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Impact of the COVID-19 pandemic on blood donation and transfusions in the United States in 2020

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Abstract

Introduction: Reports have suggested the COVID-19 pandemic resulted in blood donation shortages and adverse impacts on the blood supply. Using data from the National Blood Collection and Utilization Survey (NBCUS), we quantified the pandemic's impact on red blood cell (RBC) and apheresis platelet collections and transfusions in the United States during year 2020.

Methods: The 2021 NBCUS survey instrument was modified to include certain blood collection and utilization variables for 2020. The survey was distributed to all US blood collection centers, all US hospitals performing ≥1000 surgeries annually, and a 40% random sample of hospitals performing 100–999 surgeries annually. Weighting and imputation were used to generate national estimates for whole blood and apheresis platelet donation; RBC and platelet transfusion; and convalescent plasma distribution.

Results: Whole blood collections were stable from 2019 (9,790,000 units; 95% CI: 9,320,000–10,261,000) to 2020 (9,738,000 units; 95% CI: 9,365,000–10,110,000). RBC transfusions decreased by 6.0%, from 10,852,000 units (95% CI: 10,444,000–11,259,000) in 2019 to 10,202,000 units (95% CI: 9,811,000–10,593,000) in 2020. Declines were steepest during March–April 2020, with transfusions subsequently rebounding. Apheresis platelet collections increased from 2,359,000 units (95% CI: 2,240,000–2,477,000) in 2019 to 2,408,000 units (95% CI: 2,288,000–2,528,000) in 2020. Apheresis platelet transfusions increased from 1,996,000 units

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CONFLICT OF INTEREST STATEMENT

The authors have disclosed no conflicts of interest.

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(95% CI: 1,846,000–2,147,000) in 2019 to 2,057,000 units (95% CI: 1,902,000–2,211,000) in 2020.

Conclusion: The COVID-19 pandemic resulted in reduced blood donations and transfusions in some months during 2020 but only a minimal annualized decline compared with 2019.

Keywords

blood center operations; platelet transfusion; RBC transfusion

1 | INTRODUCTION

In 2020, the emergence of the severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) resulted in significant disruption to the US healthcare system. During March–April 2020 and extending through 2020, mitigation measures intended to control virus transmission resulted in reduced utilization of healthcare services.[1–3] The Centers for Medicare & Medicaid Services (CMS) issued recommendations to delay all nonessential medical procedures.[4] Subsequently, this recommendation along with the implementation of other mitigation measures resulted in a reduction in patients seeking routine preventive and screening measures, emergency services, surgical procedures, and other hospital-based care.[1–3,5,6]

The impact of the coronavirus disease 2019 (COVID-19) pandemic on the availability of blood in the United States is unclear. In 2020, blood collection efforts were adversely impacted by the cancelation of thousands of blood drives.[7] However, constraints on the supply of blood products appeared to correspond to substantially reduced demand for blood. Declines in transfusions during the early COVID-19 pandemic have been reported through limited studies in the United States.[8,9] Significantly lower red blood cell (RBC) and platelet utilization have been reported among COVID-19 patients compared to patients hospitalized with non-COVID-19 diagnoses.[10] Therefore, the impact on overall availability of blood in the setting of disruptions to supply and demand during 2020 on a national level remains unclear. Additionally, the introduction of COVID-19 convalescent plasma as a therapeutic for SARS-CoV-2 infection further impacted the blood supply and operations of blood centers and transfusion services in the United States.[11,12]

Since 2013, the Centers for Disease Control and Prevention (CDC) and the Office of the Assistant Secretary for Health (OASH) have administered the National Blood Collection and Utilization Survey (NBCUS). The survey is administered in even-numbered years (e.g., in 2022) for the previous odd-numbered calendar year (2021). To better quantify the impact of the early COVID-19 pandemic on the blood supply in the United States, the 2021 survey included questions pertaining to blood collection and utilization in 2020. Additional questions on transfusion of COVID-19 convalescent plasma were included to understand the extent of use of this product across the United States. We report the findings of the 2021 NBCUS pertaining to the impact of COVID-19 on blood availability and transfusions in 2020 including the use of COVID-19 convalescent plasma.

2 | METHODS

Detailed NBCUS methods are described elsewhere.[13] Briefly, blood collection facilities were identified using the U.S. Food and Drug Administration's (FDA) Blood Establishment Registration database. Hospitals were identified using the 2019 American Hospital Association Annual Survey.[14] The survey was distributed to all US blood collection centers identified using the FDA Blood Establishment Registration database, all US hospitals performing ≥1000 surgeries annually, and a 40% random sample of hospitals performing 100–999 surgeries annually. Outpatient facilities, Department of Justice, military, inpatient rehabilitation, long-term acute care, and psychiatric hospitals were excluded. The survey was administered using an online questionnaire in REDCap (Research Electronic Data Capture, Nashville, TN). Facilities were given 2 months to respond, with an extension of 3 weeks, and subsequent email and telephone out-reach to nonrespondents was conducted by CDC.[15]

Six new questions were added to the 2021 NBCUS that captured data from 2020 on monthly whole blood collection procedures, monthly apheresis platelet distributions, annual COVID-19 convalescent plasma collections, monthly allogeneic RBC transfusions, and monthly apheresis platelet transfusions.

National estimates were calculated using multiple imputation and survey weighting. The following stratifications were used: community-based blood centers were stratified based on whole blood or RBC collections (fewer than 50,000; 50,000–199,999; 200,000–399,999; 400,000 or more units), hospital-based blood centers were stratified based on inpatient surgical procedures (fewer than 1000, 1000–7999, and 8000 or more procedures conducted annually), and transfusing hospitals were stratified based on the number of inpatient surgical procedures (100–999, 1000–1399, 1400–2399, 2400–4999, 5000–7999, and 8000 or more procedures conducted annually).[16] Survey weights were calculated as the ratio of total number of eligible participants to the total number of respondents. Blood collection centers in the highest volume strata (400,000 or more units) were designated a weight of 1.0. The Taylor Series method was used to calculate confidence intervals (CIs) for national collection and transfusion estimates.[17] Imputed variables were all continuous and non-normally distributed. A two-step imputation process was used to accommodate distributions skewed toward zero using established imputation factors from previous surveys.[18,19]

An additional analysis of RBC transfusions by state was conducted using a domain analysis of the monthly data for 2020. State population estimates from 2020 were obtained from the US Census Bureau,[20] and the RBC transfusions per population for each month were derived. All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

3 | RESULTS

Table 1 shows the national estimates of collections and transfusions during 2020 compared to 2019. Whole blood collections remained steady from 2019 (9,790,000 units; 95% CI: 9,320,000–10,261,000) to 2020 (9,738,000 units; 95% CI: 9,365,000–10,110,000) with a decrease of just 0.5%. Despite this relative parity in collections, RBC transfusions (from

whole blood and apheresis collections) decreased by 6.0%, from 10,852,000 units (95% CI: 10,444,000–11,259,000) in 2019 to 10,202,000 units (95% CI: 9,811,000–10,593,000) in 2020. Apheresis platelet collections increased by 2.1%, from 2,359,000 units (95% CI: 2,240,000–2,477,000) in 2019 to 2,408,000 units (95% CI: 2,288,000–2,528,000) in 2020. Apheresis platelet transfusions balanced the increase in collections with an increase of 3.1%, from 1,996,000 units (95% CI: 1,846,000–2,147,000) in 2019 to 2,057,000 units (95% CI: 1,902,000–2,211,000) in 2020. The overlapping confidence bounds for apheresis platelet collections and transfusions suggest that these changes were not significant.

Figure 1 shows the monthly estimates of whole blood collections and RBC transfusions during 2020 as well as an estimated monthly percentage of US inpatients with confirmed or suspected COVID-19.[21] The majority of whole blood collections result in whole blood-derived RBC units, but data on apheresis RBC collections for 2020 are not available. However, a previous NBCUS report showed that whole blood collections represented 84.5% of combined whole blood and apheresis RBC collections.[13] There was a decline in RBC units transfused from March to April 2020, during the early weeks of the pandemic. This reduction in use was accompanied by a reduction in collections in April and May 2020 that appears to lag the reduction in transfusions. There was a similar reduction in apheresis platelet use during April–May 2020 which was closely tracked by a slight reduction in apheresis platelet collections. There was no relationship between the percentage of US inpatients with confirmed or suspected SARS-CoV-2 infection and blood donation or utilization during 2020.

Figure 2 displays the ratio of RBC transfusions per population during April–May 2020 to RBC transfusions per population during January–February 2020. States with lower ratios used less blood (adjusted for population) during the early part of the pandemic (April–May 2020) compared to the two pre-pandemic months (January–February 2020). The majority of states experienced some reduction in RBC transfusions per population from January–February 2020 to April–May 2020, but the largest reductions were seen in New Mexico, Idaho, Wyoming, South Dakota, Minnesota, and Missouri.

National estimates of COVID-19 convalescent plasma collections and transfusions are shown in Table 2. There were 603,000 (95% CI: 534,000–672,000) units of convalescent plasma collected in 2020, with 91.5% of these being collected by community-based blood centers (552,000 units; 95% CI: 497,000–607,000). There were fewer COVID-19 convalescent plasma collections in 2021 (378,000 units; 95% CI: 321,000–435,000), with a similar percentage (93.4%) being collected at community-based blood centers (353,000 units; 95% CI: 304,000–403,000). The survey instrument only collected COVID-19 convalescent plasma transfusion data for 2021. Overall, an estimated 190,000 units (95% CI: 172,000–208,000) were transfused based on reported data.

4 | DISCUSSION

In 2020, blood collection centers across the United States reported severe disruptions to collections due to the COVID-19 pandemic.[7] These reports led to coordinated efforts by the US government to encourage blood donations, including communications by the Surgeon

General.[22] However, data from the 2021 NBCUS suggest that whole blood collections, which represent around 85% of all RBC collections, were similar in 2020 when compared with 2019, despite the COVID-19 pandemic. RBC transfusions, on an annualized basis, decreased by a relatively small 6% during 2020 compared to 2019. While RBC transfusions decreased slightly, apheresis platelet transfusions rose in 2020 when compared with 2019, suggesting that the COVID-19 pandemic did not specifically impact platelet utilization. In contrast to RBC transfusions, the increase in platelet transfusions (3.1%) tracked the increase in distributions (2.1%), reflecting the close coupling between supply and demand for platelets due to the standard 5-day shelf life. Collectively, the findings of the present study suggest that the impact of the COVID-19 pandemic on the annualized RBC and platelet supply was minimal.

During April–May 2020, which marked the early COVID-19 pandemic period in the United States, RBC transfusions and corresponding whole blood donations experienced a drop, likely due to broad implementation of COVID-19 mitigation strategies. However, these were followed by a return to baseline in the following month(s). Similarly, apheresis platelet transfusions appeared to drop during March–May 2020 but rebounded thereafter. This pattern is consistent with the observed impacts of the pandemic on the healthcare system overall, in which patients initially deferred seeking medical care during the early COVID-19 risk mitigation period but subsequently resumed healthcare utilization. The findings observed in the present study are consistent with an analysis of data from the National Healthcare Safety Network Hemovigilance Module, which found a statistically significant decrease in RBC transfusions during March–April 2020, with subsequent return to baseline.[8] This decline is broadly consistent with our findings, but the decrease early in the pandemic was negated throughout the rest of the year, suggesting a significant recovery in blood utilization. Interestingly, our results show that the reduced RBC transfusions during the early risk mitigation phase of the pandemic were not seen in states with high COVID-19 burden at that time. Additional research is required to determine reasons for this observation, but the findings suggest that individuals may have continued to seek therapies in some regions regardless of the adoption of COVID-19 risk mitigation measures. Ongoing communication between clinical providers and blood collection establishments to project anticipated blood demand during future pandemics may benefit preparedness and ensure adequate blood supplies as healthcare utilization returns to baseline.

The FDA's Expanded Access Program (EAP) to COVID-19 convalescent plasma was initiated due to a lack of therapeutics in the early phase of the pandemic.[23] Based on the findings of the present study, nearly 1 million COVID-19 convalescent plasma units were collected in the United States in 2020 and 2021. Prior case series conducted during influenza, SARS-CoV-1, and other viral infection outbreaks suggested some therapeutic benefit of convalescent plasma.[24–26] Additionally, limited case reports during the early months of the pandemic suggested that convalescent plasma was safe and may also have some survival benefit in COVID-19 patients.[27,28] However, widespread implementation of COVID-19 convalescent plasma occurred in the United States without robust clinical trial data on efficacy and, in many cases during 2020, without laboratory-based determination as to whether the transfused plasma products contained sufficient neutralizing antibody levels.[29] Only a minority of donors who presented for convalescent plasma donation

intended for study in a clinical trial had high neutralizing antibody titers.[29] Characterization of neutralizing antibody levels is complicated by discordance in measurements across different assay platforms.[30] While one study suggested benefit with high titer plasma if given prior to mechanical ventilation,[31] some clinical trials subsequently reported no morbidity or mortality benefit of convalescent plasma use as a therapeutic for COVID-19, particularly if used later in the clinical course of illness.[32–35] Based on the findings presented here, it appears that despite evidence that convalescent plasma had minimal survival benefit outside of limited circumstances, the use of this product continued in 2021, although only 50% of estimated collections in 2021 were transfused in that year. During future pandemics, rapid and robust large scale clinical trials should be prioritized before widespread adoption of convalescent plasma as therapy.

These findings are subject to the following limitations. First, imputation and weighting were used to generate national estimates. Changes in sampling and response rates could affect comparisons to previous NBCUS estimates. Next, similar to previous iterations of the NBCUS, certain hospital types were excluded (e.g., smaller hospitals, military hospitals, and outpatient facilities), potentially resulting in underestimates. Finally, while these findings may help characterize the impact of the adoption of COVID-19 risk mitigation measures on blood supply and use in the United States, the survey did not assess the direct causality of changes in monthly blood collections or transfusions.

The impact of the COVID-19 pandemic resulted in reduced blood donations and transfusions in some months during 2020, but no significant decline was seen in annualized data when compared with 2019. Future pandemic preparedness plans should include preparation for ensuring blood donations as the demand for blood products is likely to continue during public health emergencies.

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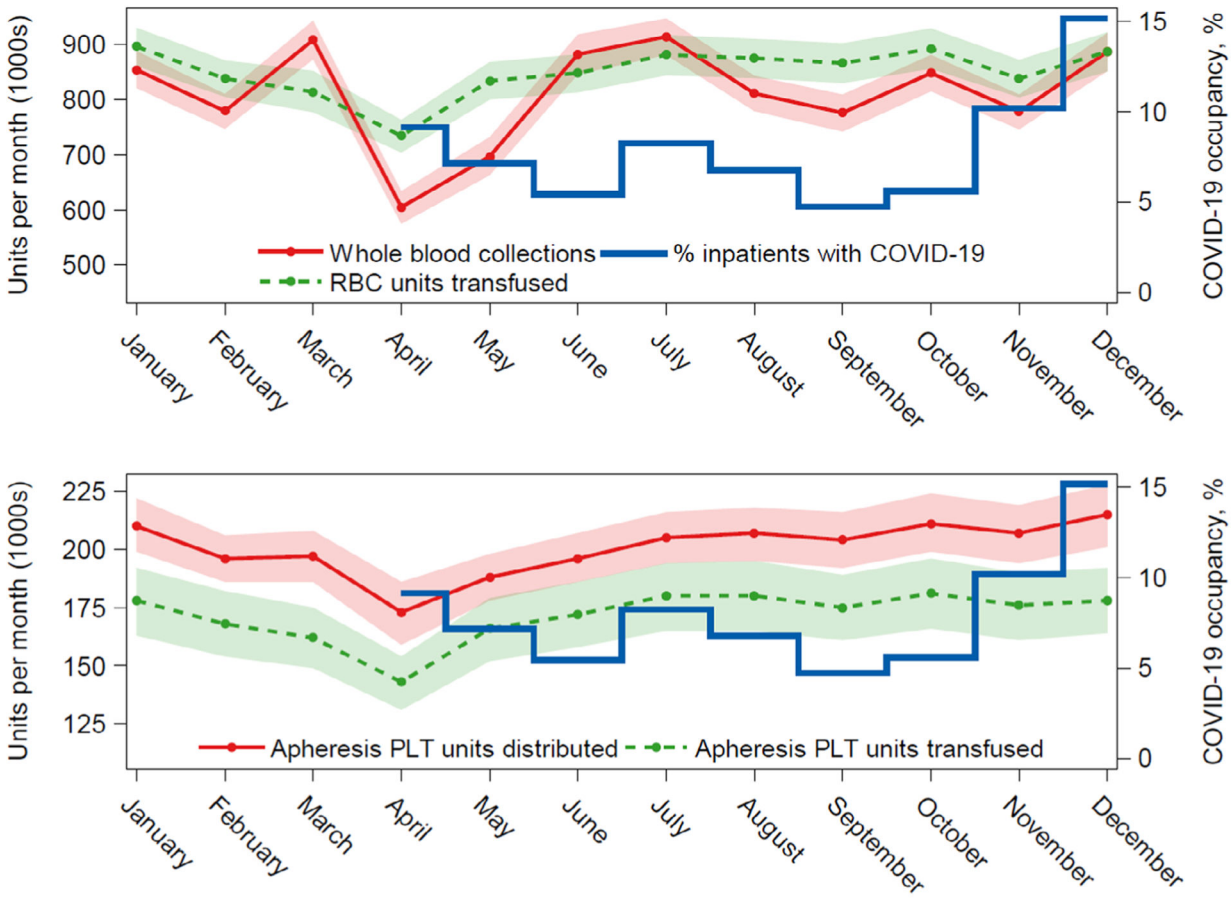

FIGURE 1.

Estimated monthly whole blood collections, red blood cell (RBC) transfusions, and apheresis platelet (PLT) units distributed and transfused in 2020 with monthly estimates of the percentage of inpatients with confirmed or suspected SARS-CoV-2 infection in the United States.

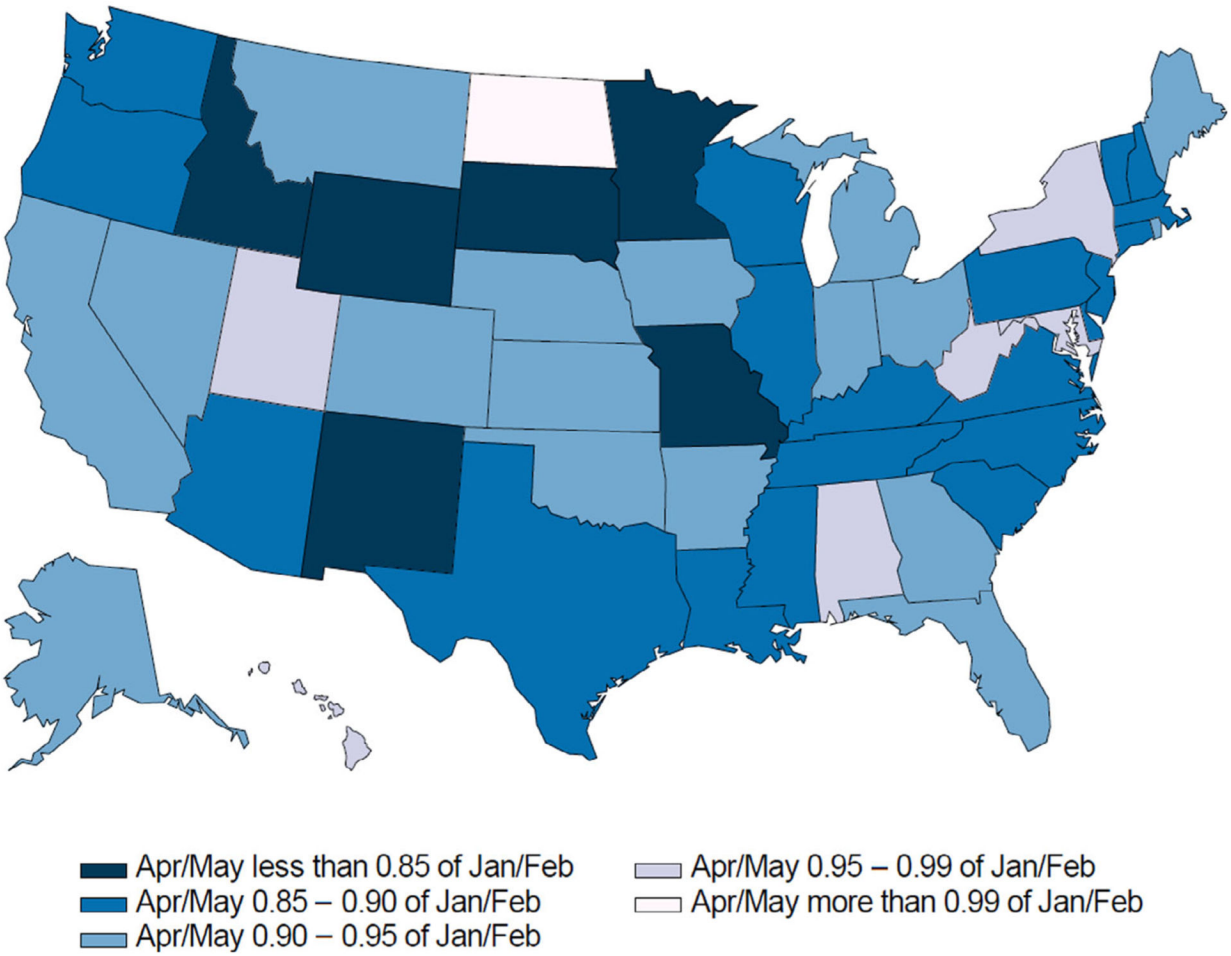

FIGURE 2.

Red blood cell transfusions per population by state expressed as ratio of transfusions during April–May 2020 divided by transfusions during January–February 2020.

TABLE 1

Estimated whole blood collections, red blood cell transfusions, and apheresis platelet units distributed and transfused in 2019 and 2020 (expressed in thousands) in the United States.

Component	2020 estimate (95% CI)	2019 estimate (95% CI)[a]	Percent change 2019–2020
Whole blood collections	9738 (9365–10,110)	9790 (9320–10,261)	−0.5
Red blood cell units transfused[b]	10,202 (9811–10,593)	10,852 (10,444–11,259)	−6.0
Apheresis PLT units distributed	2408 (2288–2528)	2359 (2240–2477)	2.1
Apheresis PLT units transfused	2057 (1902–2211)	1996 (1846–2147)	3.1

Abbreviations: CI, confidence interval; PLT, platelet.

[a]Recalculated to include allogeneic, autologous, and directed whole blood collections from Jones et al.[13]

[b]Includes apheresis red blood cell units.

TABLE 2

Estimated[a] COVID-19 convalescent plasma collections in 2020 and 2021 (expressed in thousands) and transfusions in 2021 in the United States.

	2020	2021
Total collections	603 (534–672)	378 (321–435)
Blood centers	552 (497–607)	353 (304–403)
Hospitals	51 (6–97)	24 (−4–53)
Transfusions		190 (172–208)

[a]38 of 53 community-based blood centers and 25 of 83 hospital-based blood centers reported COVID-19 convalescent plasma collection data for 2020. 38 of 53 community-based blood centers and 36 of 83 hospital-based blood centers reported COVID-19 convalescent plasma collection data for 2021. 1481 of 3684 hospitals reported COVID-19 convalescent plasma transfusion data for 2021.