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Supplemental findings of the 2019 National Blood Collection and Utilization Survey

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Abstract

Introduction: Supplemental data from the 2019 National Blood Collection and Utilization Survey (NBCUS) are presented and include findings on donor characteristics, autologous and directed donations and transfusions, platelets (PLTs), plasma and granulocyte transfusions, pediatric transfusions, transfusion-associated adverse events, cost of blood units, hospital policies and practices, and implementation of blood safety measures, including pathogen reduction technology (PRT).

Methods: National estimates were produced using weighting and imputation methods for a number of donors, donations, donor deferrals, autologous and directed donations and transfusions, PLT and plasma collections and transfusions, a number of crossmatch procedures, a number of units irradiated and leukoreduced, pediatric transfusions, and transfusion-associated adverse events.

Results: Between 2017 and 2019, there was a slight decrease in successful donations by 1.1%. Donations by persons aged 16–18 decreased by 10.1% while donations among donors >65 years increased by 10.5%. From 2017 to 2019, the median price paid for blood components by hospitals for leukoreduced red blood cell units, leukoreduced apheresis PLT units, and for fresh frozen plasma units continued to decrease. The rate of life-threatening transfusion-related adverse reactions continued to decrease. Most whole blood/red blood cell units (97%) and PLT units (97%) were leukoreduced.

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CONFLICT OF INTEREST

The authors have disclosed no conflicts of interest. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of Centers for Disease Control and Prevention (CDC) or the authors' affiliated institutions. Use of trade names, commercial sources, or private organizations is for identification only and does not imply endorsement by the U.S. Department of Health and Human Services and/or CDC.

Conclusion: Blood donations decreased between 2017 and 2019. Donations from younger donors continued to decline while donations among older donors have steadily increased. Prices paid for blood products by hospitals decreased. Implementation of PRT among blood centers and hospitals is slowly expanding.

Keywords

blood component preparations; blood management; RBC transfusion

1 | INTRODUCTION

Blood product transfusion is a life-saving treatment used in a variety of healthcare settings.[1] Ensuring the safety and adequacy of the blood supply requires regular, periodic collection of data on blood collection and utilization, including blood safety practices. CDC and the Office of the Assistant Secretary of Health (OASH) conduct the National Blood Collection and Utilization Survey (NBCUS),[2-4] a biennial survey of blood collection organizations and transfusing hospitals, in order to estimate blood collection and utilization in the United States. These findings are relevant for blood collection and transfusing organizations, public health policymakers, and other stakeholders. The main purposes of the NBCUS are to quantify blood collection and transfusion, monitor trends in donor demographics and donor and patient adverse reactions, and identify changes in transfusion safety practices. Data are also collected on blood donor and donation characteristics, blood inventory and supply, cost of blood products, platelet (PLT) bacterial testing, transfusion dosing, hospital policies and practices related to transfusion services and donor and recipient adverse reactions. Previous reports produced from the survey have been considered when developing public health policy and considering efforts to ensure blood supply sustainability.[5]

The 2019 NBCUS survey questions were largely consistent with the previous four surveys in order to allow longitudinal comparison. However, implementation of the 2019 survey experienced several challenges. First, consistent with previous cycles, this survey was launched in March 2020, which coincided with the initial phase of the COVID-19 pandemic. Despite efforts to ensure participation, including detailed facility follow-up and survey deadline extension, providing survey responses was challenging for many facilities. Second, a new software platform was utilized to administer the 2019 survey which resulted in a different user interface and experience.

Separately, overall findings of blood collection and utilization have been published.[6] The information presented here include remaining findings of the 2019 NBCUS providing additional insight into collection, use, and cost of whole blood, red blood cells (RBCs), PLTs, and plasma.

2 | METHODS

The survey methods are consistent with the 2013–2017 calendar year surveys and have been previously described.[7,8]

2.1 | Questionnaire design

The 2019 survey includes 44 questions, 18 applicable to blood collection centers and 26 applicable to transfusing hospitals. While the current survey was largely unchanged from the 2017 survey, questions were reorganized to improve clarity and responsiveness. One difference was that the 2013–2017 NBCUS versions were administered using the MrInterview (SPSS Inc., Chicago, IL, USA) software package. The 2019 NBCUS was administered through REDCap (Vanderbilt University, Nashville, TN, USA), a survey platform used routinely by CDC for public health surveys. The use of a different platform necessitated modification to the formatting of individual questions. Most notably, MrInterview allowed questions to be posed in a tabular format which was not possible in REDcap. Therefore, questions were included as separate and ungrouped items with language adjusted for clarity.

2.2 | Sampling method

The development of the sampling frame for the 2019 NBCUS followed the same approach as described for previous surveys.[2,3,7] In November 2019, blood collection centers were identified using the Food and Drug Administration's Blood Establishment Registration (FDA-BER) database. Facilities that collect or manufacture blood products are required to register in the FDA-BER.[9] Transfusing hospitals were identified using the 2017 American Hospital Association (AHA) annual survey database, which was the most recent data available at the time.[10] Hospitals with the following characteristics were excluded from survey dissemination: performing <100 inpatient surgical operations annually; location in U.S. territories; operation by the military or Department of Justice; and classification as rehabilitation, acute long-term care, or psychiatric facilities.

Blood collection centers (i.e., community and hospital-based collectors listed on the FDA-BER) were sampled at 100%. Among all hospitals included in the sampling frame, 100% of hospitals performing ≥1000 inpatient surgical operations per year were surveyed and 40% of hospitals performing 100–999 inpatient surgical operations per year were randomly selected to be surveyed. Hospitals listed as blood collection centers on the FDA-BER that performed 100–999 inpatient surgical operations per year were also sampled at 100%.

All community-based blood centers were contacted via email or telephone to confirm contact information. All hospitals in the sample, including hospital-based blood centers, received a web-based contact information form via email. Facilities that did not complete this web-based form were contacted by letter and subsequently by telephone, if needed. Facility contact information was confirmed for all included facilities between October 2019 and March 2020.

Survey dissemination of the 2019 NBCUS began in March 2020 when hospitals and blood centers were heavily impacted by the COVID-19 pandemic. Sampled facilities received a unique survey link via email. Respondents were initially asked to respond within 2 months. However, to assist with survey completion, the deadline to complete the 2019 NBCUS was extended by 2 months, from May 2020 to July 2020 to give hospitals and blood centers adequate response time and maximize participation. Facilities were notified of the extension

via email at the end of the first month of the data collection period. During the weeks following survey dissemination, facilities were further reminded about the survey via mail, email, or phone to increase participation.

2.3 | Stratification, imputation, and weighting

Blood centers and hospitals were stratified based on similar methods used in 2017.[7] Community-based blood collection centers were stratified based on annual RBC collection volume in 2017 into four categories: <50,000 units; 50,000–199,999 units; 200,000–399,000 units; and ≥400,000 units. For collection questions, hospital-based blood collection centers were stratified into the following categories using annual inpatient surgical operations from the AHA database: <1000, 1000–7999, and ≥8000 inpatient surgical operations during 2017. Transfusing hospitals were stratified into six categories based on annual inpatient surgical operations during 2017 using the AHA database: 100–999, 1000–1399, 1400–2399, 2400–4999, 5000–7999, and ≥8000 inpatient surgical operations.

To account for missing data, facility responses were imputed using similar methods applied in 2017.[7,11] All imputed variables were continuous and non-normally distributed. The imputation procedure involved a two-step method for variables skewed toward zero.[12] Case analysis was used for variables with missing data exceeding 20% of respondents rather than being imputed.[13] Imputation was utilized only when missing data items were less than 20% and for variables for which a national estimate was described.

Facility responses were weighted to adjust for nonresponses within each stratum. Weights were calculated by dividing the total number of eligible facilities by the number of respondents for each stratum. Community-based blood collection centers with a RBC collection volume >400,000 could not be reliably weighted or imputed so weighted estimates were not calculated when one of these facilities was missing data. Hospitals with 100–999 annual inpatient surgical operations were sampled at a rate of 40% and were therefore weighted for nonresponse and for sampling. Confidence intervals (CIs) were determined for national collection and transfusion estimates and calculated using the Taylor series method.[14]

Weighting and imputation were used to determine national estimates for the following: autologous and directed donations and transfusions of blood components; PLT components collected and transfused; plasma components collected and transfused; granulocyte components collected and transfused. The following were estimated using available case analysis: number of persons presenting to donate; deferred donors; donations by age and type; repeat and allogeneic donors; crossmatch procedures performed on whole blood/RBCs; irradiated and leukoreduced units transfused by hospitals; and transfusion-associated adverse events. Summary statistics were calculated for the remaining variables and are presented as means, medians, and percentages of responding facilities. Results including estimates of whole blood/RBCs include whole blood, whole blood-derived RBCs, and apheresis RBCs combined. Estimates were rounded to the nearest 1000.

As in previous analyses, information on cost estimates for each component required additional data cleaning for facilities that reported the total amount spent on blood products

instead of the price per unit. Values exceeding five times the standard deviation above the mean were excluded. Information on cost of whole blood-derived PLTs and cryoprecipitated AHF required further cleaning due to facilities reporting cost of pooled components. To adjust for outliers resulting from pooled estimates, a threshold of $350 for whole blood-derived PLTs and $200 for cryoprecipitate was implemented. Costs are presented in whole dollar amounts.

A matched analysis of facilities was performed to compare differences in the number of pediatric and neonatal transfusions occurring between 2017 and 2019. Facilities were matched if they responded to these survey questions in both 2017 and 2019. A t-test was used to determine significant changes in the mean cost of blood components between 2017 and 2019. The significance for these associations was set at $p < .05$. All analyses were performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA).

2.4 | Variables analyzed in this report

Survey participation for 2019 was compared with previous years and summarized by facility type, volume of RBC collections, annual inpatient surgical operations, and by geographic region determined by Health and Human Services (HHS) regions.[15] National estimates are reported for donor deferrals stratified by reason for deferral and sex, and total donors presenting to donate were stratified by sex for 2019 compared with data reported in 2017. Reports also include the number of donations by donor age and the number of donations by minority donors. Total number of individual blood donors are presented and categorized by first-time and repeat allogeneic donors. This summary includes the number of autologous and directed whole blood and RBC donors, units donated, recipients and units transfused. The number of directed PLT donors, units donated, and recipients are also presented. The mean and median dollar amount paid by hospitals per blood product are reported for the following: RBC (leukoreduced and non-leukoreduced), whole blood-derived PLTs, apheresis PLTs, fresh frozen plasma (FFP), plasma frozen between 8 and 24 h of donation (PF24) and cryoprecipitated AHF. Questions on costs for non-leukoreduced RBCs and whole blood-derived PLTs were removed for the 2019 NBCUS, and an additional question on the cost of pathogen-reduced apheresis PLT units was added. Costs paid by hospitals were further evaluated by inpatient surgical operations, and HHS region for the following: leukoreduced RBCs, apheresis PLTs, and FFP. Hospital policies and practices implemented to enhance transfusion safety are presented for 2019 and compared with 2017. Analyses on severe donor-related adverse events and reaction rates were excluded in 2019 due to limited availability of data for these questions, which prevented accurate calculations of national estimates.

The number of apheresis PLT units collected from either single, double, or triple collections and the number of facilities preparing apheresis PLTs using PLT additive solution are described for 2019 and 2017. Total units of apheresis and whole blood-derived plasma collected and transfused by component type are presented for 2019 and 2017. Reports by transfusing hospitals on the criteria used for routine dosing of transfusions for plasma, prophylactic PLT, and therapeutic PLT transfusions are shown. The age of RBC, apheresis PLT units, and whole blood-derived PLT units at the time of transfusion is reported by

age group for 2019 and 2017. The percent of Group O+ and O− RBC units distributed, transfused, and outdated is described for 2019 and 2017. The number of group O RBC units in inventory on an average weekday and the number of O+ RBCs that determine when a supply is considered critically low is reported, stratified by annual inpatient surgical operations. Total crossmatch procedures are reported by crossmatch procedure method for 2019 and 2017. A number of irradiated units used by hospitals stratified by component type and irradiation method are reported. The number of adult-equivalent units used in whole or in part for pediatric (aged >4 months) and neonatal (aged ≤4 months) patients and the number of pediatric or neonatal recipients are shown for 2019 and 2017. These values are stratified by blood component and stratified by neonatal and pediatric patients. Additionally, policies used for neonatal aliquot production is presented.

The number of blood collection centers that treated PLT units with PRT, leukoreduced blood products, or genotyped donors are reported. A summary is also provided for the number of hospitals that transfused PRT-treated units, had a policy to transfuse only leukoreduced units or white blood cell-filtered units at bedside, performed secondary testing to detect bacterial contamination of PLTs, or performed genotyping of transfusion recipient red blood cell antigens. The mean and median percentage of total units leukoreduced were determined for facilities that reported number of leukoreduced units. Mean percentages of total donors and recipients genotyped were also evaluated.

3 | RESULTS

3.1 | Survey participation

Participation was lower overall for the 2019 survey (2266 of 2951 facilities sampled responded; 76.8%; Table 1) compared with the 2017 survey (2588 of 3020; 85.7%). However, the 2019 overall response rate was slightly higher than the rate for 2015 (74.2%). Community-based blood centers that met inclusion criteria decreased from 65 in 2017 to 53 in 2019. After stratification by annual volume of RBC collections, all strata including community-based blood collection centers collecting ≤399,000 RBC collections per year decreased while centers collecting ≥400,000 increased (Table 2). Of the 53 community-based blood centers invited to participate, 50 (94.3%) responded to the 2019 NBCUS, a participation rate consistent with previous years. The three community-based blood centers which did not respond to the 2019 NBCUS all had <50,000 RBC collections per year.

The number of hospital-based blood centers declined from 108 facilities in 2017 to 90 facilities in 2019 (Table 1). A reduction was seen among hospitals performing ≥1000 surgeries per year but not among hospitals performing <1000 surgeries per year (Table 2). The response rate among hospital-based blood centers decreased slightly from 85.2% in 2017 to 84.4% in 2019.

The overall number of hospitals in the sample declined from 2847 in 2017 to 2808 in 2019 (Table 1). Among hospitals, the response rate decreased from 85.5% in 2017 to 76.2% in 2019, although this was still slightly higher than the rate for 2015 (73.9%). Compared with 2017, the 2019 response rate for hospitals decreased 9.3 percentage points, while the 2019 response rate for both community-based and hospital-based collection centers did not

substantially change (Table 1). Across all surgical operations strata, the response rate ranged from 72.0% to 84.8%, a relatively wider range compared with previous years (Table 3). When stratified by HHS region, there was more variation observed from response rates, with Regions 8 and 9 having the lowest response rates (71.7% and 67.7%, respectively) and Region 2 having the highest response rate at 91.6% (Table 4). Between 2017 and 2019, HHS regions 3 and 8 showed the largest change in response rate with a decrease by 15% and 16.5%, respectively.

3.2 | Donor characteristics

Table 5 describes the estimated number of donors presenting to donate, including successful, unsuccessful, and deferred donors stratified by reason for deferral. The number of donors presenting to donate declined in 2019 by 7.1% with 13,022,000 (95% CI, 12,467,000–13,576,000) donors compared with 14,018,000 donors presenting to donate in 2017 (Table 5). Of those presenting to donate, deferred donors decreased by 2.8% with a total of 2,472,000 (95% CI, 2,056,000–2,889,000) donors deferred in 2019 compared with 2017 (2,544,000 deferrals). The donor deferral rate in 2019 (19.0%) was slightly higher than reports in 2017 (18.1%). Donor deferrals were mostly driven by low hemoglobin or hematocrit, other non-medical reasons, and blood pressure and/or pulse which accounted for 43.1%, 21.4% and 11.2% of deferrals, respectively. Deferrals due to low hemoglobin/hematocrit decreased by 49,000 (4.4%) from 1,115,000 deferrals in 2017 to 1,066,000 (95% CI, 999,000–1,134,000) deferrals in 2019. Deferrals associated with blood pressure and/or pulse accounted for 278,000 (95% CI, 251,000–305,000) deferrals in 2019, a 3.5% decrease compared with 2017. Deferrals for other non-medical reasons increased by 228,000 (75.8%) from 301,000 deferrals in 2017 to 529,000 (95% CI, 385,000–673,000) deferrals in 2019. Other medical reasons include, but are not limited to, use of medications on the medication deferral list, growth hormone from human pituitary glands, and Hepatitis B Immune Globulin. Deferrals for other reasons decreased by 331,000 (63.3%) from 523,000 deferrals in 2017 to 192,000 (95% CI, 154,000–230,000) deferrals in 2019. There was a 9.2% increase in deferrals for men who have sex with men (MSM) from 6000 deferrals in 2017 to 7000 (95% CI, 5000–8000) deferrals in 2019. Number of donors deferred for travel reasons increased by 55,000 (47.9%) from 114,000 deferrals in 2017 to 169,000 (95% CI, 80,000–257,000)deferrals in 2019.

Questions on the number of donors deferred stratified by male/female were first included in the 2017 NBCUS and continued to be included in 2019. The distribution of males and females presenting to donate were similar between 2019 and 2017, with 6,644,000 males and 6,378,000 females in 2019 (Table 5). Similar to 2017, females were more likely to be deferred than males in 2019, with 1,628,000 females deferred (65.9% of all deferrals) compared with 844,000 males (34.1% of all deferrals). This difference was primarily attributed to deferrals for low hemoglobin/hematocrit, for which 861,000 females were deferred compared with 205,000 males. More females were also deferred for other non-medical reasons (333,000 females; 196,000 males), for an abnormal pulse and/or blood pressure (144,000 females; 134,000 males), tattoo/piercing (46,000 females; 17,000 males), and other medical reasons (108,000 females; 84,000 males). The following categories included more males deferred compared with females deferred: prescription

drug use (37,000 males; 35,000 females), travel (87,000 males; 82,000 females) and high-risk behaviors related to male sexual contact (6000 males; 1000 females who had sex with MSM) and all other high-risk behaviors (e.g., nonmedical parenteral drug use and incarceration), with a total of 9000 men deferred overall compared with 6000 females deferred overall. Differences in donor deferrals stratified by male/female were largely unchanged between 2017 and 2019.

In 2019, there were 13,022,000 presenting donors (Table 5), from whom 10,981,000 (95% CI, 10,342,000–11,620,000) successful donations were collected, which is similar to the 11,101,000 successful donations in 2017 (Table 6). Successful donations were collected from 7,316,000 (95% CI, 6,912,000–7,720,000) total individual donors, an 8.5% decrease from 2017, when there were 7,996,000 total individual donors who donated successfully (Table 7). The number of repeat allogeneic donors who donated successfully decreased by 14.4% from 5,921,000 in 2017 to 5,069,000 (95% CI, 4,753,000–5,385,000) in 2019. The number of first-time allogeneic donors who donated successfully increased by 6.6% from 2,076,000 in 2017 to 2,213,000 (95% CI, 2,007,000–2,419,000) in 2019. In 2019, 2,146,000 (95% CI, 1,615,000–2,678,000) donations were made by ethnic or racial minority donors (including African American, Pacific Islander, American Indian, and Hispanic donors), accounting for 19.5% of all donations. This represented a 6.4% increase from 2,018,000 donations reported from minority donors in 2017 (Table 6). Among all successful donations, the proportion from ethnic or racial minority donors increased from 18.2% in 2017 to 19.5% in 2019.

The national estimates on the number of donations by donor age during 2017 and 2019 are described in Table 6. Donations were primarily from donors between the ages of 25 and 64 years (63.2%) followed by donors aged ≥65 years (16.1%), donors aged 16–18 years (11.2%), and donors aged 19–24 years (8.6%). Donations by persons aged <65 years decreased by 289,000 between 2017 and 2019, including 139,000 fewer donations (10.1% decrease) among donors aged 16–18 years, 169,000 fewer donations (15.1% decrease) by donors aged 19–24 years, and 67,000 fewer donations (1.0% decrease) among donors aged 25–64 years. In comparison, donations by donors aged ≥65 years increased by 169,000 (10.5%) from 1,603,000 in 2017 to 1,772,000 (95% CI, 1,647,000–1,897,000)in 2019. From 2017 to 2019, 2000 more donations (31.7% increase) were reported among donors aged 15 years, 1000 fewer donations (0.3% decrease) by donors aged 16 years, 69,000 fewer donations (11.8% decrease) by donors aged 17 years and 79,000 fewer donations (16.1% decrease) by donors aged 18 years.

3.3 | Autologous and directed transfusions

The number of autologous whole blood/RBC transfusions was mostly unchanged (27,000 units in 2017 and 29,000 units [95% CI, 8000–51,000] in 2019), but the number of recipients of autologous donations decreased from 25,000 in 2017 to 16,000 (95% CI, 4000–27,000) in 2019, though these numbers are not statistically significant (Table 8). The total number of directed RBC/whole blood transfusions decreased from 56,000 units in 2017 to 18,000 (95% CI, 5000–31,000) units in 2019. Similarly, the number of recipients of

directed donations decreased from 38,000 recipients in 2017 to 9000 recipients (95% CI, 2000–16,000) in 2019.

3.4 | RBC units transfused and recipients

Table 9 shows the estimated number of RBC units transfused and recipients. Between 2017 and 2019, the number of allogeneic RBC units transfused was not significantly different (10,555,000 units transfused in 2017; 10,801,000 units transfused in 2019 [95% CI, 10,395,000–11,206,000]). Similarly, the number of allogeneic RBC recipients was also not significantly different (4,031,000 recipients in 2017; 4,206,000 recipients in 2019 [95% CI, 3,995,000–4,416,000]).

3.5 | Cost

The cost of blood components as reported by hospitals is described in Table 10. Between 2017 and 2019, the median price paid per unit increased by $1 for both leukoreduced RBCs and for a single unit of cryoprecipitated AHF. For both apheresis PLTs and for FFP, the median price paid per unit decreased by $1. There was no change in price paid per unit for plasma frozen between 8 and 24 h of donation (PF24). The only statistically significant change in reported cost from 2017 to 2019 was a decrease of $4 observed for the mean cost of FFP units, from $57 in 2017 to $53 in 2019.

The median cost of a leukoreduced RBC unit (Table 11) was highest among hospitals performing the least amount of annual inpatient surgical operations (100–999; $217) and lowest for hospitals performing the most inpatient surgical operations (≥8000; $203). Between 2017 and 2019, facilities in all strata reported an increase in mean or median amount paid except for facilities performing ≥8000 inpatient surgical operations. The largest increase in the median amount paid was observed among facilities performing 1000–1399 inpatient surgical operations from $206 in 2017 to $210 in 2019.

In comparison with 2017, hospitals reported more geographic variation in the cost of leukoreduced RBCs in 2019 (Table 12). The median price of leukoreduced RBCs ranged from $199–$222, with hospitals in HHS Region 5 (IL, IN, MI, MN, OH, WI) reporting the lowest median price per unit and hospitals in HHS Region 1 (CT, MA, ME, NH, RI, VT) reporting the highest median price per unit in 2019. The mean price paid per unit ranged from $206–$227. Respondents in nearly all HHS regions reported an increase in mean price paid for leukoreduced RBCs with only hospitals in HHS region 4 and 10 reporting a decrease.

Similar to previous survey years, apheresis PLT products were the most expensive blood component as reported by hospitals (Table 10). The highest cost ($534) for apheresis PLT units was reported among hospitals performing the least amount of inpatient surgical operations (100–999) and the lowest cost ($502) reported among hospitals performing the most inpatient surgical operations (≥8000) (Table 11). In 2019, the cost of a pathogen-reduced apheresis PLT unit was added to NBCUS and was reported by 314 hospitals (Table 10). The median price paid per pathogen-reduced apheresis PLT unit was $617 compared with $516 per non-PRT apheresis PLT unit.

As with RBC, geographic variation was observed in reported prices of apheresis PLT (Table 12). Facilities located in HHS Region 2 (NJ, NY) and HHS Region 6 (AR, LA, NM, OK, TX) reported the highest median price per apheresis PLT unit in 2019 ($525; range: 444–628) while facilities responding from HHS Region 9 (AZ, CA, HI, NV) reported the lowest median price per apheresis PLT unit ($491; range: 422–588).

Of the 2140 hospitals which responded to the 2019 survey, 941 (44.0%) reported the cost for a FFP unit and 1276 (59.6%) reported the cost for a PF24 unit (Table 10). The median price for FFP and PF24 units were similar in 2019 ($50 [IQR $43–59] for FFP and $50 [IQR $43–58] for PF24) when compared with 2017 ($51 for FFP and $50 for PF24). The highest median cost for FFP units ($57) and PF24 units ($57) were reported among hospitals with 100–999 inpatient surgical operations, both of which decreased since 2017 (Table 11). The lowest median cost for FFP units ($45) and PF24 units ($45) were reported among hospitals with ≥8000 inpatient surgical operations, both of which were unchanged from 2017. The median price paid for FFP decreased in most HHS regions, although HHS Regions 1, 4, and 5 showed no change and HHS Region 9 (AZ, CA, HI, NV) reported a slight increase (Table 12).

3.6 | Hospital policies and practices related to transfusion services

3.6.1 | Transfusion safety officers—Between 2017 and 2019, the proportion of hospitals reporting a Transfusion Safety Officer (TSO) on staff declined from 19.3% to 17.9% (Table 13). Among the 338 facilities reporting a TSO on staff in 2019, 93.2% (315/338) reported TSO employment by the hospital and 4.1% (14/338) reported employment by a blood center, and the remaining 2.7% (9/338) of facilities did not identify the TSO employer.

3.6.2 | Data on sample collection errors—Between 2017 and 2019, the percentage of transfusing facilities that collected data on sample collection errors remained steady (82.9% of facilities in 2017 and 81.1% of facilities in 2019) (Table 13). The mean number of sample collection errors reported per facility, increased from 41.8 in 2017 to 50.2 in 2019. The proportion of responding facilities which reported having an established program to manage patients who refused blood components for religious, cultural, or personal reasons, increased slightly from 73.5% in 2017 to 75.3% in 2019.

3.6.3 | Bacterial screening of platelets—Table 14 presents the number of hospitals reporting on secondary bacterial testing of PLTs. The proportion of hospitals which reported performing secondary testing increased from 2017 to 2019, though only a small number of total respondents reported performing testing in either year. Secondary bacterial testing was reported more commonly among the largest hospitals (performing ≥8000 annual inpatient surgical operations).

Hospitals reported a decrease in culture-based tests from a total of 50,922 tests reported in 2017 to 35,266 tests reported in 2019. In comparison, the use of rapid immunoassay tests increased from 63,220 tests reported in 2017 to 92,805 tests reported in 2019 (Table 15). Among reports from hospitals, 14 culture-based tests and 22 rapid immunoassay tests

were reported as having a confirmed positive result in 2019 compared with 13 and 10, respectively, in 2017.

3.6.4 | Genotyping—Molecular genotyping, consisting of molecular phenotyping of non-ABO RBC antigens, of donors and recipients remains uncommon in the United States. In 2019, 19.1% (21/110) of blood collection centers which responded to this question reported molecular genotyping of donors compared with 22.5% (32/142) reported in 2017 (Table 16). The number of donors per facility that were genotyped in 2019 was only slightly higher in 2019 compared with 2017 (3.8% vs 2.7%). The largest blood centers were more likely to report genotyping donors. Additionally, a slightly higher percentage of hospitals reported genotyping recipients in 2019 compared with 2017 (2.4% vs 1.3%). Large hospitals (≥8000 annual inpatient surgical operations) more commonly reported genotyping recipients.

3.6.5 | Pathogen reduction technology—Table 17 presents a summary of blood collection centers utilizing pathogen reduction technology. Of the 126 blood collection centers that participated in the 2019 NBCUS, 112 (89%) responded to the survey question on PRT implementation. Among these, 26 (23%) facilities reported the production of PRT apheresis PLT units. Among blood centers responding to this question in 2017, 19% of blood centers reported manufacturing PRT apheresis PLT units. In 2019, 221,933 (95% CI, 71,352–515,232) apheresis PLT units were produced, an increase compared with 2017 when 60,751 PRT apheresis PLTs were produced.

Table 18 presents a summary of transfusing hospitals utilizing pathogen reduction technology. Of the 2140 hospitals that participated in the survey, 1908 (89%) responded to questions pertaining to PRT. Of these facilities, 247 (13%) reported transfusing PRT-treated apheresis PLTs. Among hospitals responding to this question in 2017, 6% reported transfusing PRT-apheresis PLTs. In 2019, 175,017 (95% CI, 115,346–234,544) PRT apheresis PLT units were transfused, an increase compared with 2017 when 52,752 PRT apheresis PLTs were transfused.

3.6.6 | Leukoreduction—In 2019, 97.2% (95% CI, 95.7–98.6) of all RBC/whole blood units collected were leukoreduced, an increase from 2017 when 95.8% of all RBC/whole blood units collected were leukoreduced (Table 19). In 2019, 96.7% (95% CI, 93.9–99.4) of all apheresis PLT units collected were leukoreduced, a decrease from 2017 when 99.8% of all apheresis PLT units collected were leukoreduced.

3.6.7 | Irradiated and leukoreduced units used by hospitals by component—Table 20 presents the number of whole blood, RBC, and apheresis PLT units that were irradiated and leukoreduced in 2017 and 2019. For the 2019 NBCUS, questions related to specific methods of irradiation were removed. The number of irradiated whole blood and RBCs increased from 16.0% in 2017 to 18.6% in 2019 (1,983,000 units; 95% CI, 1,688,000–2,278,000). In 2019, facilities were also asked to report the number of units leukoreduced before and after storage for whole blood, RBC, and apheresis PLT units. The number of whole blood and RBC units leukoreduced before storage increased from 7,765,000 units (72.9% of total units) in 2017 to 9,100,000 units (85.4% of total units;

95% CI, 8,660,000–9,541,000) in 2019. Similarly, the number of apheresis PLT units leukoreduced before storage, rose from 1,497,000 units (81.0% of total units) in 2017 to 1,756,000 units (95.0% of total units; 95% CI, 1,599,000–1,913,000) in 2019. During 2019, 1,777,000 (16.7% of total units; 95% CI, 1,481,000–2,072,000) whole blood and RBC units were leukoreduced after storage and 265,000 (14.4% of total units; 95% CI, 194,000–336,000) apheresis PLT units were leukoreduced after storage.

3.6.8 | PLT-related considerations—Table 21 presents data on the number of apheresis PLT units collected through single, double, or triple collections for 2017 and 2019. Total apheresis PLT units collected increased from 2,338,000 units in 2017 to 2,359,000 (95% CI, 2,240,000–2,477,000) in 2019. In 2017, the percentage of PLT units from single, double and triple apheresis collections were 23.2%, 46.0% and 30.9%, respectively. In 2019, the distribution for single, double and triple apheresis PLT collections were 23.1%, 45.1% and 31.7% of units collected, respectively.

The number of blood collection centers that reported use of PLT additive solution (PAS) to prepare apheresis PLT units (Table 22) increased from 2017 (n = 12 facilities) to 2019 (n = 16 facilities). Among these facilities, there was a decrease in the mean number of units prepared using PAS per facility from 2742 in 2017 to 2349 in 2019. Of the 16 facilities that reported using PAS to prepare PLT units, 11 were community-based blood centers and the remaining 5 were hospital-based blood centers.

3.6.9 | Plasma-related results—Table 23 provides estimates for the number of plasma units distributed during 2019 stratified by plasma product type from both whole blood and apheresis collections. Between 2017 and 2019, plasma units distributed decreased from 3,209,000 units in 2017 to 2,679,000 (95% CI, 2,525,000–2,833,000) units in 2019. Of the 2,679,000 units distributed, the majority were distributed as PF24 (1,506,000 units; 95% CI, 1,318,000–1,694,000). Of the PF24 units, 90% were manufactured from whole blood collections. The majority of the remaining plasma units were distributed as FFP (680,000 units; 95% CI, 539,000–820,000 units), with 75% of FFP units manufactured from whole blood collections. Compared with 2017, FFP units distributed decreased by 30.2% in 2019. A small proportion of plasma units distributed came from plasma frozen within 24 h after collection and held at room temperature up to 24 h after collection (PF24RT24) (494,000 units; 95% CI, 438,000–550,000 units) in 2019. There were an additional 152,000 (95% CI, 131,000–173,000) units of plasma distributed as liquid plasma in 2019, a 83.1% increase from 83,000 units in 2017.

Table 24 presents the estimated number of plasma components transfused during 2019 and 2017. Overall, plasma units transfused declined from 2374,000 units in 2017 to 2,185,000 (95% CI, 2,068,000–2,301,000) units in 2019. Among plasma transfusions, similar distributions were reported for FFP and PF24 units.

Tables 23 and 24 also include estimates for Group AB plasma and cryoprecipitate-reduced plasma during 2019 and 2017. Of the 2,679,000 plasma units collected, 341,000 units (12.7%; 95% CI, 311,000–370,000) were of AB plasma. Of the 2,185,000 units transfused in 2019, 255,000 (11.7%; 95% CI, 226,000–283,000) units were from AB plasma.

Cryoprecipitate-reduced plasma units collected during 2019 decreased from 118,000 units in 2017 to 30,000 (95% CI, 23,000–38,000) units in 2019.

3.6.10 | Granulocyte collection and transfusion—National estimates of granulocyte units distributed and transfused for 2019 and 2017 are reported in Table 25. During 2019, blood collection centers recorded 1857 (95% CI, 764–2951) granulocyte units distributed, a 54.3% decrease compared with the 4062 (95% CI, 1809–6315) units estimated for 2017. The number of granulocyte units transfused in 2019 was 2215 (95% CI, 1132–3299), a 29.0% increase from 2017 estimates (1717 units; 95% CI, 1000–2433). Blood collection centers were also asked if they used hematopoietic growth factor mobilization for granulocyte collections in 2019. Of 112 facilities that responded to the question, 10 (8.9%) reported using hematopoietic growth factor mobilization for granulocyte collections.

3.6.11 | Inventory, dosing, and supply considerations—A summary of the guidelines used by transfusing hospitals for routine dosing of plasma, prophylactic PLT, and therapeutic PLT transfusions for non-pediatric patients is presented in Table 26. In 2019, 66.7% of transfusing hospitals used dosages based on the level of coagulation factor deficiency, INR, or degree of bleeding for plasma and 64.8% and 68.5% of transfusing hospitals used dosages based on the level of thrombocytopenia or level of bleeding for prophylactic and therapeutic PLTs, respectively. These are similar to the percentages described in 2017. Weight-based dosing was more common for plasma transfusions (5.5%) than for PLT transfusion (2.9% for prophylactic PLTs and 2.9% for therapeutic PLTs). In contrast, dosage based on a standard number of units regardless of weight was more often reported among PLT transfusions (13.9% for prophylactic PLTs and 12.3% for therapeutic PLTs) than plasma (10.3%), similar to reports for 2017. Of the remaining facilities, less than one-fifth reported using dosage criteria based on other factors (17.5% for plasma, 18.4% for prophylactic PLTs, and 16.2% for therapeutic PLTs), a slight decrease compared with reports from 2017.

Table 27 presents the distributions of RBC, whole blood-derived PLTs and apheresis PLT units by unit age at time of transfusion. Between 2017 and 2019, the percentage of RBC, whole blood-derived PLT, and apheresis PLT units by age at time of transfusion did not change substantially. Most apheresis PLT units (59.2%) were 4–5 days old at transfusion in 2019, with 38.5% of apheresis PLT units being 1–3 days old. These distributions were similar to reports from 2017. In 2019, facilities reported 2.4% of apheresis PLT units were aged 6 or 7 days old during transfusion, similar to reports in 2017.

Table 28 describes the mean percentage of group O+ and O− units processed, distributed, transfused, and outdated. In 2019, blood centers reported that 35.2% of processed RBC units were O+ and 8.9% were O−. The percentage of group O RBC units distributed includes 37.1% for O+ and 11.4% for O−, slightly higher than the percentage processed. Group O+ and O− RBCs accounted for 9.5% and 4.6% of RBC outdates, respectively. Group O+ and O− RBCs units comprised a smaller percentage of outdates compared with processed units. These values were relatively similar to those reported in 2017. Among units transfused, O+ and O− RBC units accounted for 41.3% and 11.6% of all RBC transfusions, respectively, largely unchanged from estimates reported in 2017. Among all Group O RBC outdates

reported by transfusing facilities, 16.7% were O+ and 12.9% were O−, which was less than the proportion transfused.

Table 29 presents the mean number of group O RBC units on the shelf and considered critically low stratified by number of inpatient surgical operations. The mean number of group O RBC units on shelf on an average weekday was similar between 2017 and 2019 among hospitals of all inpatient surgical volume categories. From 2017 to 2019, there was a minimal increase in the mean number of group O RBC units at which the supply is considered critically low among hospitals of all inpatient surgical volume categories.

National estimates of the number of crossmatch procedures performed on whole blood and RBCs during 2019 and 2017 are reported in Table 30. The total number of crossmatch procedures performed on whole blood/RBCs were estimated to be 15,562,000 (95% CI, 14,547,000–16,578,000) in 2019, which represented a slight decrease compared with the 15,747,000 procedures reported in 2017. There was an increase in the percentage of crossmatch procedures performed electronically from 47.6% in 2017 to 59.1% in 2019.

3.7 | Pediatric transfusions

During 2019, respondents at 815 of 2140 hospitals (38.1%) reported that their hospitals transfused blood to pediatric (e.g., aged >4 months) or neonatal (e.g., aged ≤4 months) patients. Table 31 presents both the number of adult-equivalent units used in whole or in part for pediatric and neonatal patients and the number of pediatric or neonatal recipients. There was a non-statistically significant increase by 7.1% in the number of whole blood and RBC units transfused to pediatric and neonatal patients from 378,000 units in 2017 to 405,000 (95% CI, 299,000–511,000) units in 2019. There was also a non-statistically significant increase in the number of pediatric and neonatal recipients from 92,000 recipients in 2017 to 117,000 (95% CI, 74,000–160,000) recipients in 2019. Over two-thirds (272,000 units; 95% CI, 179,000–365,000) of whole blood or RBC units were transfused to pediatric patients while the remaining units (133,000 units; 95% CI, 108,000–158,000) were transfused to neonates. In 2019, pediatric patients represented a greater share of recipients (77,000 recipients; 95% CI, 38,000–117,000) than neonatal patients (40,000 recipients; 95% CI, 32,000–47,000). PLT and plasma-related transfusion data to pediatric patients are further described in Table 31.

Table 32 describes data from 813 facilities that responded to a question on neonatal aliquot production. Of these facilities, 465 (57.2%) reported neonatal aliquots were made using a syringe from a full-size unit, which was comparable to 2017 (55.8%). Among the 813 facilities responding, 411 (50.6%) reported using pedipacks[1] for neonatal transfusions, a slight increase from 2017 (46.5%). Of the 773 facilities that answered, 647 (83.7%) attempted to use aliquots from the same full-size unit for transfusions for an individual neonatal patient, a slight increase from reports in 2017 (82.5%).

[1]A pedipack is a small RBC pack, intended for neonatal transfusion, into which a parent component is divided.

3.8 | Transfusion-related adverse reactions

Table 33 presents the number of transfusion-related adverse reactions requiring any diagnostic or therapeutic intervention and rates of reactions per 100,000 components transfused reported in 2017 and 2019. During 2019, there were 293.7 reactions per 100,000 units transfused (95% CI, 273.0–314.3) requiring any diagnostic or therapeutic intervention, compared with 281.8 reactions per 100,000 units transfused in 2017. A continued decrease in the rate of life-threatening adverse reaction has been observed since 2015 when 9.4 reactions per 100,000 units transfused were reported.[16] Since 2015, the rate of these reactions has declined to 4.7 reactions per 100,000 units transfused in 2017 and to 2.7 reactions per 100,000 units transfused in 2019 (95% CI, 0.8–4.6).

Most adverse reactions occurred at similar rates in 2017 and 2019, with overlap between number of reactions reported in 2017 and 95% CI for 2019 (Table 33). Rates of transfusion-associated circulatory overload increased from 11.7 reactions per 100,000 transfusions in 2017 to 13.4 reactions per 100,000 transfusions in 2019 (95% CI, 11.9–14.9), which was the largest absolute increase in rate among all reaction types. In 2019, rates of bacterial, viral, and parasitic TTIs were 0.35 (95% CI, 0.17–0.54), 0.021 (95% CI, 0–0.051) and 0.023 (95% CI, 0–0.054) reactions per 100,000 units transfused, respectively. From 2017 to 2019, higher rates of bacterial TTIs were reported while rates of parasitic and viral TTIs decreased.

4 | DISCUSSION

This report provides nationally representative data related to blood collection and utilization as reported to the 2019 NBCUS. Blood is a critical component to life-saving therapy for patients, and continued monitoring of blood collection and utilization is vital to protect the blood supply and for emergency preparedness and planning.[17]

4.1 | Donor characteristics

The donor population continued the trend toward a lower proportion of younger donors. The proportion of total donations by donors who were aged 16–65 years decreased between 2017 and 2019, similar to the trend observed between 2015 and 2017, with the greatest decrease observed among donors aged 19–24 years followed by donors aged 16–18 years.[7] Donor recruitment previously prioritized younger donors (<20 years) to improve retention and facilitate increased blood supply with a substantial increase seen among donors in this age group in the United States during 2001–2015.[8,18,19] However, the decline observed in recent years might reflect changes to recruitment practices due to concerns that donor-related adverse event rates are higher among younger donors than older donors.[20] A decrease in younger donors and increase in donors aged ≥65 years indicates the overall donor population is aging, which might present a risk to maintaining an adequate blood supply. There is no upper age limit for blood donation and the efficacy of blood transfused from donors aged >65 years is comparable to that of younger donors.[18,21] However, older donors may eventually become too medically frail to donate. Therefore, implementation of innovative strategies to recruit and maintain younger donors are necessary.[19]

The NBCUS does not include source plasma centers as part of the survey sample. However, one additional consideration may be that monetary incentives, primarily for plasma donations, may result in more new donors for source plasma donations than for community blood centers.[22] As the number of sites for source plasma donations increases, further monitoring is necessary to assess the impact on the ability of blood centers to recruit and maintain younger donors who may eventually replace an aging blood donor population.[22] Apheresis PLT and plasma products are typically collected at fixed sites and require more time for donation compared with other blood products, which may contribute to the increased age of these donors and difficulty in recruiting younger donors.[23]

Between 2017 and 2019, the number of donations from racial and ethnic minority donors increased. Several conditions, notably sickle cell disease, require frequent blood transfusions and are more common in racial and ethnic minority populations.[24] Recruitment of donors from racial and ethnic minority groups is necessary in order to the reduce the possibility of alloimmunization or to provide better matching for rare blood groups. Although these populations continue to be underrepresented among blood donors in the United States, the percentage of white first-time and repeat donors has decreased between 2006 and 2015 largely attributable to an increase in Hispanic or Latino donors.[25] As the U.S. population becomes more diverse, increasing the number of donations from racial and ethnic minority donors is important to ensure adequate blood availability and decrease the risk of alloimmunization among populations who may have rare blood types.

4.2 | Donor deferrals and vital signs

Women were more commonly deferred from donation than men in 2019, mostly attributable to low hemoglobin/hematocrit, similar to previous years.[7] Increased deferrals due to low hemoglobin/hematocrit among women can be attributed to the impact of menstruation and pregnancy which can result in lower hemoglobin and iron stores.[26] Iron supplementation has been demonstrated to reduce deferrals due to low hemoglobin among women and frequent donors.[27,28]

Substantial numbers of persons presenting to donate were deferred due to pulse or blood pressure measurements. Current recommendations include physician evaluation for donors with pulse or blood pressure outside established ranges. Additional study is necessary to determine the impact of measuring pulse rates before blood donation on donor safety.[29,30] Outside of the United States, blood centers including Canadian Blood Services (CBS) and LifeBlood in Australia have observed limited impact on donor safety of deferring donors for out of range blood pressure.[31] In those studies, pre-donation blood pressure was not predictive of vasovagal reactions.[31] Similarly, in the United States, considerations to reassess the need for pre-donation pulse and blood pressure requirements have been proposed, including to limit these requirements to specific donors who may be at higher risk of adverse events, or to allow blood center medical directors to approve protocols allowing for donations from otherwise healthy donors who may have out-of-range blood pressure or pulse measurements at the time of pre-donation assessment.[31]

The number of donor deferrals associated with MSM were similar in 2017 and 2019. Deferrals for tattoos/piercings continued to increase in 2019, likely related to the prevalence

of tattoos increasing in the United States over the years.[32] Women were more likely to be deferred for tattoos or piercings. Although deferrals for tattoos and piercings are reported in aggregate, women are generally more likely to have body piercings than men while tattoos tend to be distributed similarly among men and women.[33] In response to the impact of the COVID-19 pandemic on the blood supply, in April 2020, the FDA shortened the deferral period for MSM-associated reasons, tattoos and piercings, and travel to malaria-endemic areas (for residents of malaria non-endemic countries) from 12 to 3 months.[34] Additionally, donations from donors with travel to malaria-endemic areas can now proceed if collected with an approved pathogen reduction device. Furthermore, other recent changes to deferral policy include elimination of deferral for travel to certain countries associated with a risk for Creutzfeldt-Jakob Disease or Variant Creutzfeldt-Jakob Disease.[35] CDC and OASH will continue to monitor the impact of donor deferral changes on the blood supply.

4.3 | Platelet transfusions and bacterial contamination

Bacterial contamination of PLTs continues to be the highest risk for transfusion-transmitted infection in the United States.[36] The use of bacterial mitigation interventions such as PRT can greatly reduce the risk of sepsis from bacterial contamination of PLTs.[36] However, in 2019, adoption of PRT remained low. Only about 10% of the available supply of PLTs were subjected to PRT in 2019. Additionally, adoption of secondary bacterial testing, another strategy which may reduce the risk of sepsis from bacterial contamination of PLTs, remained low in the 2019. Furthermore, since 2015, the use of culture-based secondary testing has declined while rapid immunoassay use has increased.[16] When compared with secondary rapid testing, secondary culture can have an almost 10× higher residual bacterial detection rate after primary culture.[37] These findings suggest that additional adoption of bacterial risk mitigation methods may further prevent morbidity and mortality among transfusion recipients in the United States. Some recent encouraging steps have occurred including the introduction of a more sensitive and efficient rapid immunoassay and planned expanded adoption of PRT for apheresis PLT in the United States.[38-41]

4.4 | Transfusion-associated adverse reactions

The decrease in the rate of life-threatening adverse reactions reported in 2019 is an encouraging sign of improved transfusion recipient safety in the United States and may be attributable to continued adoption of safety measures to prevent transfusion-related adverse reactions along with standardization among reporting that improves early identification of reactions.[42] Increased adoption of PAS, which replaces approximately 65% of plasma volume, could further prevent the risk of serious adverse reactions associated with high plasma volume products including acute hemolytic transfusion reactions and transfusion-related acute lung injury.[43-45] With the adoption of additional bacterial risk mitigation methods and molecular genotyping, serious adverse reactions may continue to decline in the United States. Future NBCUS surveys will continue to collect data on adverse reactions. Participation in national hemovigilance efforts, such as the National Healthcare Safety Network (NHSN) Hemovigilance Module, allows for a more effective method of monitoring transfusion recipient safety nationally due to the use of a standardized protocols, case definitions, and systematic reporting of transfused components and adverse reactions.[46]

4.5 | Limitations

The findings of this study are subject to the following limitations. First, the 2019 NBCUS was disseminated during the period when the COVID-19 pandemic affected hospitals and blood collection centers, which likely caused the decrease in the hospital response rate compared with the 2017 survey. Additionally, the COVID-19 pandemic might have affected data quality in ways that cannot be easily quantified and would not be encapsulated by the confidence intervals presented (e.g., respondents had less time to verify responses). Second, data collected from NBCUS are self-reported by facilities. A limited number of blood centers were contacted for clarification of reported data when data quality protocols revealed potential discrepancies or missing information among responses. Additionally, this year was the first NBCUS administered using REDCap and the associated changes in question formatting may have resulted in differing interpretations. Third, to account for non-responses and missing data, national estimates were produced using imputation and weighting and any errors related to these methods are expressed within confidence intervals. Finally, the 2019 NBCUS sampling frame was created using annual inpatient surgical operations collected from the 2017 AHA annual survey database. While this was the most recent data available, subsequent changes occurring among hospitals would not have been captured and may have resulted in inaccurate stratification. Any impact on these findings cannot be quantified but is likely to be minimal.

5 | CONCLUSION

The COVID-19 pandemic had a substantial impact on the healthcare delivery in the United States and likely had substantial impact on blood collection and use in the United States in 2020. While these data were not available for this present report which was limited to 2019, a recent study has quantified the impact of the initial COVID-19 pandemic period on blood utilization among hospitals consistently participating in the NHSN Hemovigilance Module.[47] The next iteration of NBCUS, which will capture 2021 calendar year data, will also include variables to ascertain the impact of the COVID-19 pandemic on blood collection and utilization in 2020.

Abbreviations:

CDC	centers for disease control and prevention
FFP	fresh frozen plasma
MSM	men having sex With men
NBCUS	national blood collection and utilization survey
OASH	officer of the assistant secretary of health
PLT	platelets
PRT	pathogen reduction technology
RBC	red blood cells

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TABLE 1

National Blood Collection and utilization survey response rates among blood centers and hospitals, 2005–2019

Facility type	2019	2017	2015	2013	2011	2009	2007	2005
Community-based collection centers	94.3% (50/53)	93.8% (61/65)	90.0% (72/80)	64.8% (59/91)	96.3% (131/136[a])	93.3% (126/135[a])	91.4% (128/140[a])	92.3% (131/142[a])
Hospital-based collection centers	84.4% (76/90)	85.2% (92/108)	71.8% (102/142)	41.2% (63/153)	N/A[b]	N/A[b]	N/A[b]	N/A[b]
Hospitals (utilizing blood)	76.2% (2140/2808)[c]	85.5% (2435/2847)[c]	73.9% (2138/2892)[c]	33.3% (1101/3305)[d]	42.3% (1342/3175)[c]	51.5% (1529/2970)[e]	59.9% (1707/2848)[f]	56.8% (1604/2825)[g]
Overall response rate	76.8% (2266/2951)[c]	85.7% (2588/3020)[c]	74.2% (2312/3114)[c]	34.5% (1223/3549)[d]	44.5% (1473/3311)[c]	53.3% (1655/3105)[e]	61.4% (1835/2988)[f]	58.5% (1735/2967)[g]

[a]Surveys conducted by AABB (2005–2011) included regional subcenters of collection centers in their total facility count. The number of individual responding collection centers was not available for 2005–2011.

[b]Surveys conducted before 2011 did not report the unique number of hospital-based collection centers.

[c]The 2011, 2015, 2017, and 2019 surveys included a sample of 40% of surgical operation Category 1 (100–999 inpatient surgical procedures annually) hospitals.

[d]The 2013 survey did not use sampling, but contact information was unavailable for 610 of 3915 hospitals, and these were not sampled.

[e]The 2009 survey included a sample of 33% of surgical operation Category 1 (999–1000 inpatient surgical procedures annually).

[f]The 2007 survey included a sample of 33% of surgical operation Category 1 (999–1000 inpatient surgical procedures annually) and 66% of surgical operation Category 2 (1000–1399 inpatient surgical procedures annually).

[g]The 2005 survey included a sample of 32.6% of surgical operation Category 1 (999–1000 inpatient surgical procedures annually), 86% of surgical operation Category 2 (1000–1399 inpatient surgical procedures annually), and 88.4% of surgical operation Category 3 (1400–2399 inpatient surgical procedures annually).

TABLE 2

National Blood Collection and utilization survey response rates among collection facilities stratified by annual volume of RBC collections and annual inpatient surgical operations, 2013–2019

		2019		2017		2015		2013	
Facility type	**Strata**	**%**	**n/N**	**%**	**n/N**	**%**	**n/N**	**%**	**n/N**
Community-based collection centers	Less than 50,000 RBC collections per year	88.0	22/25	90.0	27/30	92.5	37/40	56.9	29/51
Community-based collection centers	50,000–199,000 RBC collections per year	100.0	19/19	96.2	25/26	87.1	27/31	74.2	23/31
Community-based collection centers	200,000–399,000 RBC collections per year	100.0	4/4	100.0	6/6	75.0	3/4	42.9	3/7
Community-based collection centers	400,000 or more RBC collections per year	100.0	5/5	100.0	3/3	100.0	5/5	100.0	4/4
Hospital-based collection centers	Less than 1000 surgeries per year	84.2	16/19	94.7	18/19	58.3	7/12	38.5	5/13
Hospital-based collection centers	1000–7999 surgeries per year	83.8	31/37	86.7	39/45	73.5	61/83	35.5	33/93
Hospital-based collection centers	8000 or more surgeries per year	85.3	29/34	79.5	35/44	72.3	34/47	53.2	25/47

TABLE 3

National Blood Collection and Utilization Survey response rates among transfusing facilities stratified by annual inpatient surgical operations, 2013–2019

	2019		2017		2015		2013[a]	
Surgical operations category	**%**	**n/N**	**%**	**n/N**	**%**	**n/N**	**%**	**n/N**
100–999 surgeries	73.1	489/669	82.9	525/633	73.6	495/673	26.1	426/1634
1000–1399 surgeries	72.0	252/350	87.1	352/404	72.4	283/391	28.8	117/406
1400–2399 surgeries	76.7	452/589	85.7	504/588	72.3	416/575	27.3	155/567
2400–4999 surgeries	77.0	525/682	84.7	611/721	75.2	547/727	28.6	219/765
5000–7999 surgeries	78.6	221/281	89.0	251/282	75.3	225/299	31.2	97/311
8000 or more surgeries	84.8	201/237	87.7	192/219	75.8	172/227	37.5	87/232

[a]The 2013 survey did not use sampling, but contact information was unavailable for 610 of 3915 hospitals, and these were not sampled.

TABLE 4

National Blood Collection and utilization survey response rates among transfusing facilities stratified by HHS region, 2013–2019

	2019		2017		2015		2013[a]	
HHS region	**%**	**n/N**	**%**	**n/N**	**%**	**n/N**	**%**	**n/N**
1 (CT, MA, ME, NH, RI, VT)	86.5	109/126	94.4	119/126	71.2	94/132	39.5	70/177
2 (NJ, NY)	91.6	174/190	91.3	189/207	80.5	165/205	32.9	77/234
3 (DC, DE, MD, PA, VA, WV)	76.0	200/263	91.0	252/277	78.5	219/279	33.8	114/337
4 (AL, FL, GA, KY, MS, NC, SC, TN)	72.7	412/567	84.9	496/584	75.2	436/580	25.4	197/777
5 (IL, IN, MI, MN, OH, WI)	80.5	408/507	85.7	437/510	77.2	407/527	26.9	201/746
6 (AR, LA, NM, OK, TX)	72.0	283/393	79.2	316/399	70.3	281/400	31.5	182/577
7 (IA, KS, MO, NE)	81.7	134/164	90.1	145/161	71.1	118/166	26.7	70/262
8 (CO, MT, ND, SD, UT, WY)	71.7	81/113	88.2	97/110	75.8	91/120	20.0	38/190
9 (AZ, CA, HI, NV)	67.7	245/362	79.9	282/353	65.0	234/360	25.1	112/446
10 (AK, ID, OR, WA)	76.4	94/123	85.0	102/120	75.6	93/123	23.7	40/169
All regions	76.2	2140/2808	85.5	2435/2847	73.9	2138/2892	28.1	1101/3915

[a]The 2013 survey did not use sampling, but contact information was unavailable for 610 of 3915 hospitals, and these were not sampled.

TABLE 5

Estimated number of donors and deferrals in the United States, 2019 (expressed in thousands)[a]

	2019				% of total deferrals		
	Males	**Females**	**Total (95% CI)**	**Total, 2017**	**2019**	**2017**	**% change 2019–2017**
Donor deferrals							
Low hemoglobin/hematocrit	205	861	1066 (999–1134)	1115	43.1	43.8	−4.4
Prescription drug use	37	35	72 (64–79)	56	2.9	2.2	27.8
Pulse and/or blood pressure	134	144	278 (251–305)	288	11.2	11.3	−3.5
Other medical reasons	84	108	192 (154–230)	523	7.8	20.5	−63.3
High-risk behavior, MSM[b] only	6	1[c]	7 (5–8)	6	0.3	0.2	9.2
High-risk behavior, all other behaviors	9	6	15 (14–17)	20	0.6	0.8	−22.9
Travel	87	82	169 (80–257)	114	6.8	4.5	47.9
Tattoo/piercing	17	46	63 (48–78)	61	2.5	2.4	3.2
Other	196	333	529 (385–673)	301	21.4	11.8	75.8
Total deferrals	844	1628	2472 (2056–2889)	2544			−2.8
Total presenting to donate[d]	6644	6378	13,022 (12,467–13,576)	14,018			−7.1

[a]Excludes directed and autologous donors.

[b]MSM = men who have sex with men.

[c]Females deferred include those who had sex with MSM.

[d]Repeat donors who donated >1 time during 2019 are only counted once.

TABLE 6

Donations stratified by donor age and type in the United States, 2017 and 2019 (expressed in thousands)[a]

	Donations		% of total donations		
	2019 (95% CI)	**2017**	**2019**	**2017**	**% change 2019–2017**
Donations by donor age (years)					
15	8 (0–19)	6	0.1	0.1	31.7
16	285 (253–317)	286	2.6	2.6	−0.3
17	517 (465–569)	586	4.7	5.3	−11.8
18	414 (386–442)	493	3.8	4.4	−16.1
16–18	1226 (1120–1333)	1365	11.2	12.3	−10.1
19–24	948 (885–1011)	1117	8.6	10.1	−15.1
25–64	6943 (6571–7315)	7010	63.2	63.1	−1.0
65 or older	1772 (1647–1897)	1603	16.1	14.4	10.5
Minority donations[b]	2146 (1615–2678)	2018	19.5	18.2	6.4
Total successful donations	10,981 (10,342–11,620)	11,101			−1.1

[a]Minority donors include African American, Pacific Islander, American Indian, and Hispanic donors.

[b]Excludes directed and autologous donors.

TABLE 7

Number of blood donors in the United States, 2017 and 2019 (expressed in thousands)[a]

	Donors		% of total donors		
	2019 (95% CI)	**2017**	**2019**	**2017**	**% change 2019–2017**
Number of donors					
First time, allogeneic	2213 (2007–2419)	2076	30.2	26	6.6
Repeat, allogeneic[a]	5069 (4753–5385)	5921	69.3	74	−14.4
Total individual donors[b]	7316 (6912–7720)	7996			−8.5

[a]Repeat donor who donated >1 time during 2019 are only counted once.

[b]Excludes directed and autologous donors. Only includes donors from which blood products were successfully collected.

TABLE 8

Autologous and directed donors, donations, recipients, and transfusions in the United States, 2017 and 2019 (expressed in thousands)

	2019			2017		
Component	**Donors or recipients (95% CI)**	**Units (95% CI)**	**Units per donor or recipient**	**Donors or recipients**	**Units**	**Units per donor or recipient**
Transfusions						
Autologous RBCs/WB[a]	16 (4–27)	29 (8–51)	1.9	25	27	1.1
Directed RBCs/WB[a]	9 (2–16)	18 (5–31)	2.0	38	56	1.5
Directed PLTs		3 (1–6)			21	
Total directed units		21 (9–34)			77	

[a]RBCs/whole blood estimate includes whole blood, whole blood–derived RBCs, and apheresis RBC collections.

TABLE 9

Estimated number of red blood cell units transfused and recipients, 2017 and 2019 (expressed in thousands)

Component		2019 total (95% CI)	2017 total (95% CI)
Red blood cells	Allogeneic units[a]	10,801 (10,395–11,206)	10,555 (10,218–10,893)
	Allogeneic recipients	4206 (3995–4416)	4031 (3814–4249)
	Allogeneic units per recipient	2.57 (2.48–2.66)	2.62 (2.51–2.73)

[a]These values only represent RBC units; WB + RBC values were previously reported for 2019[6] and 2017.[4]

TABLE 10

Median and mean dollar amount paid per blood product unit (in US dollars) as reported by hospitals in the United States, 2017 and 2019

	Amount paid, 2019 ($)			Amount paid, 2017 ($)			Difference, 2019–2017 ($)		
Component	Median (N)	IQR	Mean	Median (N)	IQR	Mean	Median	Mean	Matched mean
RBCs, leukoreduced	208 (1607)	198–223	215	207 (1946)	196–223	213	1	2	2.2
Apheresis PLTs, leukoreduced	516 (1537)	491–543	520	517 (1923)	490–550	522	−1	−2	2.5
Pathogen-reduced apheresis PLTs	617 (314)	570–659	610						
FFP	50 (941)	43–59	53	51 (1134)	43–60	57	−1	−4[a]	−0.9
PF24	50 (1276)	43–58	53	50 (1616)	43–60	55	0	−2	−0.9
Cryoprecipitated AHF, each unit	51 (731)	42–62	55	50 (1161)	43–61	54	1	1	0.6

[a]Significant difference between 2017 and 2019 with $p < .05$.

TABLE 11

Median and mean dollar amount paid per blood product unit (in US dollars), as reported by hospitals and stratified by annual inpatient surgical operations in the United States, 2017 and 2019

			Amount paid, 2017 ($)		Amount paid, 2017 ($)		Difference, 2019–2017 ($)	
Component	**Surgical procedures per year**	**N**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**
RBCs, leukoreduced	100–999	398	$217	$224	$216	$224	1	0
	1000–1399	286	$210	$215	$206	$212	4	3
	1400–2399	386	$208	$215	$208	$214	0	1
	2400–4999	496	$206	$212	$205	$208	1	4
	5000–7999	217	$205	$208	$203	$207	2	1
	≥8000	163	$203	$207	$203	$207	0	0
Apheresis PLTs, leukoreduced	100–999	347	$527	$534	$540	$549	−13	−15
	1000–1399	288	$520	$534	$518	$523	2	11
	1400–2399	389	$520	$523	$519	$523	1	0
	2400–4999	515	$511	$514	$510	$513	1	1
	5000–7999	220	$510	$504	$506	$511	5	−7
	≥8000	164	$506	$502	$509	$506	−3	−4
Pathogen-reduced apheresis PLTs	100–999		$600	$577				
	1000–1399		$625	$611				
	1400–2399		$622	$618				
	2400–4999		$634	$624				
	5000–7999		$614	$604				
	≥8000		$612	$603				
FFP	100–999	145	$57	$61	$60	$72	−3	−11
	1000–1399	151	$52	$56	$54	$58	−2	−2
	1400–2399	232	$50	$55	$51	$57	−1	−2
	2400–4999	330	$50	$51	$50	$54	0	−3
	5000–7999	151	$47	$48	$49	$54	−2	−6
	≥8000	125	$45	$49	$45	$50	0	−1
Plasma frozen between 8 and 24 h of donation (PF24)	100–999	276	$57	$63	$58	$65	−1	−2

Component	Surgical procedures per year	Amount paid, 2017 ($)			Amount paid, 2017 ($)		Difference, 2019–2017 ($)	
		N	Median	Mean	Median	Mean	Median	Mean
Cryoprecipitate, each unit	1000–1399	$53	238	$56	$51	$55	2	1
	1400–2399	325	$50	$54	$50	$54	0	0
	2400–4999	435	$48	$50	$50	$52	−2	−2
	5000–7999	195	$47	$49	$48	$50	−1	−1
	≥8000	147	$45	$48	$45	$50	0	−2
	100–999	122	$59	$62	$55	$58	4	4
	1000–1399	170	$56	$57	$50	$55	6	2
	1400–2399	234	$51	$58	$51	$54	0	4
	2400–4999	339	$52	$54	$50	$54	2	0
	5000–7999	164	$48	$51	$50	$52	−2	−1
	≥8000	132	$48	$49	$48	$48	0	−1

TABLE 12

Median and mean dollar amount paid per blood product unit as reported by hospitals (in US dollars) and stratified by HHS region in the United States, 2017 and 2019

		Leukoreduced RBCs		Apheresis PLTs		FFP	
HHS region	**Year**	**Median (N)**	**Mean (SD)**	**Median (N)**	**Mean (SD)**	**Median (N)**	**Mean (SD)**
1 (CT, MA, ME, NH, RI, VT)	2017	$222 (93)	$226 ($26)	$502 (97)	$511 ($80)	$41 (62)	$54 ($24)
	2019	$222 (74)	$227 ($26)	$504 (72)	$520 ($72)	$41 (44)	$50 ($16)
	2019–2017	0	1	2	8	0	−3
2 (NJ, NY)	2017	$214 (157)	$217 ($28)	$531 (162)	$548 ($88)	$45 (105)	$49 ($15)
	2019	$213 (142)	$218 ($21)	$525 (137)	$534 ($63)	$42 (95)	$47 ($12)
	2019–2017	−1	1	−6	−14	−3	−3
3 (DC, DE, MD, PA, VA, WV)	2017	$207 (214)	$214 ($29)	$520 (209)	$538 ($79)	$51 (118)	$76 ($61)
	2019	$210 (152)	$216 ($25)	$520 (144)	$532 ($42)	$50 (82)	$53 ($12)
	2019–2017	4	3	0	−6	−1	−22
4 (AL, FL, GA, KY, MS, NC)	2017	$199 (393)	$207 ($34)	$520 (388)	$520 ($65)	$51 (242)	$54 ($23)
	2019	$202 (314)	$207 ($22)	$520 (300)	$520 ($74)	$51 (197)	$54 ($18)
	2019–2017	3	−1	0	1	0	−0
5 (IL, IN, MI, MN, OH, WI)	2017	$197 (365)	$201 ($22)	$503 (360)	$504 ($56)	$50 (203)	$51 ($15)
	2019	$199 (313)	$206 ($35)	$495 (301)	$503 ($62)	$50 (168)	$54 ($23)
	2019–2017	2	5	−8	−1	0	3
6 (AR, LA, NM, OK, TX)	2017	$216 (241)	$218 ($29)	$525 (233)	$534 ($93)	$53 (138)	$57 ($19)
	2019	$214 (209)	$220 ($32)	$525 (198)	$536 ($92)	$48 (130)	$54 ($19)
	2019–2017	−2	1	0	1	−5	−3
7 (IA, KS, MO, NE)	2017	$200 (121)	$206 ($20)	$490 (116)	$493 ($83)	$52 (47)	$58 ($34)
	2019	$206 (96)	$209 ($25)	$500 (91)	$499 ($53)	$50 (43)	$52 ($7)
	2019–2017	6	3	10	6	−2	−6
8 (CO, MT, ND, SD, UT, WY)	2017	$216 (70)	$217 ($35)	$521 (70)	$530 ($93)	$65 (42)	$66 ($32)
	2019	$216 (61)	$222 ($32)	$516 (55)	$541 ($119)	$59 (42)	$60 ($15)
	2019–2017	0	5	−5	11	−7	−6
9 (AZ, CA, HI, NV)	2017	$220 (208)	$225 ($29)	$490 (206)	$504 ($75)	$49 (125)	$54 ($31)
	2019	$218 (170)	$226 ($33)	$491 (167)	$505 ($83)	$50 (95)	$53 ($18)

		Leukoreduced RBCs		Apheresis PLTs		FFP	
HHS region	Year	Median (N)	Mean (SD)	Median (N)	Mean (SD)	Median (N)	Mean (SD)
10 (AK, ID, OR, WA)	2019–2017	−2	2	1	0	1	−1
	2017	$218 (84)	$230 ($37)	$567 (82)	$579 ($179)	$69 (52)	$71 ($19)
	2019	$216 (76)	$224 ($36)	$522 (72)	$543 ($98)	$55 (45)	$60 ($16)
	2019–2017	−2	−6	−45	−37	−14	−11

TABLE 13

Hospital policies and practices to enhance safety of recipient of blood or blood components, 2017 and 2019

	2019		2017	
	%	n/N	%	n/N
Policy to transfuse only leukoreduced components	83.9%	(1618/1928)	79.7%	(1886/2366)
Program to treat patients who refused blood components for religious, cultural, or personal reasons	75.3%	(1415/1880)	73.5%	(1697/2310)
Transfusion Safety Officer (TSO) on staff	17.9%	(338/1884)	19.3%	(448/2319)
Data on sample collection error	81.1%	(1540/1899)	82.9%	(1931/2330)

TABLE 14

Number of hospitals performing pretransfusion bacterial testing[a] of platelet units in the United States, 2017 and 2019

	Hospitals performing pre-transfusion bacterial testing on platelets, % (n/N)	
Hospital size	**2019**	**2017**
All hospitals, total	6.4% (125/1946)	5.7% (134/2336)
100–999 surgeries per year	0% (2/440)	2% (9/498)
1000–1399 surgeries per year	3% (8/233)	2% (6/335)
1400–2399 surgeries per year	2% (9/410)	3% (16/485)
2400–4999 surgeries per year	9% (41/471)	6% (37/593)
5000–7999 surgeries per year	14% (29/207)	12% (29/239)
8000 or more surgeries per year	19% (36/185)	20% (37/186)

[a]Not including testing performed by the blood collection facility.

TABLE 15

Number of bacterial tests performed for pretransfusion testing of platelet units by transfusing hospitals and number of confirmed positive results by type in the United States, 2017 and 2019

	Confirmed positive results/total tests (false positives, indeterminate results)	
Year	**Culture-based testing**	**Rapid immunoassay (e.g., VERAX)**
2019	14/35,266 (15, 2)	22/92,805 (209, 30)
2017	13/50,922 (40, 3)	10/63,220 (255, 14)

TABLE 16

Genotyping of whole blood and RBC unit donors by blood collection centers and whole blood and RBC recipients by transfusing hospitals in the United States, 2017 and 2019

Facility type	Question	2019, % (n/N)	2017, % (n/N)
BC	Facilities responding to yes/no question	87.3% (110 / 126)	92.8% (142/153)
	Facilities reporting genotyping for RBC antigens	19.1% (21 / 110)	22.5% (32/142)
	Facility mean (median)	3.8% (1.8%)	2.7% (1.1)
Hospital	Facilities responding to yes/no question	89.0% (1904 / 2140)	96.4% (2347/2435)
	Facilities reporting genotyping for RBC antigens	2.4% (45 / 1904)	1.3% (31/2347)
	Facility mean (median)	5.7% (2.6)	10.5% (3.4)

TABLE 17

Use of pathogen reduction technology (PRT) by blood centers and hospital-based blood centers; United States, 2017 and 2019

Year	Facility type	Percent of facilities reporting collection of PRT units, % (n/N)	PRT apheresis platelet units treated (n)	PRT plasma units treated (n)
2019	All facilities	23 (26/112)	221,933 (n = 24)	0 (n = 24)
	Blood centers with 200,000 or more RBC units collected annually[a]	78 (7/9)	191,378 (n = 7)	0 (n = 7)
	Blood centers with less than 200,000 RBC units collected annually[a]	36 (12/33)	17,065 (n = 11)	0 (n = 11)
	Hospital-based blood centers	10 (7/70)	13,490 (n = 6)	0 (n = 6)
2017	Blood Center Use of Pathogen Reduction Technology, Total	19 (28/144)	60,751 (n = 26)	2628 (n = 26)
	Greater than 200,000 or more RBC units collected annually[a]	78 (7/9)	27,806 (n = 7)	0 (n = 7)
	Less than 200,000 RBC units collected annually[a]	27 (13/49)	20,572 (n = 11)	2628 (n = 11)
	Hospital-based blood centers	9 (8/86)	12,373 (n = 8)	0 (n = 8)

[a]Excluding hospital-based blood centers.

TABLE 18

Use of pathogen reduction technology (PRT) and transfusion of PRT-treated units by hospitals and hospital-based blood centers; United States, 2017 and 2019

Year	Facility type	Percent of facilities reporting transfusion of PRT units, % (n/N)	PRT apheresis platelet units transfused (n)	PRT plasma units transfused (n)
2019	Hospital Transfusion of Pathogen Reduced Units, Total	13 (247/1908)	175,017 (n = 214)	5886 (n = 206)
	Hospital-based blood center	17 (11/64)	33,617 (n = 10)	0 (n = 8)
	8000 or more inpatient surgeries annually[a]	29 (46/159)	104,052 (n = 42)	3679 (n = 42)
	Less than 8000 inpatient surgeries annually[a]	11 (190/1685)	37,348 (n = 162)	2207 (n = 156)
2017	Hospital Transfusion of Pathogen Reduced Units, Total	6 (138/2279)	52,752 (n = 119)	7322 (n = 111)
	Hospital-based blood center	13 (11/84)	18,796 (n = 11)	3151 (n = 11)
	Greater than 8000 inpatient surgeries annually[a]	14 (22/152)	22,380 (n = 19)	998 (n = 19)
	Less than 8000 inpatient surgeries annually[a]	5 (105/2043)	11,576 (n = 89)	3173 (n = 81)

[a]Excluding hospital-based blood centers.

TABLE 19

Percent of components leukoreduced before storage at blood collection centers in the United States, 2017 and 2019

	Percent units leukoreduced	
	2019, % (95% CI)	**2017, %**
Whole blood/red blood cells	97.2 (95.7–98.6)	95.8
Apheresis platelets	96.7 (93.9–99.4)	99.8

TABLE 20

Components transfused at hospitals that were irradiated or leukoreduced, before and after storage, in 2017 and 2019 (expressed in thousands)

		Units		% of total units	
		2019 (95% CI)	**2017**	**2019**	**2017**
Irradiated	Whole blood/red blood cells	1983 (1688-2278)	1703	18.6	16.0
Irradiated	Apheresis platelets	1124 (968–1280)	970	60.8	52.5
leukoreduced before storage	Whole blood/red blood cells	9100 (8660-9541)	7765	85.4	72.9
leukoreduced before storage	Apheresis platelets	1756 (1599-1913)	1497	95.0	81.0
leukoreduced after storage	Whole blood/red blood cells	1777 (1481-2072)		16.7	
leukoreduced after storage	Apheresis platelets	265 (194–336)		14.4	

TABLE 21

Estimated number of apheresis platelet units collected as single, double and triple collections in the United States, 2017 and 2019 (expressed in thousands)

	2019		2017	
Apheresis platelet collections	**Number units (95% CI)**	**% all platelets**	**Number units (95% CI)**	**% all platelets**
Single	545 (275–673)	23.1%	541	23.2%
Double	1065 (788–1063)	45.1%	1075	46.0%
Triple	749 (595–708)	31.7%	722	30.9%
Total	2359 (2240-2477)		2338	

TABLE 22

Use of platelet additive solution to prepare apheresis platelets, 2017 and 2019

	2019	2017
Percentage of facilities using platelet additive solution	14.0% (16/114)[a]	8.5% (12/141)[b]
Mean number of units prepared using platelet additive solution	2349 (n = 13)	2742 (n = 11)

[a]Of 16 facilities reporting platelet additive solution use in 2019, 11 were community-based blood collection centers, and five were hospital-based blood collection centers.

[b]Of 12 facilities reporting platelet additive solution use in 2017, 8 were community-based blood collection centers, and four were hospital-based blood collection centers.

TABLE 23

Estimated number of apheresis and whole blood-derived plasma units distributed in the United States, 2017 and 2019 (expressed in thousands)

	2019 (95% CI)			2017 (95% CI)		
Plasma product	**Whole blood-derived units**	**Apheresis units**	**All units**	**Whole blood-derived units**	**Apheresis units**	**All units**
All plasma products			2679 (2525-2833)			3209
FFP	497 (370–623)	168 (132–204)	680 (539–820)	799	176	974
FFP, jumbo size (>400 ml)		47 (4–89)			48	
PF24	1356 (1228-1484)	196 (87–304)	1506 (1318–1694)	1794	171	1964
Plasma, PF24RT24[a]	203 (188–219)	293 (247–339)	494 (438–550)		169	
Liquid	152 (131–173)			83		
Cryoprecipitate reduced	30 (23–38)			118		
Group AB[b]			341 (311–370)			312

[a]Plasma, frozen within 24 h after up to 24 h at room temperature.

[b]Group AB plasma is not an exclusive category and includes units counted as other product types.

TABLE 24

Estimated number of plasma units transfused in the United States, 2017 and 2019 (expressed in thousands)

Plasma product	2019 (95% CI)	2017
All plasma products	2185 (2068-2301)	2374
FFP	1041 (924–1158)	1021
FFP, pediatric size (100 ml)	31 (20–42)	34
FFP, jumbo size (>400 ml)	27 (13–42)	46
PF24	1050 (935–1164)	1183
Plasma, PF24RT24[a]	90 (60–120)	39
Liquid	56 (40–73)	14
Cryoprecipitate reduced	22 (15–29)	27
Group AB[b]	255 (226–283)	278

[a]Plasma, frozen within 24 h after up to 24 h at room temperature.

[b]Group AB plasma is not an exclusive category and includes units counted as other product types.

TABLE 25

Estimated number of granulocyte units distributed and transfused in the United States, 2017 and 2019

	2019, units (95% CI)	**2017 units (95% CI)**
Granulocytes distributed	1857 (764–2951)	4062 (1809–6315)
Granulocytes transfused	2215 (1132–3299)	1717 (1000–2433)

TABLE 26

Routine dosing criteria used by U.S. transfusing hospitals for non-pediatric patients, 2017 and 2019

	2019			2017		
Dosing criteria	**Plasma % (n)**	**Prophylactic platelet transfusions % (n)**	**Therapeutic platelet transfusions % (n)**	**Plasma % (n)**	**Prophylactic platelet transfusions % (n)**	**Therapeutic platelet transfusions % (n)**
Weight-based dosing (e.g., 20 ml/kg)	5.5% (90)	2.9% (46)	2.9% (48)	5.4% (119)	1.7% (36)	1.5% (33)
Standard number of units regardless of weight	10.3% (170)	13.9% (221)	12.3% (201)	8.6% (188)	11.4% (248)	11.3% (246)
Dosage varies based on level of thrombocytopenia or bleeding	66.7% (1102)	64.8% (1034)	68.5% (1115)	66.4% (1454)	67.7% (1475)	70.3% (1535)
Number of units ordered not consistent with any of the above	17.5% (289)	18.4% (294)	16.2% (264)	19.6% (429)	19.2% (419)	16.9% (368)

TABLE 27

Percentage of units transfused, by unit age, 2017 and 2019

	2019		2017	
Component, age	**N**	**% (n/N)**	**N**	**% (n/N)**
Red blood cells	n = 799		n = 194	
1–35 days		80.0% (1,585,634/1,980,959)		82.0% (630,433/768,450)
36–42 days		19.1% (379,325/1,980,959)		18.0% (138,017/768,450)
Whole Blood Derived Platelets	n = 1063		n = 1394	
1–3 days		15.7% (3992/25,377)		20.0% (1775/8894)
4–5 days		84.3% (21,385/25,377)		80.0% (7119/8894)
Apheresis Platelets	n = 834		n = 394	
1–3 days		38.5% (176,295/458,408)		39.6% (87,070/220,148)
4–5 days		59.2% (271,187/458,408)		58.4% (128,623/220,148)
6–7 days		2.4% (10,926/458,408)		2.0% (4455/220,148)

TABLE 28

Percent of group O (positive and negative) RBC distributed, transfused, and outdated (as a percentage of all allogeneic RBC) in the United States, 2017 and 2019

	2019, % (SD, n)		2017% (SD, n)	
	Group O−	**Group O+**	**Group O−**	**Group O+**
Processed	8.9% (6.0%, n = 73)	35.2% (18.8%, n = 73)	8.2% (5.5%, n = 97)	32.4% (19.5%, n = 98)
Distributed	11.4% (12.9%, n = 48)	37.1% (20.9%, n = 48)	11.0% (5.5%, n = 62)	39.8% (13.9%, n = 61)
Outdated (blood center)	4.6% (7.4%, n = 46)	9.5% (17.1%, n = 46)	5.3% (9.1%, n = 62)	12.5% (15.3%, n = 63)
Transfused	11.6% (7.6%, n = 1446)	41.3% (12.3%, n = 1433)	11.2% (7.3%, n = 1498)	40.2% (13.6%, n = 1480)
Outdated (hospital)	12.9% (19.2%, n = 1062)	16.7% (22.1%, n = 1059)	12.5% (19.6%, n = 1055)	16.4% (22.1%, n = 1053)

TABLE 29

Group O red blood cell (RBC) units in inventory and number at which group O blood supply is considered critically low, 2017 and 2019

	Group O RBC units on shelf, average weekday		Group O+ and O− RBC units at which supply considered critically low	
Annual inpatient surgical operations	**2019 mean (S.D.)**	**2017 mean (S.D.)**	**2019 mean (S.D.)**	**2017 mean (S.D.)**
100–999 surgeries	13.2 (8.9)	12.9 (8.0)	5.8 (5.0)	5.7 (4.3)
1000–1399 surgeries	22.2 (11.9)	23.5 (15.3)	11.1 (7.1)	10.8 (8.0)
1400–2399 surgeries	29.5 (19.4)	28.8 (15.7)	14.0 (9.8)	13.7 (11.6)
2400–4999 surgeries	47.4 (32.8)	45.5 (26.4)	22.5 (18.0)	21.1 (16.1)
5000–7999 surgeries	72.4 (80.6)	71.4 (40.1)	32.1 (21.7)	31.9 (21.2)
>8000 surgeries	144.3 (93.2)	145.6 (102.1)	65.0(46.1)	63.4 (52.9)

TABLE 30

Crossmatch procedures performed on whole blood and red blood cells in the United States, 2017 and 2019 (expressed in thousands)

	2019		2017	
Crossmatch procedure method	**Number of procedures (95% CI)**	**% of any method**	**Number of procedures**	**% of any method**
Any method	15,562 (14,547-16,578)		15,747	
Electronic	9198 (8174-10,222)	59.1	7491	47.6
Manual serologic	6228 (5734-6723)	40.0	7658	48.6
Automated serologic	558 (435–682)	3.6	723	4.6

TABLE 31

Pediatric transfusions and recipients in the United States, 2017 and 2019 (expressed in thousands)

Component	Patient age group[a]	Adult-equivalent units used in whole or part for pediatric patients			Total number of pediatric recipients	
		2019 (95% CI)	2017	% change 2019–2017	2019 (95% CI)	2017
Whole blood or RBCs	Pediatric and neonatal	405 (299–511)	378	7.1	117 (74–160)	92
	Pediatric	272 (179–365)	240	13.3	77 (38–117)	44
	Neonatal	133 (108–158)	141	−5.8	40 (32–47)	48
Apheresis PLTs	Pediatric and neonatal	168 (118–217)	90	86.4	47 (27–67)	24
	Pediatric	120 (78–162)	49	144.6	30 (14–46)	12
	Neonatal	48 (34–62)	41	17.0	17 (9–25)	12
Plasma	Pediatric and neonatal	79 (54–103)	76	3.3	24 (13–35)	16
	Pediatric	48 (29–67)	48	−0.1	14 (4–25)	6
	Neonatal	31 (22–39)	28	9.3	10 (7–12)	10

[a]Pediatric (aged >4 months old) and neonatal (aged ≤4 months old).

TABLE 32

Hospital policies for neonatal aliquot production, 2017 and 2019

Question	2019			2017		
	% yes	N yes	N yes or no[a]	% yes	N yes	N yes or no[a]
Neonatal aliquots made using syringes from full-size units	57.2%	465	813	55.8%	523	937
Neonatal aliquots made using pedipacks	50.6%	411	813	46.5%	436	937
For neonatal patients, attempt to use aliquots from the same full-size unit for every transfusion	83.7%	647	773	82.5%	768	931

[a]Excludes facilities that did not perform pediatric or neonatal transfusions.

TABLE 33

Transfusion-associated adverse reactions in the United States, 2017 and 2019

	Number of reactions (95% CI)		Reactions per 100,000 components transfused (95% CI)	
Adverse transfusion reactions	**2019**	**2017**	**2019**	**2017**
Total number of reactions that required any diagnostic or therapeutic intervention[a]	48,342 (44,178–52,507)	45,165	293.7 (273.0–314.3)	281.8
Febrile, nonhemolytic transfusion reaction	19,891 (18,131–21,652)	19,317	119.1 (109.6–128.5)	120.5
Mild to moderate allergic reactions	13,697 (12,139–15,255)	14,170	81.5 (74.4–88.6)	88.4
Delayed serologic transfusion reaction	3208 (2595–3821)	2981	19.0 (15.6–22.5)	18.6
Transfusion-associated circulatory overload	2247 (1968–2526)	1877	13.4 (11.9–14.9)	11.7
Hypotensive transfusion reaction	1442 (1187–1697)	1462	8.7 (7.2–10.3)	9.1
Transfusion-associated dyspnea	1150 (851–1448)	1036	7.0 (5.3–8.7)	6.5
Delayed hemolytic transfusion reaction	692 (539–844)	770	4.1 (3.2–5.0)	4.8
Severe allergic reactions	442 (289–594)	398	2.7 (1.8–3.6)	2.5
Transfusion-related acute lung injury	258 (196–320)	243	1.5 (1.2–1.9)	1.5
Acute hemolytic transfusion reaction (other antibodies)	173 (120–225)	135	1.0 (0.7–1.3)	0.84
Posttransfusion purpura	104 (38–171)	579	0.63 (0.23–1.03)	3.7
Transfusion-transmitted bacterial infection (previously asked as posttransfusion sepsis)	58 (26–90)	37	0.35 (0.17–0.54)	0.23
Acute hemolytic transfusion reaction (ABO)	55 (26–84)	33	0.33 (0.16–0.49)	0.21
Transfusion-transmitted parasitic infection	4 (0–9)	10	0.023 (0.000–0.054)	0.068
Transfusion-transmitted viral infection	3 (0–8)	6	0.021 (0.000–0.051)	0.039
Transfusion-associated graft-versus-host disease	0[b]	0[b]		
Reactions that were life threatening, requiring major medical intervention[c]	442 (135–749)	758	2.7 (0.8–4.6)	4.7

[a]Diagnostic tests were defined as “any test to confirm a reaction occurred” and therapeutic intervention was defined as “intervention to treat a reaction (e.g., vasopressors, intubation, transfer to intensive care to prevent impairment, permanent damage, or death).

[b]Zero events reported in the sample for 2019 and 2017. Therefore, no national estimate of the number of occurrences could be made in either year.

[c]For example, vasopressors, blood pressure support, intubation, or transfer to the intensive care unit.