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Has the trend of declining blood transfusions in the United States ended? Findings of the 2019 National Blood Collection and Utilization Survey

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Abstract

Introduction: Previous iterations of National Blood Collection and Utilization Survey (NBCUS) have demonstrated declines in blood collection and transfusion in the United States since 2008, including declines of 3.0% and 6.1% in red blood cell (RBC) collections and transfusions between 2015 and 2017, respectively. This study describes results of the 2019 NBCUS.

Methods: The survey was distributed to all US blood collection centers, all 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were used to generate national estimates for units of blood and components collected, distributed, transfused, and outdated.

Results: In 2019, 11,590,000 RBC units were collected (95% confidence interval [CI], 11,151,000–12,029,000 units), a 5.1% decrease compared with 2017, while 10,852,000 RBC units were transfused (95% CI, 10,444–11,259 units), a 2.5% increase from 2017. Between 2017 and 2019, platelet distributions (2,508,000 units; 95% CI, 2,375,000–2,641,000 units) decreased by 2.0%, and plasma distributions (2,679,000 units; 95% CI, 2,525,000–2,833,000 units) decreased by 16.5%. During the same time period, platelet transfusions (2,243,000 units; 95% CI, 1,846,000–2,147,000 units) increased by 15.8% and plasma transfusions (2,185,000 units; 95% CI, 2,068,000–2,301,000 units) decreased by 8.0%.

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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 the Centers for Disease Control and Prevention.

Conclusion: Utilization of RBC in the United States might have reached a nadir. Between 2017 and 2019, RBC collections declined while RBC transfusions did not significantly change, suggesting a narrowing between blood supply and demand. Monitoring national blood collection and utilization data is integral to understanding trends in blood supply safety and availability.

Keywords

blood components; blood donation; blood transfusion

1 | INTRODUCTION

Blood transfusion is a common hospital procedure, with 5.7% of hospitalized patients receiving a red blood cell (RBC) transfusion during 2014 in the United States.[1] To monitor the numbers of blood collections and transfusions in the United States, national surveys have been conducted since 1971 with support from the federal government. Since 1997, the National Blood Collection and Utilization Survey (NBCUS) has been the primary source of data related to annual blood collections and transfusions occurring in the United States.[2–5]

Since 2008, data reported to the NBCUS have identified continuing declines in blood products collected and transfused. Decreases in collection have likely been a result of a decrease in demand for blood due to broad implementation of patient blood managements.[1,4,6] Patient blood management (PBM) refers to evidence-based medical and surgical programs to minimize blood loss and ensure appropriate hemoglobin levels to minimize the need for transfusion.[7] These programs have been demonstrated to reduce the amount of blood transfused while improving patient outcomes.[7,8] While declines were steepest between 2008 and 2013, the rate of decline slowed and appeared to stabilize between 2015 and 2017, particularly among larger U.S. hospitals.[4] In addition, the price paid for blood components has also decreased during this time. The median price paid by hospitals for a leukoreduced RBC unit declined from $221 in 2013 to $207 in 2017.[4] This combination of declining transfusions and reductions in prices paid for blood products suggests financial pressures on blood collection organizations in the United States.[6,9,10]

Here, data from the 2019 NBCUS are presented and include estimates on blood component collection, distribution, and transfusion in the United States.

2 | METHODS

The survey methods and questionnaire design for the 2019 survey were consistent with previous NBCUS surveys.[2,3,11] The 2019 survey included 44 questions, of which 18 were intended for blood collection facilities and 26 were directed toward transfusing hospitals.

Blood collection facilities were identified using the US Food and Drug Administration's Blood Establishment Registration database, through which 53 community-based (e.g., non-hospital-based) and 90 hospital-based blood collection centers were identified and sent a survey (Figure 1). Community and hospital-based blood centers that were included in the database in 2017 but not included in 2019 were contacted to ascertain reasons for no longer being included in the blood establishment database. Transfusing hospitals were identified

using the 2017 American Hospital Association annual survey database. As with previous surveys, hospitals with the following characteristics were excluded for any of the following reasons: performing <100 inpatient surgeries annually, location in a US territory, operated by the military or Department of Justice, or classified as rehabilitation, acute long-term care, or psychiatric facilities. After these exclusion criteria were applied, 3808 hospitals were included in the sampling frame. Of these, 100% of hospitals performing ≥1000 inpatient surgical operations a year (n = 2139) were surveyed and 40% of hospitals that performed 100 to 999 inpatient surgical operations per year were randomly selected to be surveyed (n = 669/1669).

For 2013–2017, the NBCUS surveys were administered with the MrInterview (IBM Corporation, Armonk, New York) software package. The 2019 survey was conducted using REDCap (Research Electronic Data Capture, Nashville, Tennessee).[12]

Following survey dissemination, facilities were contacted via mail, email, and/or phone to increase participation. Due to challenges posed by the COVID-19 pandemic, the survey deadline was extended by 2 months to allow hospitals and blood centers additional response time.

National estimates were calculated for the number of units of blood and blood components collected, distributed, transfused, and outdated in 2019. These estimates were rounded to the nearest 1000 units. To assist with weighting and imputation, blood collection centers were stratified based on expected levels of collection or transfusion in 2019. Community-based blood centers were stratified into the following categories derived from the number of whole blood or RBC units collected in 2017: fewer than 50,000, 50,000 to 199,999, 200,000 to 399,000, and 400,000 or more units. Hospital-based blood centers were stratified into the following categories derived from the number of inpatient surgical operations performed in 2017: fewer than 1000, 1000–7999, and 8000 or more inpatient surgical operations. Transfusing hospitals were stratified into the following categories derived from the number of inpatient surgical operations performed in 2017: 100–999, 1000–1399, 1400–2399, 2400–4999, 5000–7999, and 8000 or more surgical operations. Transfusing hospitals are categorized by the number of inpatient surgeries because this is the most accurate proxy variable to predict hospital RBC utilization rates.[13]

To account for non-responses within each stratum, responses were weighted by dividing the total number of eligible participants by the total number of respondents. Blood collection centers with an expected collection volume of more than 400,000 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.[14]

To account for missing data, a multiple imputation method was applied. 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.[11,15,16] The following variables were weighted and imputed: whole blood and apheresis RBCs collected, distributed, rejected, outdated, and transfused; and apheresis platelets (PLTs), plasma, and cryoprecipitate units collected and transfused. To express

whole blood-derived PLTs as apheresis equivalents, the numbers of whole blood-derived PLTs were divided by the median reported pool size, which was five.

Non-weighted data were used to calculate and report on mean and median cost per unit of blood and blood components paid by transfusing hospitals. Due to occurrence of outliers, medians were preferred over means for comparing differences in unit costs.

National rates of whole blood and RBC collection per 1000 population were calculated by dividing the total estimated number of units collected before the removal of rejected units by the 2019 US population aged 16–64 years. This denominator was used to maintain consistency with previous NBCUS reports and to correspond with the general age range of blood donors (Figure 2C). National rates of whole blood and RBC transfusion per 1000 population were calculated by dividing the total estimated number of units transfused by the entire 2019 US population. All population estimates were determined using state-specific and age-specific estimates from the US Census Bureau for 2019.[17] A subset of transfusing hospitals completing both 2017 and 2019 surveys was created to determine if differences in collection and utilization estimates between 2017 and 2019 surveys were influenced by sampling and response rates. This matched subset of NBCUS respondents from 2017 to 2019 was used for sensitivity analyses to determine if differences observed between these 2 years were uniform or varying when holding the responding facilities constant. All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

3 | RESULTS

3.1 | Survey participation

The response rates for the 2019 NBCUS were 94.3% (50/53) for community-based blood collection facilities, 84% (76/90) for hospital-based blood collection facilities, and 76% (2140/2808) for transfusing hospitals. The total number of community-based blood centers that were eligible for inclusion decreased from 65 in 2017 to 53 in 2019. During 2017–2019, 11 community-based blood centers had been acquired by a larger center or merged, and one had closed. Community-based blood centers collecting <400,000 RBC per year decreased from 62 in 2017 to 48 in 2019. Community-based blood centers which reported collecting ≥400,000 RBC per year increased from 3 in 2017 to 5 in 2019, likely due to mergers between organizations or acquisitions of smaller centers. The number of hospitals which reported collecting blood decreased, from 107 in 2017 to 90 in 2019, as these facilities ceased blood collection operations.

3.2 | Whole blood and RBC collections and transfusions

In 2019, 11,590,000 units of whole blood and apheresis RBC units were collected in the United States (95% confidence interval [CI], 11,151,000–12,029,000 units), a 5.1% decrease compared with 2017, when 12,211,000 units were collected (Table 1). Between 2017 and 2019, the number of whole blood units collected decreased by 6.1%, while the number of apheresis units increased by 0.7%. Among all whole blood units collected during 2019, 99.9% were collected for allogenic, nondirected transfusions. During 2019, 10,852,000 units of whole blood-derived and apheresis RBC units were transfused in the

United States (95% CI, 10,444,000–11,259,000 units), a 2.5% increase compared with 2017, when 10,654,000 units were transfused (Table 1). Between 2017 and 2019, the decline in the number of RBC units distributed from blood centers to hospitals continued (Figure 2A). However, although the number of RBC units transfused had decreased during 2008–2017, no significant decrease occurred between 2017 and 2019. Similarly, the number of whole blood and RBC units collected per 1000 population has decreased from a maximum of 86.4 in 2008 to 55.3 in 2019 (Figure 2C). However, RBC units transfused per 1000 population were highest in 2008 (49.4), decreased until 2017 (32.8), and increased in 2019 (33.1).

During 2019, 5000 units (95% CI, 4000–6000 units) of whole blood were collected for autologous transfusions and 9000 units (95% CI, 5000–12,000 units) were collected for directed transfusions, a 50.1% and 46.6% decrease compared with 2017, respectively. Approximately 103,000 units (95% CI, 83,000–124,000) were rejected after collection because of abnormal disease marker results (e.g., infectious disease testing) during 2019, a 32.6% increase compared with 2017 and a 94.3% increase since 2015. Approximately 608,000 units (95% CI, 541,000–675,000) were rejected after collection for other reasons during 2019, such as insufficient volume or a broken bag, a 3.6% increase since 2017 and a 19.2% increase since 2015. Among all whole blood and RBC units rejected after collection, the proportion of units rejected because of abnormal disease markers has continued to increase from 9.4% in 2015 to 11.7% in 2017 and 14.5% in 2019. After accounting for rejections, the total available supply of whole blood and RBC units in 2019 was 10,879,000 (95% CI, 10,484,000–11,274,000) units, a 5.8% decrease from 2017. During 2019, 349,000 whole blood and RBC units were outdated (95% CI, 321,000–377,000), a 21.7% decrease compared with 2017.

3.3 | RBC transfusion by hospital size and by location within a health care facility

Among 1606 hospitals that provided RBC allogeneic transfusion data for both the 2017 and 2019 NBCUS, the median percent difference in the number of RBC units transfused between 2017 and 2019 was −2.2% (Table 2). The median percent difference differed by surgical volume category. Hospitals with lower surgical volumes were associated with a larger decrease in RBC transfusion volume between 2017 and 2019. The median percent difference of RBC transfusions between 2017 and 2019 among hospitals with 100–999 surgical operations per year was −7.9%, while transfusions increased by 1.9% among hospitals performing ≥8000 surgical operations per year.

In 2019, among locations within a healthcare facility, the highest volume of RBC units were transfused in inpatient medicine settings (3,909,000 units; 95% CI, 3,593,000–4,226,000 units), followed by critical care (1,810,000 units; 95% CI, 1,645,000–1,975,000 units), outpatient and non-acute inpatient settings (1,512,000 units; 95% CI, 1,335,000–1,689,000 units), surgery (1,380,000 units; 95% CI 1,236,000–1,525,000 units), and emergency departments (1,277,000 units; 1,163,000–1,391,000 units) (Table 3).

Trends in RBC transfusion differed by location within healthcare facilities (Table 3). The largest increase between 2017 and 2019 was seen in emergency departments, with an 18.4% increase. Between 2017 and 2019, no substantial changes in RBC transfusions were reported among inpatient medicine, critical care, surgery, or outpatient and non-acute

inpatient settings. When restricting the analysis to hospitals that responded in both 2017 and 2019, an increase in the matched median percent difference of RBC units transfused between 2017 and 2019 was only reported for transfusions performed in emergency departments (+20.6%). A decrease in the matched median percent difference was reported for transfusions performed in inpatient medicine settings (−7.5%), critical care (−9.4%), surgery (−5.9%), and outpatient and non-acute inpatient settings (−6.1%).

3.4 | PLT, plasma, and cryoprecipitate distribution and transfusion

In 2019, 2,359,000 units (95% CI, 2,240,000–2,477,000 units) of apheresis PLT units were distributed, a 0.9% increase compared with the 2,338,000 units distributed in 2017 (Table 4). Approximately 149,000 units (in apheresis unit equivalents; 95% CI, 105,000–193,000 units) of whole blood-derived PLTs were distributed in 2019, a 33.1% decrease compared with the 223,000 units distributed in 2017. Among all PLT units distributed, the proportion that were whole blood-derived decreased from 8.7% in 2017 to 5.9% in 2019.

In 2019, 2,243,000 apheresis and whole blood-derived PLT units (95% CI, 1,930,000–2,555,000 units) were transfused, a 15.8% increase from the 1,937,000 units transfused in 2017. Approximately 1,996,000 apheresis PLT units (95% CI, 1,846,000–2,147,000 units) were transfused in 2019, an 8.0% increase from the 1,848,000 units transfused in 2017 and a 10.5% increase from the 1,807,000 units transfused in 2015. Approximately 243,000 whole blood-derived platelet units (in apheresis equivalents; 95% CI, 0–503,000 units) were transfused in 2019, a 197% increase from 2017 and 42.1% increase from 2015. In 2019, among locations within a healthcare facility, the highest volume of PLT units were transfused in inpatient medicine settings (1,050,000 units; 95% CI: 488,000–1,612,000 units), followed by outpatient and non-acute inpatient settings (462,000 units; 95% CI, 215,000–709,000 units), critical care (448,000 units; 95% CI, 345,000–551,000 units), surgery (280,000 units; 95% CI 239,000–321,000 units), and emergency departments (105,000 units; 86,000–124,000 units). Between 2017 and 2019, the largest increase in PLT transfusions was seen in outpatient and non-acute inpatient settings (28.1%), inpatient medicine settings (25.5%), and critical care (16.4%) (Table 5).

A total of 2,679,000 units of plasma (95% CI, 2,525,000–2,833,000 units) were distributed in 2019, a 16.5% decrease compared to the 3,209,000 of plasma distributed in 2017. This value includes all types of plasma, including fresh-frozen plasma, plasma frozen within 24 h of collection, cryoprecipitate-reduced plasma, and liquid plasma. A decrease was also seen in the number of plasma units transfused. Approximately 2,185,000 plasma units (95% CI, 2,068,000–2,301,000 units) were transfused in 2019, an 8.0% decrease compared to the 2,374,000 plasma units transfused in 2017.

In total, 2,304,000 units of cryoprecipitated AHF (95% CI, 2,045,000–2,562,000 units) were distributed in 2019, a 6.3% increase compared to the 2,168,00 units of cryoprecipitated AHF distributed in 2017. Similarly, the number of transfused cryoprecipitated AHF units increased by 11.3%, from 1,064,000 units in 2017 to 1,184,000 units in 2019 (95% CI, 1,030,000–1,339,000 units).

A combined 229,000 units of platelets, plasma, and cryoprecipitated AHF were outdated in community and hospital-based blood centers in 2019 (95% CI, 194,000–264,000), a 28.5% decreased compared to the 320,000 units outdated in 2017. The number and percent of units outdated at blood centers during 2019 included 118,000 (4.8% of sum of units distributed and outdated) apheresis PLT units, 70,000 whole blood-derived PLT apheresis equivalents (32.0%), 32,000 plasma units (1.2%), and 9000 cryoprecipitated AHF units (0.4%). In hospitals, the number of PLT, plasma, and cryoprecipitated AHF units outdated increased 12.1% from 446,000 in 2017 to 500,000 (95% CI, 466,000–534,000) in 2019. Outdated components at hospitals during 2019 included 192,000 apheresis PLT units (8.8% of sum of units transfused and outdated), 15,000 whole blood-derived PLT apheresis equivalents (5.8%), 197,000 plasma units (8.3%), and 96,000 cryoprecipitate units (7.5%).

4 | DISCUSSION

Since 2008, steep declines in blood utilization have been reported in the United States.[4] During the same time period, US blood collection organizations have reported fewer donations and collections of blood products.[4] The findings of the 2019 NBCUS suggest that transfusions have not decreased on an annual basis in the United States for the first time since 2008. Declines in blood transfusion have been largely attributable to adoption of patient blood management programs, decreased surgical blood loss, and other scientific and medical advancements in clinical care.[1,4,6] The trends in RBC transfusion differed by hospital surgical volume and by the location within the healthcare facility the transfusion occurred. Similar to 2017, hospitals with lower surgical volumes reported greater decreases in red blood cell transfusion than hospitals with larger surgical volumes.[4] However, a greater median percent difference between 2017 and 2019 compared to difference between 2015 and 2017 was noted across all surgical volume categories. This suggests that larger hospitals are, on average, no longer experiencing a decrease in RBC utilization, and the decline in utilization among smaller hospitals continues to slow. Although further study is required, one reason may be that larger hospitals have fully implemented patient blood management programs and reached a nadir in blood use, while smaller hospitals continue to develop and implement these initiatives. An additional notable finding in the present study is that RBC utilization in high acuity settings such as critical care units and emergency departments increased between 2017 and 2019. While reasons for this increase are unclear, one explanation may be that many patient blood management program strategies (limiting phlebotomy for testing, treating preoperative anemia, implementing red cell recovery techniques and other surgery-associated strategies) are likely to have greater impact in other clinical settings, but not in the delivery of critical and emergency care.[7] However, RBC utilization also increased in outpatient and nonacute settings, demonstrating a variety of clinical settings have reported an increase in RBC use.

Many other countries have seen changing trends in RBC utilization. Among countries reporting to the European Blood Alliance, between 2016 and 2017 most reported decrease in RBC units issued (2.2% decrease in the total among all reporting countries), but between 2017 and 2018, 7 of 18 countries reported an increase and only 11 reported a decrease (1.1% decrease in total).[18] Other regions and countries that have reported slowing of declines or increases in red blood cell demand include New Zealand, Australia, and Quebec.[19–21]

Many countries continue to have lower rates per population of red blood cell utilization compared to the United States (33.1 red blood cell units transfused per 1000 population). In 2019, reported rates of red blood cell units issued per 1000 population include 20.9 in New Zealand, 24.2 in Quebec, 24.7 in Australia, and 24.6 in England.[19,20,22] The cause for these differences is unclear but suggests that the United States could further decrease its rate of RBC utilization.

Between 2017 and 2019, RBC collections continued to decrease while transfusions increased slightly, indicating a narrowing between blood supply and demand. This suggests the potential for reduced elasticity in blood supply, which may impact blood sufficiency if blood demand increases or blood supply decreases during public health emergencies.[23] The potential for reduced elasticity has resulted in both governmental and non-governmental stakeholders to express concerns about the adequacy of the blood supply.[6,10,23] In June 2019, the U.S. Congress passed the Pandemic and All-Hazards Preparedness and Advancing Innovation Act, which directs the U.S. Department of Health and Human Services to perform periodic assessments about the safety and adequacy of the blood supply during disasters and public health emergencies.[6,23,24] In response, the Advisory Committee on Blood and Tissue Safety and Availability developed recommendations, including (1) funding a national blood campaign and supporting studies on attracting and maintaining blood donors, (2) developing a system to collect real-time national blood collection and utilization data to determine if blood supply is meeting demand, and (3) creating a blue ribbon panel to address funding and reimbursement issues that might pose challenges in maintaining an adequate blood supply.[23] CDC and the Office of the Assistant Secretary of Health (OASH) will continue to monitor the impact of the current COVID-19 pandemic on blood demand and the adequacy of the blood supply using both existing hemovigilance data (as part of the National Healthcare Safety Network Hemovigilance Module) and as part of the next NBCUS survey.

Since 2015, the number of collected and transfused apheresis PLT units has increased. An aging US population may lead to an increase in the need for PLT transfusions because of an increase in the incidence of cancer and other chronic diseases.[1,25] Between 2017 and 2019, PLT transfusions increased in inpatient, critical care, and outpatient and non-acute inpatients settings, consistent with an increase in demand for PLT transfusions associated with clinical conditions in an aging patient population. The increasing demand for PLTs may pose future challenges to maintaining an adequate PLT supply.[25,26] The average age of apheresis PLT donors is increasing,[25] with blood centers reporting difficulties with recruiting and retaining younger apheresis PLT donors. Most PLTs in the United States are collected through apheresis procedures, which generally require more time than whole blood donations and can discourage younger donors from donating.[25] PLTs also have a shorter shelf life than red blood cells and plasma.[26] Potential strategies to increase the PLT supply could include improving recruitment and retention of PLT donors, adopting technology to increase the shelf-life of PLTs (e.g., cold storage), and utilizing whole blood-derived PLT units.[25,26]

The findings are subject to several limitations. First, 2019 NBCUS data were collected during the period when hospitals were experiencing significant disruptions due to the

COVID-19 pandemic. Data are self-reported and minimal verification of hospital data was performed to avoid overburdening facilities. Although the deadline for completing the 2019 NBCUS was extended, the hospital response rate was lower than the 2017 NBCUS hospital response rate. Additionally, there is potential for novel pandemic-related data quality issues that cannot be easily quantified and would not be encapsulated by the confidence intervals presented. Second, imputation and weighting were used to generate national estimates. Changes in sampling and response rates could affect comparisons to previous NBCUS estimates. Finally, 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.

In conclusion, the 2019 NBCUS suggests that the decline in utilization rates of RBC in the United States might have ended. Between 2017 and 2019, RBC collections declined while RBC transfusions did not significantly change, suggesting a narrowing between blood supply and demand. However, apheresis PLT collection and utilization have increased since 2015, and additional strategies may be needed to ensure a sufficient PLT supply. CDC and OASH will continue to monitor national blood collection and utilization data to support efforts to ensure the safety and availability of the blood supply.

Abbreviations:

NBCUS	national blood collection and utilization survey
OASH	office of the assistant secretary of health
PBM	patient blood management
PLTs	platelets
RBC	red blood cell

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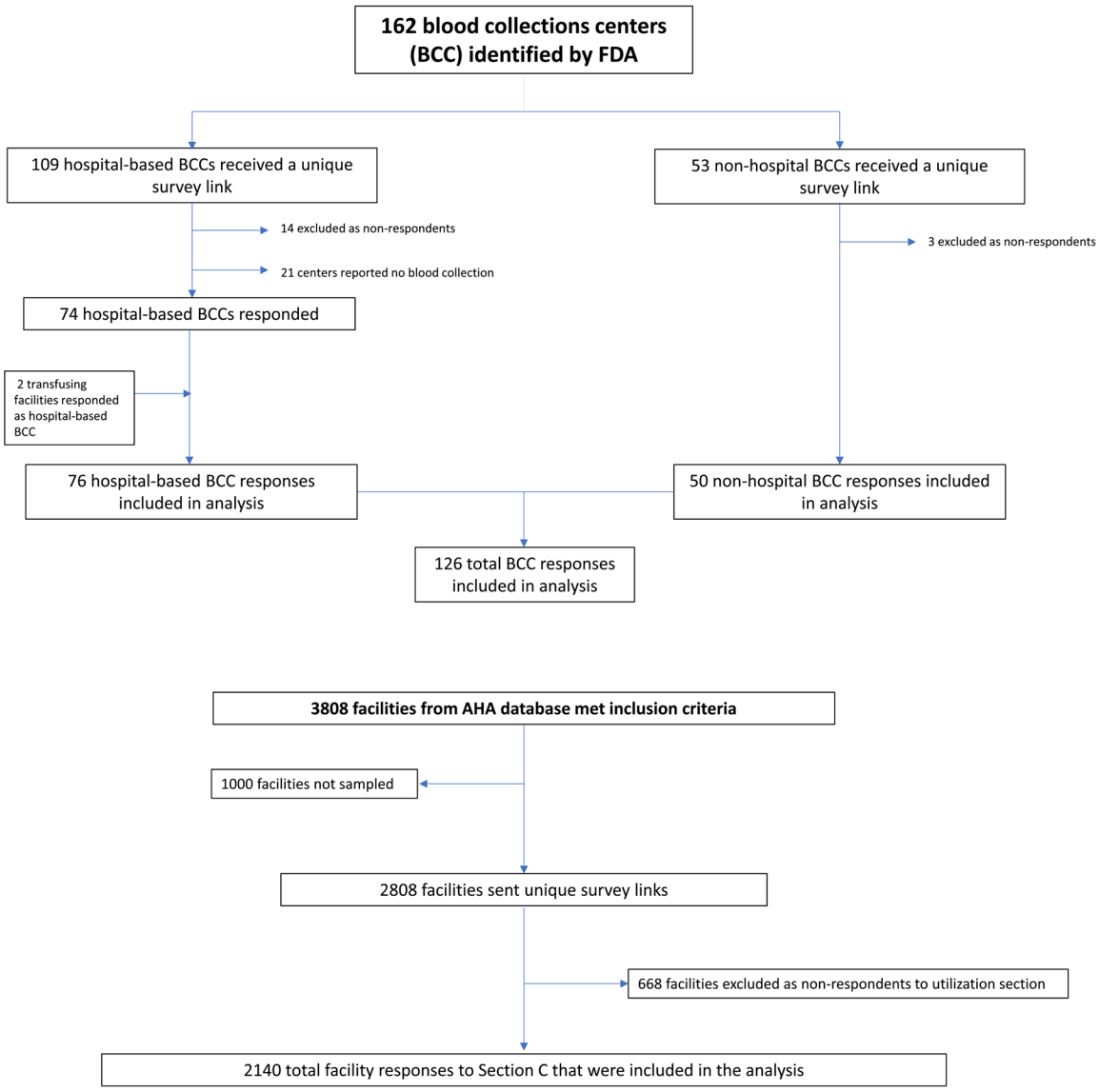

FIGURE 1.

Flow diagram depicting identification, stratification, sampling, exclusion, and recategorization of 2019 National Blood Collection and use survey respondents. AHA, American Hospital Association

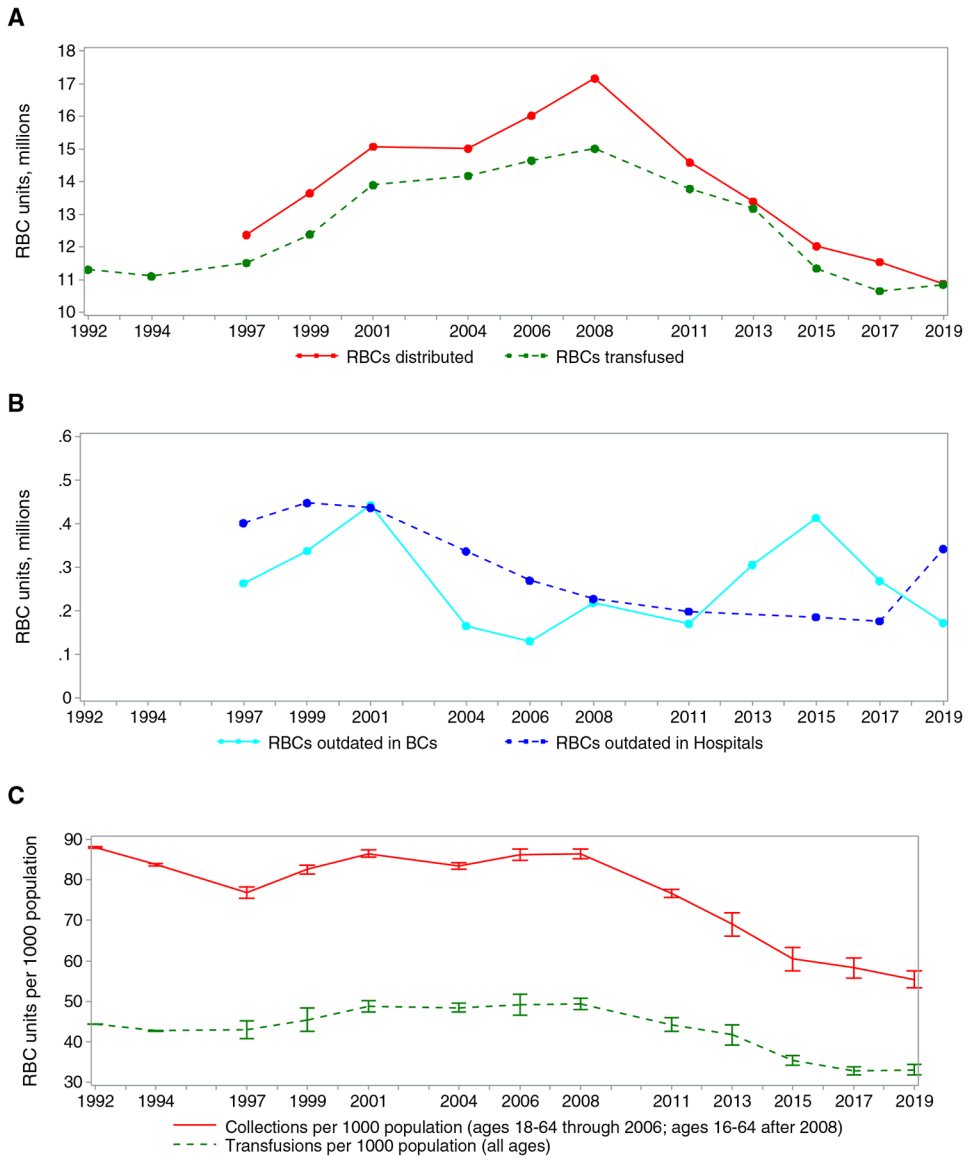

FIGURE 2.

Trends in (A) RBC distributions and transfusions, (B) RBC units outdated in blood centers and hospitals, and (C) RBC collections and transfusion per 1000 population

TABLE 1

Estimated numbers of whole blood and RBC units collected, transfused, and outdated in 2019 (expressed in thousands)

	Blood centers	Hospitals	Combined totals	95% CI	2017 totals[a]	% change 2019–2017
Collections						
Whole blood units						
Allogeneic, nondirected	9370	407	9777	(9306–10,248)	10,399	−6.0%
Autologous	4	1	5	(4–6)	10	−50.8%
Directed	5	4	9	(5–12)	16	−46.6%
Apheresis RBC units[b]	1789	11	1800	(1645–1955)	1787	0.7%
Total supply	11,167	423	11,590	(11,151–12,029)	12,211	−5.1%
Rejected on testing	97	6	103	(83–124)	78	32.6%
Rejected for other reasons[c]	592	16	608	(541–675)	587	3.6%
Total available supply	10,478	401	10,879	(10,484–11,274)	11,545	−5.8%
Transfusions						
Allogeneic, nondirected		10,834		(10,427–11,241)	10,572	2.5%
Autologous		9		(2–15)	27	−68.4%
Directed		9		(4–15)	56	−83.7%
Total Transfusions		10,852		(10,444–11,259)	10,654	1.9%
Outdated whole blood or RBCs	173	177	349	(321–377)	446	−21.7%

[a] 2017 totals were obtained from the 2017 NBCUS.[4]

[b] Apheresis RBC units include allogeneic, autologous, directed, and concurrent collections.

[c] Units rejected for other reasons do not include outdated units.

TABLE 2

Percent difference in allogeneic RBC units transfused in 2017 and 2019 from matched hospitals

Surgical volume category	N[a]	Median (mean) 2019 allogeneic RBCs[a]	Median % difference[b]	IQR[c] of % difference[b]
100–999 surgical operations per year	170	392 (525)	−7.3%	35.2%
1000–1399 surgical operations per year	207	1216 (1326)	−6.2%	23.4%
1400–2399 surgical operations per year	398	1863 (2038)	−3.8%	25.6%
2400–4999 surgical operations per year	462	3483 (4061)	−1.1%	21.2%
5000–7999 surgical operations per year	199	6001 (6568)	−0.8%	19.0%
8000 or more surgical operations per year	170	13,262 (15,507)	1.9%	12.5%
Total	1606	2666 (4355)	−2.2%	22.9%

[a]Based on matched facilities reporting allogeneic red blood cells in both 2017 and 2019 NBCUS surveys.

[b]% difference calculated as 100*(2019–2017)/2017.

[c]Interquartile range (75th–25th percentile).

TABLE 3

Red blood cell units transfused by location in 2019 (expressed in thousands)

	2019 (95% CI)	2017	% diff	Matched median % diff
All surgery (including transplant)	1380 (1236–1525, n = 980)	1409	−2.0%	−5.9% (n = 465)
Emergency department	1277 (1163–1391, n = 993)[a]	1042	18.4%	20.6% (n = 484)
Inpatient medicine (including hematology/oncology)	3909 (3593–4226, n = 982)	3896	0.3%	−7.5% (n = 499)
Obstetrics/gynecology	219 (195–242, n = 976)	241	−10.2%	−2.2% (n = 354)
Pediatrics	159 (89–229, n = 1004)	143	10.3%	0.0% (n = 89)
Neonates	103 (78–128, n = 1031)	106	−3.0%	0.0% (n = 170)
Critical care	1810 (1645–1975, n = 916)	1718	5.1%	−9.4% (n = 369)
Outpatient and non-acute inpatient settings[b]	1512 (1335–1689, n = 969)	1416	6.3%	−6.1% (n = 381)

[a]Indicates statistically significant change ($p < .05$).

[b]Includes outpatient dialysis, rehabilitation, and long-term care.

TABLE 4

Estimated number of platelets, plasma, and cryoprecipitate units distributed, transfused, and outdated in 2019 (expressed in thousands)

	Blood centers	Hospitals	Combined totals	95% CI	2017 Totals[a]	% change 2019–2017
Distributed						
Apheresis platelets	2215	144	2359	(2240–2477)	2338	0.9%
Whole-blood-derived PLTs[b]	133	16	149	(105–193)	223	−33.1%
Total platelets	2348	160	2508	(2375–2641)	2560	−2.0%
Total plasma	2535	144	2679	(2525–2833)	3209	−16.5%
Cryoprecipitate[c]	2179	125	2304	(2045–2562)	2168	6.3%
Blood center outdates[d]	197	32	229	(194–264)	320	−28.5%
Transfused						
Apheresis platelets		1996		(1846–2147)	1848	8.0%
Whole-blood-derived PLTs[b]		243		(−17–503)	82	196.5%
Total platelets (includes directed units)		2243		(1930–2555)	1937	15.8%
Total plasma		2185		(2068–2301)	2374	−8.0%
Cryoprecipitate[c]		1184		(1030–1339)	1064	11.3%
Hospital outdates[e]		500		(466–534)	446	12.1%

[a] 2017 totals were obtained from the 2017 NBCUS.[4]

[b] Whole-blood-derived platelets are expressed as apheresis equivalents.

[c] Cryoprecipitates are expressed as individual unit equivalents.

[d] Blood center outdates are units that were outdated at non-hospital and hospital-based blood centers.

[e] Hospital outdates are units that were outdated at transfusing hospitals.

TABLE 5

Platelet units transfused by location in 2019 (expressed in thousands)

	2019 (95% CI)	2017	% diff	Matched median % diff
All surgery (including transplant)	280 (239–321, n = 890)	300	−7.2%	0.0% (n = 346)
Emergency department	105 (86–124, n = 891)	99	5.8%	12.1% (n = 310)
Inpatient medicine (including hematology/oncology)	1050 (488–1612, n = 906)	783	25.5%	−3.8% (n = 400)
Obstetrics/gynecology	11 (9–13, n = 876)[a]	16	−43.4%	0.0% (n = 146)
Pediatrics	79 (25–133, n = 903)	84	−6.1%	0.0% (n = 44)
Neonates	34 (20–47, n = 914)	34	0.1%	−5.0% (n = 106)
Critical care	448 (345–551, n = 860)	375	16.4%	1.1% (n = 300)
Outpatient and non-acute inpatient settings[b]	462 (215–709, n = 888)	332	28.1%	8.5% (n = 262)

[a]Indicates statistically significant change ($p < .05$).

[b]Includes outpatient dialysis, rehabilitation, and long-term care.