

BRIEF REPORT

Blood transfusion utilization in hospitalized COVID-19 patients

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Abstract

Background: The acute respiratory illness designated coronavirus disease 2019 (COVID-19) was first reported in Wuhan, China, in December 2019 and caused a worldwide pandemic. Concerns arose about the impact of the COVID-19 pandemic on blood donations and potential significant blood transfusion needs in severely ill COVID-19 patients. Data on blood usage in hospitalized COVID-19 patients are scarce.

Study Design and Methods: We performed a retrospective observational study of blood component transfusions in the first 4 weeks of COVID-19 ward admissions. The study period began 14 days before the first COVID-19 cohort wards opened in our hospital in March 2020 and ended 28 days afterward. The number of patients and blood components transfused in the COVID-19 wards was tabulated. Transfusion rates of each blood component were compared in COVID-19 wards versus all other inpatient wards.

Results: COVID-19 wards opened with seven suspected patients and after 4 weeks had 305 cumulative COVID-19 admissions. Forty-one of 305 hospitalized COVID-19 patients (13.4%) received transfusions with 11.1% receiving red blood cells (RBCs), 1.6% platelets (PLTs), 1.0% plasma, and 1.0% cryoprecipitate (cryo). COVID-19 wards had significantly lower transfusion rates compared to non-COVID wards for RBCs (0.03 vs 0.08 units/patient-day), PLTs (0.003 vs 0.033), and plasma (0.002 vs 0.018; all $p < 0.0001$). Cryo rates were similar (0.008 vs 0.009, $p = 0.6$).

Conclusions: Hospitalized COVID-19 patients required many fewer blood transfusions than other hospitalized patients. COVID-19 transfusion data will inform planning and preparation of blood resource utilization during the pandemic.

The acute respiratory illness designated coronavirus disease 2019 (COVID-19) was first reported on December

31, 2019, in Wuhan, China, and on January 7, 2020, the causal agent was identified as the novel severe respiratory distress syndrome coronavirus 2 (SARS-CoV-2).¹ Only 2 weeks later, the United States reported its first case of COVID-19.² The disease spread rapidly leading to a worldwide pandemic and the declaration of a U.S.

Abbreviations: cryo, cryoprecipitate; DIC, disseminated intravascular coagulation; ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit.

national emergency on March 13, 2020.³ By April 15, 2020, there were 632,000 cases in the US, including over 25,000 in Illinois.^{4,5} Concerns arose about a severe impact of the COVID-19 pandemic on blood donations and potential significant blood transfusion needs in severely ill COVID-19 patients.^{6,7}

Loss of blood collections due to societal closures as well as widespread illness caused significant drops in blood donations in countries with early severe outbreaks.^{8,9} Washington state and other areas of the United States saw a temporary significant decrease in blood supply during the early period of the pandemic.¹⁰ Hospitals and blood centers proactively implemented blood conservation strategies as well as efforts to maintain blood donations.¹¹ However, no studies to date have provided detailed blood usage in COVID-19 patients. Better understanding of this aspect of COVID-19 care can aid planning and preparation during the pandemic. Our brief report describes the blood transfusion needs of hospitalized COVID-19 patients.

1 | MATERIALS AND METHODS

We performed a retrospective observational study of blood component transfusions in the first 4 weeks of COVID-19 admissions in our 900-bed adult urban academic medical center. The study period started 14 days before (Weeks -2 and -1) the first COVID-19-cohort wards opened in our hospital on March 13, 2020, and ended 28 days afterward (Weeks 1-4). All confirmed and clinically suspected COVID-19 admissions were located on the COVID-19 cohort wards. The beginning of Week 1 also marked the onset of in-hospital patient testing to facilitate rapid rule-out testing and avoidance or relocation of COVID-19-negative patients from the COVID-19 wards.

At the beginning of Week -1 due to projections for inadequate blood supplies and a request from our main blood supplier to reduce transfusion service blood inventories by 25%, our transfusion service notified all providers to adhere to hospital transfusion guidelines and expanded our prospective blood order reviews. Postponement of all elective surgeries was implemented during Week 1. The study period was prior to local availability of COVID-19 convalescent plasma.

The numbers of patients and blood components transfused in the COVID-19 wards and all other inpatient wards were obtained from transfusion locations recorded in our laboratory information system (Cerner PathNet, North Kansas City, MO). Cryoprecipitate (cryo) was expressed as pools. Total weekly inpatient and outpatient transfusions were also compiled from the laboratory

information system. The daily numbers of total hospital inpatients and COVID-19 ward inpatients were obtained from hospital patient census records. Total numbers of COVID-19 admissions during the study period were obtained from hospital data provided to the Illinois Department of Public Health. Transfusion rates were expressed as blood components per patient per day to control for the rapidly changing numbers of COVID-19 patients. Transfusion rates were calculated for the pre-COVID-19 period (all wards, Weeks -2 and -1), the non-COVID-19 wards during the COVID-19 period, and the COVID-19 wards during the COVID-19 period (both wards, Weeks 1-4). Statistical comparisons of transfusion rates employed 95% confidence intervals (CIs) and two-tailed Fisher's exact tests seeking $p < 0.05$ (Prism 8.0.3, GraphPad Software, San Diego, CA).

2 | RESULTS

Our COVID-19 wards opened with seven suspected patients, less than 1% of 852 inpatients. After 4 weeks, we had 305 cumulative COVID-19 admissions, of which 139 were still admitted (23% of 607 inpatients), 160 were discharged and six had died. Table 1 shows the proportions of COVID-19-ward patients transfused, and the numbers of units they received. Eleven percent of patients received red blood cells (RBCs), but less than 2% received each of the other components. Platelet (PLT) and plasma transfusions were especially low. The COVID-19 wards accounted for 12.3% of all inpatient-days during Weeks 1 through 4, but received only 4% of all inpatient blood components during that time. The COVID-19 intensive care unit (ICU) wards, which accounted for 34% of the COVID-19 ward patient-days, transfused 51% to 62% of the COVID-19-ward RBCs, PLTs, and cryo and all COVID-19 ward plasma units (data not shown).

Two of the three patients receiving COVID-19 ward cryo (six and nine pools, respectively) had disseminated intravascular coagulation (DIC), a recognized complication of severe COVID-19.^{12,13} The DIC case who received nine cryo pools was one of five COVID-19 patients on extracorporeal membrane oxygenation (ECMO) during the study period.

COVID-19 wards had significantly lower transfusion rates compared to concurrent non-COVID-19 wards for RBCs (0.030 vs 0.075 units/patient-day), PLTs (0.003 vs 0.033), and plasma (0.002 vs 0.018; all $p < 0.0001$; (Fig. 1). Expressed as percentages, these COVID-19 ward transfusion rates were 40, 9, and 11% of the non-COVID-19 rates, respectively. The cryo usage rate on COVID-19 wards was not significantly different than on non-COVID-19 wards. COVID-19 ICU wards had significantly

TABLE 1 COVID-19-ward transfusions^a

	Transfused patients	% of COVID-19 ward admissions transfused	Transfused units: COVID-19 wards/total inpatient (%)
Any transfusion	41	13.4	90/2122 (4.2%)
RBC	34	11.1	63/1192 (5.3%)
PLTs	5	1.6	7/500 (1.4%)
Plasma	3	1.0	4/280 (1.4%)
Cryo	3	1.0	16/150 (10.7%)

^aTransfusions in the first 4 weeks of COVID-19 wards. Cryo units are expressed as pools.

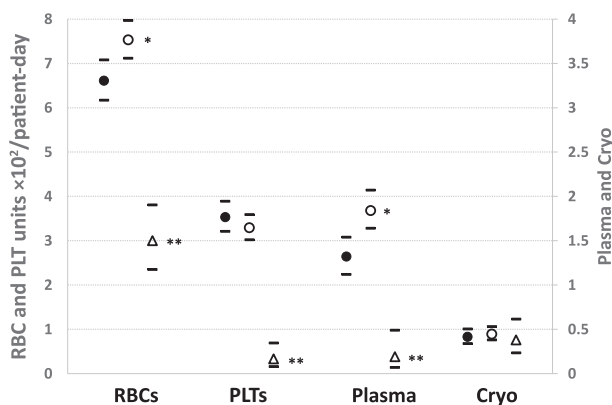


FIGURE 1 Inpatient transfusion rates before and after COVID-19. * $p < 0.01$ versus pre-COVID-19 period. ** $p < 0.0001$ versus all wards before COVID-19 and non-COVID-19 wards during COVID-19. Bars: 95% CIs. Transfusion rates: units $\times 10^2$ /patient-day. ●, All inpatient wards before COVID-19: 2-week baseline period before COVID-19 wards opened. ○, Non-COVID-19 wards during COVID-19 period. Δ, COVID-19 wards: 4-week period after COVID-19 wards opened

higher rates than COVID-19 non-ICU wards for RBCs (0.045 vs 0.022 units/patient-day, $p < 0.01$) and plasma (0.006 vs 0.000, $p < 0.05$), but not for PLTs (0.006 vs 0.002, $p = 0.24$) or cryo (0.014 vs 0.004, $p = 0.30$).

After elective surgeries were postponed and the COVID-19 wards opened, the patients who still needed hospitalization in the non-COVID-19 wards had higher RBC and plasma transfusion rates than inpatients in the pre-COVID-19 period (Fig. 1). However, Fig. 2 shows the marked decline in overall weekly transfusions of all blood components in the study period, associated with enhanced blood conservation measures, canceled elective surgeries, the decrease in total inpatients as wards were cleared for future COVID-19 patients, and the increasing numbers of COVID-19 ward patients receiving RBCs,

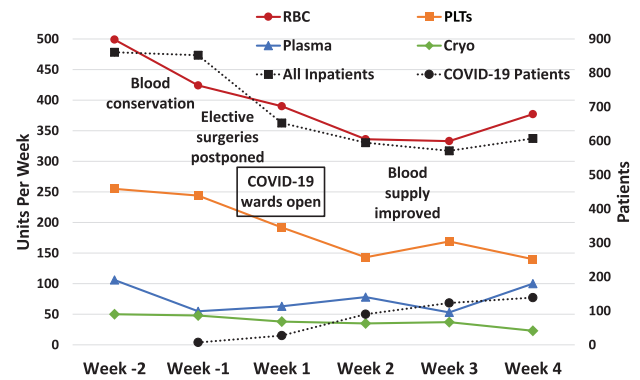


FIGURE 2 COVID-19 impact on numbers of inpatients and overall transfusions. Total weekly blood component transfusions are shown for 2 weeks before and 4 weeks after our first COVID-19 cohort hospital wards opened. Outpatient transfusions are included to reflect overall trends in blood usage for our transfusion service. Total inpatients and COVID-19 ward inpatients are shown as of the last day of each week

plasma, and PLTs at significantly lower rates. By Week 4 our blood supplier reported increased blood collections (including numerous extra blood drives in our hospital system) and improved supplies, permitting transfusion service inventories to return to normal. RBC and plasma transfusions increased somewhat in this period but PLT and cryo usage continued to decline.

3 | DISCUSSION

Our study demonstrates low blood product utilization in patients hospitalized on COVID-19 wards during the pandemic. Thirteen percent of hospitalized COVID-19 patients required transfusions, which comprised only 4% of total inpatient blood transfusions during the study period. Hospitalized COVID-19 ward patients had significantly lower transfusion rates of RBCs, PLTs, and plasma than concurrent hospitalized patients without COVID-19. COVID-19 ICUs had higher rates of RBC and plasma transfusion than COVID-19 ward patients who were not in ICUs, but the overall blood usage in both groups remained low.

Low blood usage in hospitalized COVID-19 patients may lessen the impact of the COVID-19 pandemic on the overall blood supply. Research on blood usage in hospitalized COVID-19 patients is limited. One Chinese hospital reported low numbers of blood components transfused, but did not provide the numbers of patients.¹⁴ Published hematologic variables in COVID-19 patients demonstrate most patients have normal or mildly decreased hemoglobin (Hb) and PLT counts with median

Hb nadir of 13.3 g/dL and median PLT count nadir of $185 \times 10^9/L$.¹⁵ These hematologic indices are similar to results from the 2005 SARS pandemic where decreases in PLT and Hb counts were mild and rarely required blood transfusion.¹⁶⁻¹⁸

Disease severity factors such as organ system failure and coagulopathy including DIC have been noted in COVID-19 patients and may impact transfusion needs.^{7,12,13} Hyperfibrinogenemia and hypercoagulability in thromboelastography have also been described in COVID-19 patients.^{19,20} We had two patients with severe DIC who received multiple cryo doses. However, our hospital adopted expert recommendations for anticoagulation in COVID-19 patients, which may have reduced the prevalence of this complication.¹³ Procedures performed on patients such as ECMO may increase blood transfusion needs, although in our hospital avoidance of systemic anticoagulation during ECMO was recently shown to minimize transfusion needs.^{21,22}

In this preliminary study, we used COVID-19 ward locations as a rapid means to estimate transfusion rates in a large number of patients. This included some patients who were assigned there briefly for clinical suspicion before their tests were negative. However, in-house SARS-CoV-2 testing was initiated early in Week 1, so ruled-out patients were transferred to non-COVID-19 wards promptly. Detailed analysis of patient-specific transfusion indications was beyond the scope of this study.

Patient blood management and efforts to stabilize and conserve the blood supply are applicable during pandemics and normal times. Our blood conservation recommendations may have influenced reduced transfusions. Proactive implementation of blood shortage management strategies may limit blood usage. In the COVID-19 pandemic, cancellation of elective surgeries at our hospital was associated with a further significant decrease in blood usage (Fig. 2). Initial decreases in blood donation due to donor safety concerns and canceled blood collection events can be lessened with increased donor outreach and implementation of social distancing strategies in blood donation settings.¹⁰

While pandemics may reduce blood supply, our study demonstrated that hospitalized COVID-19 patients had low blood usage. Future studies examining the impact of patient factors may help further elucidate mechanisms affecting blood utilization in hospitalized COVID-19 populations.

CONFLICT OF INTEREST

The authors have disclosed no conflicts of interest.

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