

# Characteristics, Clinical Management, and Outcomes of Leukemia, Lymphoma and Multiple Myeloma Patients Hospitalized with a Primary Diagnosis of COVID-19: Insights from Hospitals across the United States

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## Conclusions

- Our study highlights the high mortality and readmission rates among patients with conditions of leukemia, lymphoma or multiple myeloma hospitalized for COVID-19.
- Almost half of the immunocompromised patients, who may have benefited from remdesivir, did not receive it despite being hospitalized with a primary diagnosis of COVID-19; while a third received corticosteroid monotherapy contradicting guideline recommendations
- About a quarter without supplemental oxygen did not receive any COVID-19 treatment
- Appropriate clinical management of COVID-19 with antivirals among this high-risk patient group may reduce their disease burden.
  - Prior research has established the use of remdesivir was associated with improved survival among patients with immunocompromising conditions such those included in this study.<sup>6</sup>

## Background

- Immunocompromised (IC) patients remain at high risk of hospitalizations, complications, and mortality due to COVID-19.<sup>1-4</sup>
- NIH guidelines recommend administration of remdesivir (RDV) in COVID-19 IC patients, who are at high risk of severe disease or hospitalization.<sup>5</sup>
- Prior research has demonstrated that RDV is associated with lower risk of mortality in IC patients hospitalized for COVID-19.<sup>6</sup>
- However, limited information is available on the characteristics, clinical management, and outcomes of COVID-19 patients with specific IC conditions.

## Objectives

- In this study, we described the patient characteristics, clinical management and outcomes of patients with leukemia, lymphoma, or multiple myeloma hospitalized for COVID-19

## Methods

### Study Design

- Descriptive retrospective cohort study (Table 1)
- Data source: PINC AI Healthcare Database (formerly Premier Healthcare Database)
  - US hospital-based, service-level, all-payer (Commercial, Medicare, Medicaid, others) database
  - Covers ~25% of all US hospitalizations from 48 states
  - Includes patient-level information on billed services for each day of hospitalization

Table 1. Study Design

Inclusion criteria	✓	First admission to the hospital January 1, 2022-December 31, 2023	
✓	Primary discharge diagnosis of COVID-19 (ICD-10-CM: U07.1)		
Immunocompromised Conditions (ICD-10-CM codes)	Leukemia	Lymphoma	Multiple Myeloma
	C91.x, C92.x, C93.x, C94.x, C95.x	C81.x C82.x, C83.x, C84.x, C85.x	C90.x

### Statistical analysis

- All analyses conducted were descriptive in nature.
- Patient characteristics were described for the three IC conditions of leukemia, lymphoma and multiple myeloma.
- Patients were categorized based on supplemental oxygen requirements as: No supplementary oxygen charges (NSOc), low-flow oxygen (LFO), high-flow oxygen/non-invasive ventilation (HFO/NIV), invasive mechanical ventilation/extracorporeal membrane oxygenation (IMV/ECMO)
- Utilization of COVID-19 treatments overall and by supplemental oxygen requirements were described
- Outcomes of in-hospital all-cause mortality and COVID-19 related readmission were assessed.

## Results

### Leukemia

- 2356 leukemia patients were hospitalized with a primary diagnosis of COVID-19 (Table 2)
  - Median age [IQR] of 76.0 [68.0 ; 83.0] years
  - 82% White, 40% female
  - Majority (76%) with Charlson Comorbidity Index(CCI) ≥3
- Maximum supplemental oxygen requirements during the hospitalization were 31% LFO, 20% HFO/NIV 6% IMV/ECMO (Table 3)
- COVID-19 treatments used included dual therapy with Remdesivir+Corticosteroids/Baricitinib/Tocilizumab (46%), corticosteroid monotherapy (28%) and remdesivir monotherapy (9%) (Table 3)
- Mortality rate was 17% and COVID-19 related readmission rates was 11% (Table 4)

## Results (contd.)

### Lymphoma

- 2249 lymphoma patients were hospitalized with a primary diagnosis of COVID-19 (Table 2)
  - Median age [IQR] of 74.0 [66.0 ; 81.0] years
  - 83% White, 44% female
  - Majority (77%) with CCI ≥3
- Maximum supplemental oxygen requirements during the hospitalization were 31% LFO, 20% HFO/NIV and 8% IMV/ECMO (Table 3)
- COVID-19 treatments used included dual therapy with Remdesivir+Corticosteroids/Baricitinib/Tocilizumab (47%), corticosteroid monotherapy (29%) and remdesivir monotherapy (8%) (Table 3)
- Mortality rate was 21% and COVID-19 related readmission rates was 14% (Table 4)

### Multiple myeloma

- 1178 multiple myeloma patients were hospitalized with a primary diagnosis of COVID-19 (Table 2)
  - Median age [IQR] of 75.0 [67.0 ; 81.0] years
  - 66% White, 45% female
  - Majority (73%) with CCI ≥3
- Maximum supplemental oxygen requirements during the hospitalization were 27% LFO, 18% HFO/NIV and 7% IMV/ECMO (Table 3)
- COVID-19 treatments used included dual therapy with Remdesivir+Corticosteroids/Baricitinib/Tocilizumab (48%), corticosteroid monotherapy (29%) and remdesivir monotherapy (8%) (Table 3)
- Mortality rate was 16% and COVID-19 related readmission rates was 7% (Table 4)

### Treatment patterns among all three conditions

- Treatment patterns among patients with all three conditions were similar (Figure 1)
  - Half of the patients received remdesivir across all levels of oxygenation and >90% received corticosteroids among those requiring supplemental oxygen
  - Use of corticosteroid monotherapy was observed in a third of the patients requiring any supplemental oxygen, and in a quarter not requiring supplemental oxygen
- A quarter of the patients without supplemental oxygen did not receive any COVID-19 treatment (Figure 1)

Table 2. Demographic Characteristics of Leukemia, Lymphoma and Multiple Myeloma patients hospitalized for COVID-19

	Leukemia patients	Lymphoma patients	Multiple Myeloma patients	
# of Patients	n=2356	n=2249	n=1178	
# of Hospitals	n=608	n=574	n=454	
Age	Median [IQR]	76.0 [68.0 ; 83.0]	74.0 [66.0 ; 81.0]	75.0 [67.0 ; 81.0]
<18	56 (2.4%)	12 (0.5%)	0 (0.0%)	
18-34	24 (1.0%)	25 (1.1%)	0 (0.0%)	
35-49	39 (1.7%)	59 (2.6%)	27 (2.3%)	
Age Group	50-64	313 (13.3%)	409 (18.2%)	201 (17.1%)
65-74	617 (26.2%)	630 (28.0%)	344 (29.2%)	
75-84	858 (36.4%)	770 (34.2%)	415 (35.2%)	
85+	449 (19.1%)	344 (15.3%)	191 (16.2%)	
Race	White	1925 (81.7%)	1874 (83.3%)	772 (65.5%)
Black	228 (9.7%)	169 (7.5%)	292 (24.8%)	
Asian	29 (1.2%)	54 (2.4%)	24 (2.0%)	
Other	174 (7.4%)	152 (6.8%)	90 (7.6%)	
Gender	Female	936 (39.7%)	988 (43.9%)	526 (44.7%)
Ethnicity	Hispanic	194 (8.2%)	233 (10.4%)	122 (10.4%)
Commercial	293 (12.4%)	350 (15.6%)	165 (14.0%)	
Primary Payor	Medicare	1850 (78.5%)	1713 (76.2%)	917 (77.8%)
Medicaid	136 (5.8%)	114 (5.1%)	54 (4.6%)	
Other Payor	77 (3.3%)	72 (3.2%)	42 (3.6%)	
Mean [SD]	4.2 [2.2]	4.2 [2.2]	4.9 [2.4]	
Median [Q1 ; Q3]	4.0 [3.0 ; 5.0]	4.0 [3.0 ; 5.0]	4.0 [3.0 ; 6.0]	
CCI	0	0 (0.0%)	0 (0.0%)	0 (0.0%)
1	0 (0.0%)	0 (0.0%)	0 (0.0%)	
2	569 (24.2%)	525 (23.3%)	206 (17.5%)	
≥3	1787 (75.8%)	1724 (76.7%)	972 (82.5%)	
Hospital Setting	Rural	296 (12.6%)	296 (13.2%)	129 (11.0%)
Teaching Hospital	1076 (45.7%)	1084 (48.2%)	560 (47.5%)	
<100	184 (7.8%)	179 (8.0%)	72 (6.1%)	
100-199	363 (15.4%)	335 (14.9%)	179 (15.2%)	
Hospital size, no. of beds	200-299	470 (19.9%)	417 (18.5%)	252 (21.4%)
300-399	383 (16.3%)	341 (15.2%)	200 (17.0%)	
400-499	280 (11.9%)	263 (11.7%)	135 (11.5%)	
500+	676 (28.7%)	714 (31.7%)	340 (28.9%)	

<sup>1</sup>In this database, only readmission to the same hospital can be tracked  
LOS, length of stay; ICU, intensive care unit; IQR, interquartile range; NSOc: No supplementary oxygen charges; LFO: Low-Flow Oxygen; HFO/NIV: High-Flow Oxygen/Non-invasive ventilation; IMV/ECMO: Invasive Mechanical Ventilation/ Extracorporeal Membrane Oxygenation; RDV, remdesivir; CORT, corticosteroids; BARI, baricitinib; TOCI, tocilizumab; DEX, dexamethasone; CCI, Charlson Comorbidity Index;

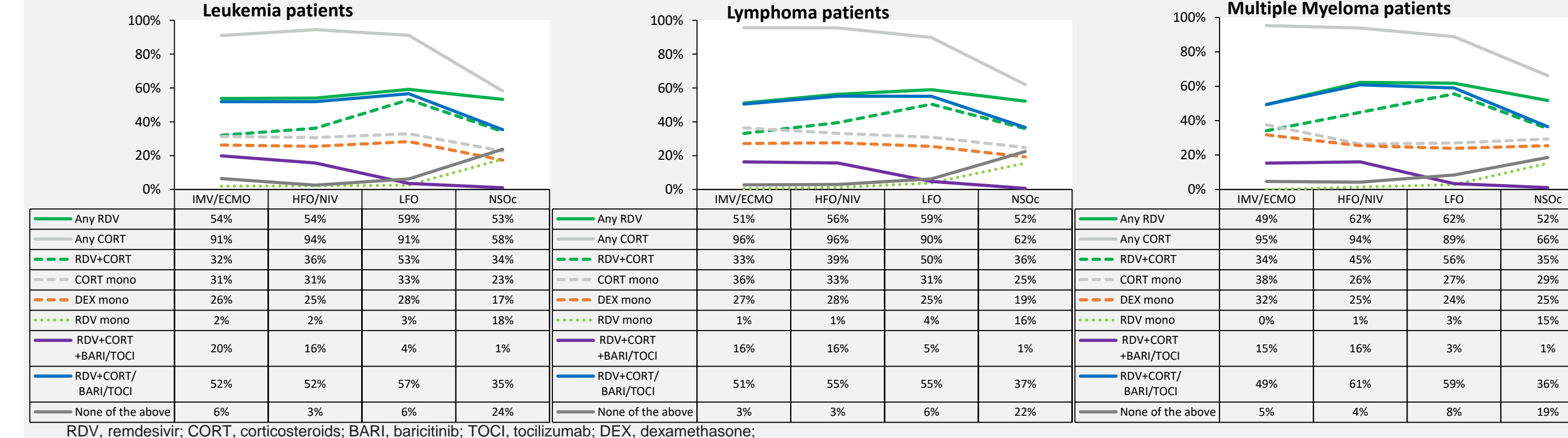
Table 3. Clinical Characteristics and Management of Leukemia, Lymphoma and Multiple Myeloma patients hospitalized for COVID-19

	Leukemia patients	Lymphoma patients	Multiple Myeloma patients	
# of Patients	n=2356	n=2249	n=1178	
# of Hospitals	n=608	n=574	n=454	
Baseline	NSOc	1296 (55.0%)	1208 (53.7%)	697 (59.2%)
oxygen support (first 2 days of hospitalization)	LFO	697 (29.6%)	672 (29.9%)	292 (24.8%)
HFO/NIV	310 (13.2%)	324 (14.4%)	157 (13.3%)	
IMV/ECMO	53 (2.2%)	45 (2.0%)	32 (2.7%)	
Maximum	NSOc	993 (42.1%)	919 (40.9%)	559 (47.5%)
oxygen support during hospitalization	LFO	735 (31.2%)	700 (31.1%)	322 (27.3%)
HFO/NIV	472 (20.0%)	446 (19.8%)	212 (18.0%)	
IMV/ECMO	156 (6.6%)	184 (8.2%)	85 (7.2%)	
COVID-19 treatment	RDV	1303 (55.3%)	1238 (55.0%)	662 (56.2%)
CORT	1836 (77.9%)	1801 (80.1%)	936 (79.5%)	
DEX	1618 (68.7%)	1564 (69.5%)	855 (72.6%)	
TOCI	118 (5.0%)	116 (5.2%)	52 (4.4%)	
BARI	119 (5.1%)	116 (5.2%)	49 (4.2%)	
None of the above	304 (12.9%)	268 (11.9%)	144 (12.2%)	
COVID-19 treatment combination or monotherapy	RDV+CORT	951 (40.4%)	921 (41.0%)	501 (42.5%)
CORT mono	661 (28.1%)	659 (29.3%)	339 (28.8%)	
DEX mono	541 (23.0%)	528 (23.5%)	300 (25.5%)	
RDV mono	210 (8.9%)	176 (7.8%)	97 (8.2%)	
RDV+CORT+	141 (6.0%)	139 (6.2%)	64 (5.4%)	
BARI/TOCI				
RDV+CORT/BARI/TOCI	1093 (46.4%)	1062 (47.2%)	565 (48.0%)	

Table 4. Outcomes of Leukemia, Lymphoma and Multiple Myeloma patients hospitalized for COVID-19

	Leukemia patients	Lymphoma patients	Multiple Myeloma patients
# of Patients	n=2356	n=2249	n=1178
# of Hospitals	n=608	n=574	n=454
LOS, Median [IQR]	5.0 [3.0 ; 9.0]	5.0 [3.0 ; 11.0]	5.0 [3.0 ; 10.0]
ICU use, %	561 (23.8%)	633 (28.1%)	309 (26.2%)
Mortality, %	398 (16.9%)	472 (21.0%)	184 (15.6%)
All-cause readmission <sup>1</sup> , %	817 (34.7%)	754 (33.5%)	392 (33.3%)
COVID-19 related readmission <sup>1</sup> , %	252 (10.7%)	311 (13.8%)	77 (6.5%)

Figure 1. COVID-19 treatments by supplemental oxygen requirements during the hospitalization



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