographic comparators, the majority were male, white, and over 65. Approximately 85% had no supplemental oxygen charges (NSOc) or low-flow oxygen (LFO) at baseline, whereas 75% received no more than NSOc or LFO as maximal oxygen support at any time during hospitalization. Remdesivir (RDV) and corticosteroid treatment utilization increased over time. By December, 50% were receiving RDV and 80% were receiving corticosteroids. A higher proportion initiated COVID-19 treatments within 2 days of hospitalization in December versus May (RDV, 87% vs 40%; corticosteroids, 93% vs 62%; convalescent plasma, 68% vs 26%). There was a shift toward initiating RDV in patients on NSOc or LFO (68.0% [May] vs 83.1% [December]). Median LOS decreased over time. Overall mortality was 13.5% and it was highest for severe patients (invasive mechanical ventilation/extracorporeal membrane oxygenation [IMV/ECMO], 53.7%; high-flow oxygen/noninvasive ventilation [HFO/NIV], 32.2%; LFO, 11.7%; NSOc, 7.3%). The ICU use decreased, whereas mortality decreased for NSOc and LFO.

Conclusions. Clinical management of COVID-19 is rapidly evolving. This large observational study found that use of evidence-based treatments increased from May to December 2020, whereas improvement in outcomes occurred over this time-period.

Keywords. clinical management; COVID-19; hospitalization; treatment patterns.

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) first emerged in China in December 2019 as the cause of what is now termed coronavirus disease-2019 (COVID-19) [1]. Rapid community spread of COVID-19 ensued and a global pandemic was declared by the World Health Organization in March 2020 [2].

Since the onset of the pandemic, clinical management of COVID-19 has evolved rapidly over time and outcomes have gradually improved with increasing knowledge of the disease [3–6]. Several pharmacologic interventions have been formally studied in randomized clinical trials, and additional treatments are under evaluation; both proven and investigational approaches are in wide use in clinical practice [7–13]. Remdesivir (RDV) was the first antiviral approved by both the US Food and Drug Administration and the European Medicines Agency for treatment of hospitalized COVID-19 patients [14–19].

In the United States, there was a 25% reduction in COVID-19 mortality rates from January to April 2020 and a substantial decline in risk-adjusted mortality rates between March and August 2020 [4, 5]. Despite initial improvements in mortality, studies in the United States have observed considerable variation in COVID-19 outcomes by hospital and geographic region [4, 20, 21]. Higher community case rates of COVID-19 were associated with worse outcomes by hospital, accounting for some of this variation [4, 20]. Regional differences in clinical management of COVID-19 [20, 22] may also explain some of the variation in outcome, but data are limited and have mostly been single-center studies or focused on small sample sizes [4, 6, 20–24]. In addition, few of these studies describe the impact of disease severity and temporal changes in COVID-19 management on mortality and outcomes

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Correspondence: R. L. Gottlieb, MD, PhD, Advanced Heart Failure and Transplant Cardiologist, Center for Advanced Heart and Lung Disease, Baylor University Medical Center, 3410 Worth St., Suite 250, Dallas, TX 75246, USA (robert.gottlieb@bswhealth.org).

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in patients with COVID-19 in real-world settings [6]. Studies that account for more recent temporal changes in COVID-19 management are also limited because there is a lag in data availability in many data sources (eg, insurance claims databases). Existing studies have focused on data through August 2020.

We therefore conducted an analysis using one of the largest COVID-19 hospitalization datasets in the United States with geographic representation across the country and included more recent data from May 2020 through end of December 2020. The objective of this study was to characterize hospitalized patients with a discharge diagnosis of COVID-19 and describe real-world treatment patterns and outcomes over time among hospitalized COVID-19 patients.

METHODS

Data Source

This study used the Premier Healthcare Database, an administrative all-payer database that covers approximately 20% of all US hospitalizations from 45 states and the District of Columbia. The data include diagnosis codes, procedure codes, admission month, discharge month, and costs per day relative to admission date. However, actual dates and time stamps are not available to ensure patient privacy. Hence, all baseline variables are examined within the first 2 days of hospitalization.

Study Population

Adult patients (≥18 years) hospitalized on May 1, 2020–December 31, 2020 with a primary or secondary discharge diagnosis of COVID-19 (*International Classification of Diseases, Tenth Revision, Clinical Modification* [ICD-10-CM] Code U07.1) were included. Only the first admission during the study period was included for each patient. The accuracy of ICD-10-CM code U07.1 has been previously validated; this code has been shown to be a reasonable measure for tracking inpatient COVID-19 discharges and associated costs [25].

Patients were excluded from the study if they were pregnant or had received RDV as part of a clinical trial/study (identified through RDV-related hospital charges that also mentioned "Study" or "Placebo"). Patients who had extended length of stay of >100 days and patients with incomprehensible/incomplete data on hospitalization were also excluded.

Patient and Hospital Characteristics

Study variables included demographics and key baseline comorbidities occurring in more than 5% of patients. Comorbidities were derived from ICD-10-CM diagnosis codes of chronic conditions present as the admitting or discharge diagnoses. Discharge diagnoses of sepsis, pulmonary embolism, respiratory failure, pneumonia, and hypoxemia among other conditions were also examined. Discharge disposition (home or home health, expired, hospice, transferred, or skilled nursing facility, rehabilitation, intermediate care facility, or long-term care) was described. Hospital characteristics included urban/rural, teaching status, region, bed size, and hospitalization characteristics included admission type and admission source. Apparent baseline severity of the patients during first 2 calendar days of hospitalization was identified as the highest category of oxygen support on an ordinal scale: (1) invasive mechanical ventilation/extracorporeal membrane oxygenation (IMV/ECMO); (2) high-flow oxygen device or noninvasive mechanical ventilation (HFO/NIV); (3) low-flow oxygen device or oxygen supply (LFO); and (4) no supplemental oxygen charges (NSOc).

Utilization of treatments with emergency use authorizations (EUA) (%) or approval among COVID-19 patients including RDV, convalescent plasma, corticosteroids, anticoagulants, tocilizumab, sarilumab, and baricitinib (overall and by ordinal scale at baseline) was examined. Utilization of other treatments such as hydroxychloroquine, azithromycin, ivermectin, and vitamin D was also examined (overall). Concomitant use of other immunomodulatory drugs used for treating immunosuppressive conditions was analyzed as well.

Treatment patterns were examined for RDV, corticosteroids, convalescent plasma, and anticoagulants: the percentage of patients initiating the respective treatment on day 1, 2, 3, 4, 5, and >5 of hospitalization. In addition, patient presence in ICU/step-down unit when RDV treatment was initiated and percentage of RDV patients initiating treatment within 2 days of the hospitalization were also reported. Severity at the time of RDV initiation was characterized based upon the oxygen support up until RDV initiation using the defined ordinal severity scale.

Hospital length of stay (LOS) over time was summarized for all patients (including those who died). The ICU utilization and ICU LOS over time were also evaluated. All-cause in-hospital mortality was identified from "expired" discharge status and examined over time.

Statistical Analysis

Descriptive analyses were conducted: categorical variables were summarized by number of observations, and percentage and continuous variables were summarized using median and interquartile range (IQR). Demographics, hospital, and hospitalization characteristics were summarized for the overall COVID-19 cohort. Treatment utilization, LOS, ICU, and mortality outcomes were summarized by month of admission (May–December) and were stratified by baseline severity. The LOS and ICU LOS outcomes were right skewed by patients who died during the hospitalization since both groups of patients were examined. Adjusted mortality rates by month and stratified by baseline ordinal scale were also extracted using a logistic regression model. The following variables were included in the adjusted model: age, gender, race, ethnicity, and comorbidities (cerebrovascular disease, chronic obstructive pulmonary disease [COPD], congestive heart failure [CHF], diabetes mellitus,

dementia, hypertension, myocardial infarction, obesity, and renal disease).

Patient Consent Statement

Given the deidentified and retrospective nature of the data obtained from the Premier Healthcare Database, as well as the observational study design, written patient consent was neither required nor sought.

Data Availability

The data that support the findings of this study are available from Premier, Inc. (https://www.premierinc.com/). Restrictions apply to the availability of these data, which were used under license for this study.

RESULTS

Patient and Hospital Characteristics

There were 295 657 patients in the study cohort from 847 hospitals (Supplementary Figure 1), after applying the inclusion and exclusion criteria. Median age was 66 (IQR, 54–77) years; more than half were male, and with respect to each characteristic treated individually, the majority were white, over 65 years old, and with Medicare as primary payor (Table 1, Supplementary Table 1). With respect to each individual category, most patients in the sample were from nonteaching, urban hospitals in the South or Midwest and were admitted from a nonhealthcare facility as an emergency admission (Supplementary Table 1).

For more than half of the patients, respiratory failure (62.1%) and pneumonia (77.0%) were recorded in the discharge diagnoses, whereas sepsis was reported for 25.6% of patients (Table 1). At baseline, ~85% patients and 74%–76% patients received no more than NSOc or LFO as maximal oxygen support at any time during the hospitalization, which remained stable over the study period (Figure 1). The proportion of patients on IMV/ECMO at baseline was 7.9% in May and 4.2% in December, and at any time during the hospitalization it was 15.3% in May and 9.8% in December; the proportion of patients on HFO/NIV at baseline was 7.1% in May and 11.1% in December, and at any time during the hospitalization it was 9.3% in May and 14.3% in December (Figure 1).

Demographic characteristics changed over time in terms of age (65 years [IQR, 52–77] in May and 69 years [IQR, 57–79] in December), racial composition (48.9% white patients, 22.8% black patients in May; 69.9% white patients, 15.4% black patients in December), and ethnicity (20.8% Hispanic patients in May and 13.3% Hispanic patients in December), as well as presence of comorbid conditions such as chronic pulmonary disorder (22.7% in May and 25.0% in December), hypertension (67.9% in May and 72.4% in December), and obesity (27.1% in May and 30.2% in December) (data not shown).

Table 1. Demographic and Hospital Characteristics of Patients Hospitalized for COVID-19, May–December 2020

Characteristics	Overall COVID-19 Cohort (N = 295 657)
Age Group, n (%), Years	
18–34	16 315 (5.5%)
35–49	39 088 (13.2%)
50–64	80 466 (27.2%)
65+	159 788 (54.0%)
Race, n (%)	
White	195 597 (66.2%)
Black	51 142 (17.3%)
Other	48 918 (16.5%)
Ethnicity, n (%)	
Hispanic	50 922 (17.2%)
Non-Hispanic	201 918 (68.3%)
Unknown	42 817 (14.5%)
Sex, n (%)	
Female	138 510 (46.8%)
Male	156 972 (53.1%)
Comorbid Conditions	
Cerebrovascular disease, n (%)	16 677 (5.6%)
Chronic pulmonary disease, n (%)	70 898 (24.0%)
Congestive heart failure, n (%)	56 017 (18.9%)
Diabetes mellitus, n (%)	86 714 (29.3%)
Dementia, n (%)	37 504 (12.7%)
Hypertension, n (%)	208 032 (70.4%)
Myocardial infarction, n (%)	27 783 (9.4%)
Obesity, n (%)	93 625 (31.7%)
Renal disease[a], n (%)	69 343 (23.5%)
Discharge Disposition, n (%)	
Home or home health	189 921 (64.2%)
Expired	39 798 (13.5%)
Hospice	7205 (2.4%)
Transferred	7853 (2.7%)
SNF, Rehab, ICF, or long-term care	46 207 (15.6%)
Other	4673 (1.6%)
Discharge diagnosis, n (%)	
Sepsis	75 694 (25.6%)
Pulmonary embolism	127 (<0.1%)
Respiratory failure	183 560 (62.1%)
Pneumonia	227 689 (77.0%)
Hypoxemia	21 515 (7.3%)
Concomitant medications	
Immunomodulatory drugs	14 215 (4.8%)

Abbreviations: COVID-19, coronavirus disease 2019; ICF, intermediate care facility; Rehab, rehabilitation; SNF, skilled nursing facility.

[a]Defined through *International Classification of Diseases, Tenth Revision* diagnosis codes for hypertensive chronic kidney disease, chronic or unspecified nephritic syndrome, chronic kidney disease, kidney failure, renal osteodystrophy, renal dialysis encounter or dependence, and kidney transplant status.

Treatment Patterns

Overall, RDV utilization in December was approximately 10 times higher than when the EUA was issued in May; by December, approximately half of all hospitalized COVID-19 patients were receiving RDV (Figure 2). Use of corticosteroids (including dexamethasone) was 34.3% in May and 59.0% in June followed by a period of consistent utilization (~80%) from July

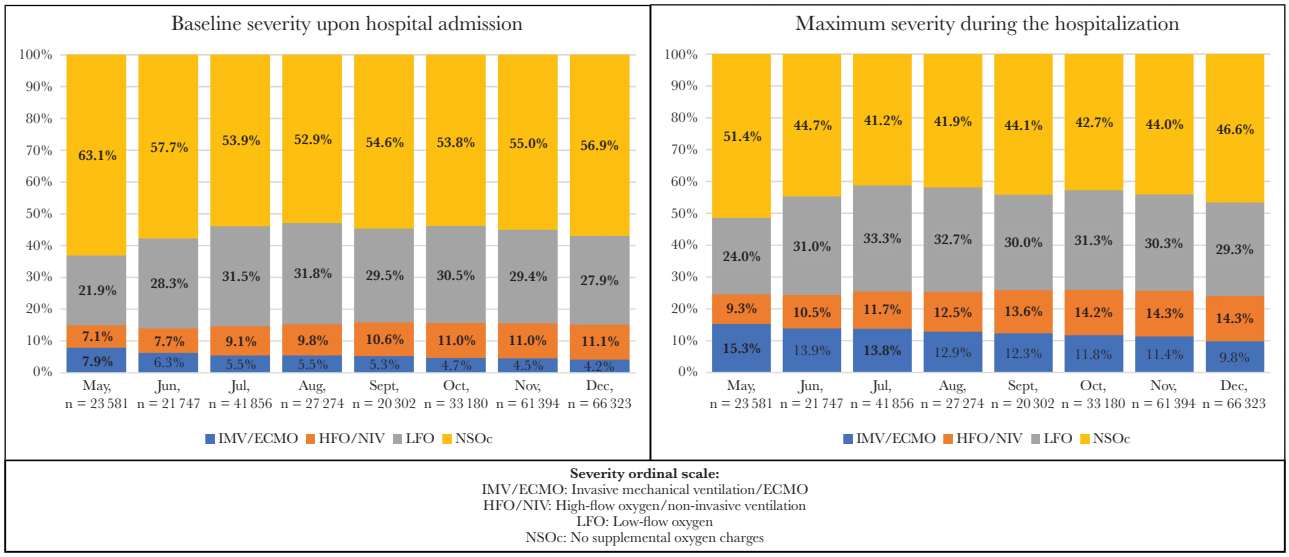

Figure 1. Baseline severity upon hospital admission and maximum severity during the hospitalization among all patients hospitalized for coronavirus disease 2019, May–December 2020.

to December (Figure 2). Use of anticoagulant treatments ranged from 32.4% in May to 27.4% in December (Figure 2). The use of convalescent plasma was 2.9% in May and peaked at 26.7% in October before declining to 17.3% in December (Figure 2). Utilization of tocilizumab (3.7%), sarilumab (<0.1%), and baricitinib (<0.1%) was sparse (sarilumab and baricitinib data not shown due to low sample sizes) (Figure 2). Treatment utilization varied by ordinal scale at baseline with lower proportion of NSOc patients receiving treatments (Figure 2). These findings were generally consistent across regions (data not shown). In addition, use of RDV and corticosteroid combination during the study period was 37.6%, corticosteroids and convalescent plasma combination was 15.8%, and RDV and convalescent plasma was 12.5% (data not shown). Other treatments were also examined: utilization of hydroxychloroquine was 9.0% in May and 0.7% in December, utilization of azithromycin was consistent from May to December (38.4% in May, 49.8% in July, and 35.2% in December), utilization of ivermectin was low (0.5% in May and 1.5% in December), and utilization of vitamin D increased from 18.1% in May to 34.3% in December (Supplementary Figure 2).

By December, 87.0% (n = 28 598) of hospitalized COVID-19 patients who received RDV at some point during the admission first received it during the first 2 days of hospitalization, whereas in May, 40.1% (n = 476) of RDV-treated patients received RDV on day 1 or 2 (Figure 3). Among the patients who were treated with corticosteroids or convalescent plasma, usage within the first 2 days of hospitalization was 62% in May and 93% in December for corticosteroids and 26% in May and 68% in December for convalescent plasma (Figure 3). Early use of anticoagulants remained consistent over time at >70% from May to December (Figure 3).

Hospitalization Outcomes

Mortality, median LOS (overall and ICU), and ICU use for the overall cohort are presented in Supplementary Table 2. Median LOS by month was 7 days (May–October) and 6 days for November and December. A similar finding was observed for ICU LOS; median by month was 5 days (May–November) and 4 days for December. Overall mortality was 15.6% in May and 13.7% in December (Supplementary Table 2).

When stratifying by baseline severity, patients on IMV/ECMO and HFO/NIV had mortality rates of 53.7% and 32.2%, respectively, compared with 7.3% (NSOc) and 11.7% (LFO) (Figure 4). Median LOS for patients who needed oxygen at baseline was 14, 11, and 7 days in May/June for IMV/ECMO, HFO/NIV, and LFO, respectively, compared to 11, 9, and 6 days in November/December (Figure 4). For patients admitted to the ICU, median ICU LOS was 10 days in May/June and 7 days in November/December for the IMV/ECMO group, 7 days in May/June and 6 days in November/December for the HFO/NIV group, 5 days in May/June and 4 days in November/December for the LFO group and 4 days in May/June and 3 days in November/December for the NSOc group (Figure 4). Intensive care unit use and mortality for all severity groups are also shown in Figure 4. The mortality for the IMV/ECMO group was 47% in May/June compared to 59% in November/December (Figure 4). After adjusting for age, gender, race, ethnicity, and comorbidities (cerebrovascular disease, COPD, CHF, diabetes mellitus, dementia, hypertension, myocardial infarction, obesity, and renal disease), the mortality rate was 9% in May and 7% in December for patients on NSOc at baseline, 18% in May and 13% in December for patients on LFO at baseline, 39% in May and 36% in December for patients on HFO/NIV at baseline, and 46% in

Figure 2. Treatment utilization by month among patients hospitalized for coronavirus disease 2019, May–December 2020. IMV/ECMO, invasive mechanical ventilation/extracorporeal membrane oxygenation; LFO, low-flow oxygen; NSOc, supplemental oxygen charges; RDV, remdesivir.

May and 60% in December for patients on IMV/ECMO at baseline (Supplementary Figure 3).

DISCUSSION

Clinical management of COVID-19 in the United States has evolved considerably over time. The improvements in COVID-19 outcomes over time observed in this study were dependent on baseline severity, similar to other real-world studies [2, 4, 6, 22, 24]. These improvements are likely due to a combination of expanding clinical experience, greater use of treatments based on outcomes from clinical studies, and provider knowledge of outcomes from randomized controlled studies that demonstrated clinical benefits of some

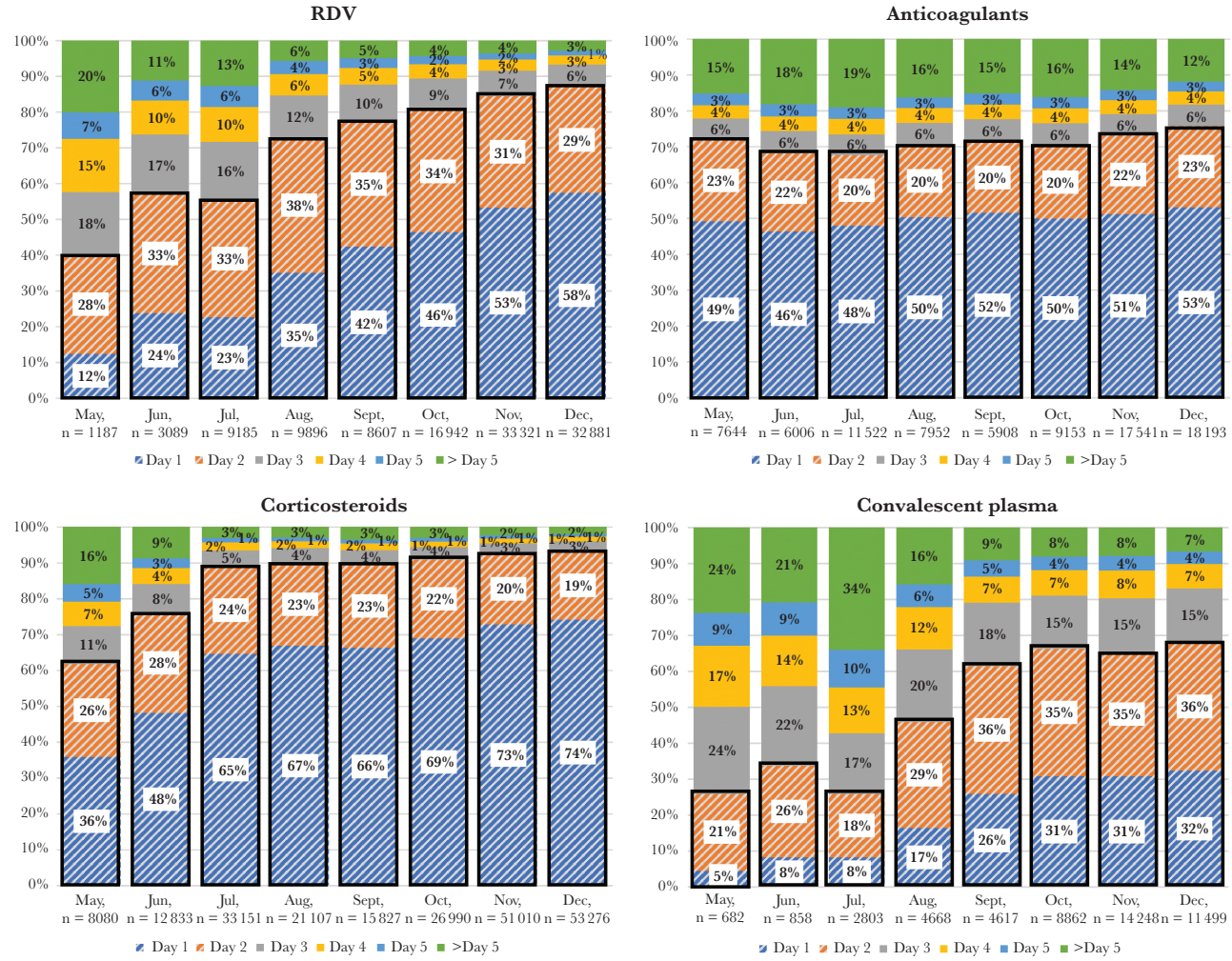

Figure 3. Treatment initiation day for remdesivir (RDV), anticoagulants, corticosteroids, and convalescent plasma, May–December 2020. The stripes and the rectangular outline in black are used to indicate patients initiated on a therapy within first 2 days of hospital admission.

interventions, most notably dexamethasone and remdesivir [9, 14]. Adjustments in treatment strategy, increasing hospital capacity, availability of new pharmacologic treatments (eg, systemic corticosteroids and RDV), nonpharmacologic interventions such as prone placement, earlier intervention, decrease in the severity of the patients admitted to the hospital over the course of the pandemic, community awareness, and public health interventions of mask wearing and social distancing have likely impacted outcomes in COVID-19 [5, 11]. The phase 3 Adaptive COVID-19 Treatment Trial (ACTT-1) trial showed that the benefit of RDV was most apparent in patients on LFO [14], and from our data it appears that treating physicians and hospital protocols across the United States have responded to the insights from this trial and other evidence. Likewise, the RECOVERY study of hospitalized patients with COVID-19 demonstrated that dexamethasone improved survival, especially among those who required oxygen or were critically ill [9]. Changes in patient characteristics over the course of the pandemic could also explain some of the improvements in outcomes [6]. The present study adds to the limited literature that provides insight into the key parameters necessary for evaluating the management of this disease. Time since start of pandemic, severity of disease, treatment patterns, and timing of treatments are all important factors to consider when conducting outcomes research of COVID-19 in real-world settings.

Although there were general improvements in some outcomes and use of treatments over time, there were some notable exceptions. Overall mortality rates observed in our study showed a modest continual downward trend over time, but mortality by severity level showed that patients in the IMV/ECMO and HFO/NIV groups had a slight increase in mortality in recent months, whereas the NSOc and LFO groups had slight decreases. These results remained consistent in the adjusted analyses. It is important to consider that because of the changing conditions of the pandemic, thresholds for hospital admission may have changed, and it is possible that less severely ill patients were being admitted in later time periods [5]. It is more

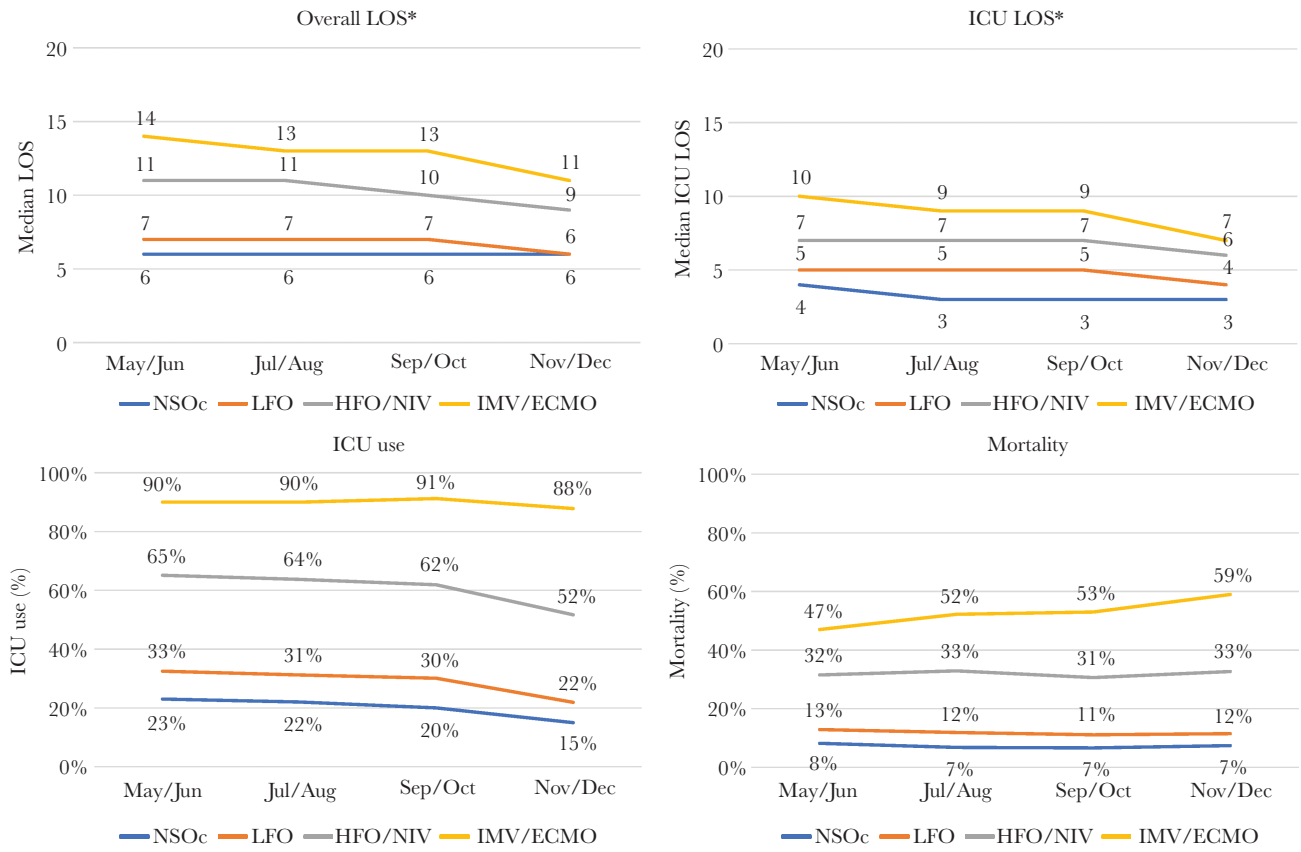

Figure 4. Outcomes by baseline severity for all patients hospitalized for coronavirus disease 2019, May–December 2020. *Overall length of stay (LOS) and intensive care unit (ICU) LOS medians are right-skewed because patients who died and did not die are both included in the analysis. HFO/NIV, high-flow oxygen/noninvasive ventilation; IMV/ECMO, invasive mechanical ventilation/extracorporeal membrane oxygenation; LFO, low-flow oxygen; NSOc, supplemental oxygen charges; RDV, remdesivir.

likely, however, that more critically ill patients were treated earlier in the pandemic with mechanical ventilation, while later managed with prone positioning and other noninvasive strategies. This trend would shift the burden of disease among those in the IMV/ECMO group in particular to be of greater severity. In support of this practice change, use of IMV/ECMO in the first 2 days of the hospital course declined from 7.9% in May to 4.2% in December 2020, and thus the patients that received mechanical ventilation reflected a more ill cohort over time.

Use of medical treatments with proven benefits in clinical trials increased. More recently, however, the proportions of use for RDV and corticosteroids appeared to have leveled somewhat. Remdesivir use increased from 5.0% in May to 51.1% in October then remained at approximately 50% since then. Likewise, corticosteroid use increased from 34.3% in May to 79.2% in July, but utilization has leveled off at an average just slightly above 80%. Approximately 85% of the study population were in the 2 lowest severity categories that may experience the greatest benefit from RDV use, and the results of this study suggest that there remain opportunities to improve treatment for these patients.

To date, there have been few studies that examine the patient and hospital characteristics and clinical management of COVID-19 in a large sample of patients, and findings from these studies have varied. An observational US cohort study from a large national health insurer (N = 38 517 adults across 955 US hospitals) conducted from January 1, 2020 to June 30, 2020 found that hospitals in the Northeast, medium to large hospitals, and hospitals with high county-level COVID-19 case rates had worse risk-standardized event rates of 30-day in-hospital mortality or referral to hospice [4]. Fried et al [21] also conducted a larger observational US claims cohort study (N = 11 721 from 245 hospitals across 38 states) during the earlier time frame of the pandemic (February 15, 2020–April 20, 2020). This study described demographics and other characteristics including oxygenation needs, mechanical ventilation, RDV, hydroxychloroquine, and other treatments but did not stratify by severity of disease [21]. The largest study to date (N = 192 550) described characteristics and outcomes over the first 6 months of the pandemic and found a significant decrease in mortality, but unlike the analysis presented here, did not describe outcomes by baseline severity [24].

Variation within and among these studies and compared with the present study may be due to the paucity of high-quality evidence to back clinical practice, differences in hospital resources to manage practices such as prone positioning, availability and

access to medications such as RDV, as well as unmeasured differences across treatment centers [20]. In addition, the present study period of May to December eliminates the early period of the pandemic (included in all other studies) when mortality rates were highest. These studies along with the current study highlight the need for robust methodologies that account for key factors specific to the rapidly changing COVID-19 disease landscape when conducting comparative analyses of evolving COVID-19 treatments. Nonrandomized comparative effectiveness studies of COVID-19 treatments should consider potential determinants of treatment decisions such severity, calendar time, fever, low oxygen saturation, presence of comorbidities, and elevated inflammatory biomarkers [23].

A key strength of our study is that it describes the characteristics of hospitalized COVID-19 patients, along with comorbidities, treatment, severity, and outcomes, in a large, geographically diverse sample that covers approximately 20% of hospitalization in the United States. Another strength of this study is that it provides a longer period (8 months) of characterization of COVID-19 hospitalizations than most published studies and illustrates how treatment patterns and outcomes changed over time. This study includes more recent data and excludes data from the early months of the pandemic in which high mortality was related to limited knowledge of disease and overwhelmed hospital capacity. In addition, this study also provides a more detailed picture of how outcomes changed over time in patients of different baseline severity levels, which can serve as important references for future comparative research. Limitations include the potential for misclassification from using administrative data to define clinical variables; variables based on billing and ICD-10 coding may misclassify or underrepresent comorbid conditions, treatments, procedures, and therapies. Because not all hospitals consistently bill for oxygen supply or oxygen devices, particularly LFO, it is possible that the category of NSOc in our study included patients who received some level of oxygen that was not billed for separately, but rather included in the room charge instead. Thereby, to capture this limitation, we denoted this group as NSOc.

CONCLUSIONS

Our study describes the demographics, hospital characteristics, and treatments of hospitalized COVID-19 patients in the largest dataset to our knowledge to date using data from as recent as December 2020. Our study showed an increase in the use of treatments over time as well as decreases in ICU use and modest decreases in mortality, except for those receiving IMV/ECMO or HFO/NIV at baseline. Because of the recent emergence of COVID-19, conditions are rapidly evolving, and these studies must be repeated and account for temporal changes over the course of the study, a changing treatment landscape including vaccinations, while also controlling for differences in disease severity to understand the potential benefit of new treatments whether as a single regimen or as a combination.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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Potential conflicts of interest. E. M., M. T., P. H., and R. H. report employment with Gilead Sciences, where they are also shareholders. S. L. reports employment with Gilead Sciences at the time of this study. A. C. , Z. Z., and R. C. are employees of Certara, which was contracted by Gilead Sciences to conduct this study. R. L. G. reported being a study investigator for Gilead Sciences, Eli Lilly, Kinevant, Johnson and Johnson, Regeneron, and Roche/Genentech, an advisor/review panel member for Eli Lilly, Gilead Sciences, and GSK, and reported receiving other financial or material support (gift-in-kind to Baylor Scott and White Research Institute for NCT03383419) from Gilead Sciences. D. R. K. reported research support from Gilead Sciences, Merck, and ViiV, being a study investigator for Atea and Novartis, and a consultant for Abpro, Atea, Decoy, Gilead Sciences, GSK, Janssen, Merck, Rigel, and ViiV. P. E. S. reported being a study investigator for Gilead Sciences and ViiV and an advisor or review panel member for Gilead Sciences, ViiV, Janssen, and Merck. D. A. W. reported grant support to his institution from Gilead Sciences, Viiv, and Merck and being on the advisory board/consultant for Gilead Sciences, ViiV, Janssen, and Merck. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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